# ‘Alternative Water Futures’

# Developing a Water Reclamation Decision Pathway Survey

Masters in Organisational Psychology
University of the Witwatersrand

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**DECLARATION**

I declare that this dissertation is my own unaided work. It is being submitted for the degree of MA by coursework and Research Report (in the field of Organisational Psychology) in the Faculty of Humanities, University of the Witwatersrand, Johannesburg.

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## ABSTRACT

The water situation that South Africa is currently facing needs to be effectively dealt with in order to sustain water supply to the country for the many years to come. Despite being a valuable resource, water is becoming an extremely scarce resource within the world. The rate that water is used at exceeds the rate that water is replenished at and there is an increasing demand for water in South Africa which is seen to be driven by growing populations, growing industrial development, rising incomes, irrigation expansion, a non-renewable electricity generation as well as a host of other factors. There needs to be a strong effort from the South African population in water preservation through water reuse. Despite the many advantageous reasons for the implementation of water reuse, one of the largest challenges that the country is facing in the water reuse project is public acceptance. The aims of this research are to take a 'people's perspective' and to understand and focus on the people of South Africa and their attitudes and feelings towards using alternative water sources such as reclaimed water. Public acceptance of environmental policies is the driving force to creating meaningful environmental change. People's behaviours in making decisions is often driven by their understanding, trust, values, and subjective norms. This research aims to understand the people of South Africa and their willingness or lack thereof, to make use of reclaimed water for potable and non-potable uses. In order to do so, the development of an instrument that will identify underlying decision-making processes is necessary. The development of a 'Water Reclamation Decision Pathway Survey' was the core aim of this research as this tool will assist environmental policy makers in understanding the various social and psychological barriers that the consumers of South Africa have for or against using reclaimed water. This research redeveloped Gregory, Flynn, Johnson, Satterfield, Slovic and Wagner's (1997) Decision Pathway Survey in a South African context with the core focus being reclaimed water. This research was qualitative in nature and data was collected through the use of three focus groups with laypeople from WitsPlus and a private advertising agency in Johannesburg and they will consist of six participants each. The researcher then conducted six one-on-one interviews with water experts from the water industry. The data was transcribed, and a thematic analysis was done in order to identify recurring themes regarding the acceptance or rejection of using reclaimed water as well as the psychological and social barriers that water users have towards reclaimed water. This assisted in developing the various decision pathways that individuals embark on when making environmental choices.



**Keywords:** *Water Reclamation, Decision-Making, environmental change, public acceptance Decision Pathway, Psychological and Social Barriers.*

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# CHAPTER 1

## 1.1 INTRODUCTION

South Africa is a water-scarce country. Current water scarcity will likely become more severe as the years go by if no action is taken (Molvi, 2017). Despite being a valuable resource, water is becoming an extremely scarce resource within the world and specifically South Africa which is on the verge of a national water crisis (Daniel, 2019). According to Wallace and Austin (2004), the process of humans using water occurs at a much faster pace than the process of replenishing it. Globally, resource constraints are a growing concern and many cities and regions around the world should be moving towards a more sustainable and resilient way of life (Molvi, 2017).

There is a growing demand for water in South Africa which is due to the growing population, industrial development, rising incomes, irrigation expansion as well as non-renewable electricity generation which is water intensive (i.e. cooling of coal-fired power stations) (Hedden & Cilliers, 2014). According to Molvi (2017), the city of Johannesburg should prepare for water cuts as the city will soon struggle to maintain a reliable water supply to all of its residents. With water scarcity being less prevalent since the early 1990's, South Africa has become complacent and forgotten their natural claim to be a 'water-scarce' country (Chernick, 2017). Therefore, water resource experts are continuously searching for additional sources of water and ways to sustain water in order to deal with the growing demand for water within the country as well as avoid future water crises (Adewumi, 2011). It was predicted that water consumption patterns need to change drastically in South Africa or the country would not be able to keep up with the growing demand for water and water scarcity would become even greater in 25 years (Adewumi, Ilemobade & Van Zyl, 2010). As the populations and industries increase, the collection of wastewater increases and therefore, there is concern regarding the effect that wastewater has on the environment when disposed in sensitive environments (Van Leeuwen, Pipe-Martin & Lehmann, 2002). Moreover, the South African government has begun the implementation of various alternative water sources such as water reclamation in order to eradicate the environmental pollution effects that wastewater has and reclaimed water can arguably be utilised for potable and non-potable purposes (Adewumi, 2011). Reclaimed water is defined as wastewater that has been treated by a sewage treatment plant to the point of purity that it may be suitable for human consumption (Grobicki & Cohen, 1999).

The use of reclaimed water is deemed as an efficient alternative in sustaining water in South Africa (Van Leeuwen et al., 2002). Some of the advantages of using recycled water include

decreased pollution due to less wastewater being discharged into the environment, replenishment of wetlands, and the monetary savings that would be made on water supply infrastructure (Joksimovic, 2006). It is also important to note that reclamation can potentially increase reticulation costs due to the dedicated piping that might be required (Committee on the Assessment of Water Reuse as an Approach to Meeting Future Water Supply Needs., & National Research Council, 2012). Despite the many advantageous reasons for the implementation of water reclamation, one of the largest challenges that the country is facing in the water reclamation project is the opinions and attitudes of the public (Adewumi, Ilemobade & Van Zyl, 2014). Public opinion regarding environmental policies potentially arises due to a lack of knowledge in the area of interest, in this case the water reticulation systems and the benefits of water reclamation, poor trust in the water service provider, politics, and control (Adewumi, 2011, Adewumi, Ilemobade & Van Zyl, 2014). The public's acceptance of alternative water sources is therefore critical in the successful implementation of reclaimed water usage and therefore the shift of focus towards the use of reclaimed water as a sustainable source of water to the consumers of South Africa is highly necessary.

## 1.2 RATIONALE

South Africa is ranked the 30$^{th}$ driest country in the world and water scarcity will likely get worse (Chernick, 2017). The water situation that South Africa is currently facing needs to be effectively dealt with in order to sustain water supply to the country for many years to come. The recent drought in Cape Town left dams such as Theewaterskloof Dam empty and saw the city's taps almost running completely dry (Chernick, 2017). The Cape Town water crisis and 'Day Zero' shed light on the effects delayed rainfall, global warming, and climate change could have on the country's water resources and emphasised the importance of efficient management of water resources (Chernick, 2017). Water is used at a much faster rate than it is replenished and it is important for individuals in South Africa to be conscientious when it comes to using water wisely. In order to promote efficient use of water, environmental policies such as water reclamation need to be considered.

Public user acceptance of environmental policies is the driving force in the implementation and success of alternative water sources and therefore it is important to understand the perceptions and values of the water users in order to achieve meaningful environmental change.

In order to understand users' perceptions, attitudes and values towards saving water in South Africa, one needs to look at the decision making pathways that people go through to arrive at what they consider as acceptable water sources. Understanding water users' attitudes and values towards using reclaimed water allows for identification of possible psychological and social barriers that are in place when it comes to the use of alternative water sources such as reclamation. This research proposes the need for the development of 'A Water Reclamation Decision Pathway Survey' in order for environmental decision makers to understand the users' values and opinions regarding reclaimed water as well as to understand why they will or won't support the use of reclaimed water. Understanding users' decision pathways will be beneficial in dealing with any fear, concern, or mistrust in the implementation of alternative water sources and water reclamation and reduce any objections in the future. This research will specifically look at urban living and individuals who reside in urban areas who have daily access to running water and who take part in decision making about household water use.

## 1.3 LITERATURE REVIEW

### 1.4 Introduction to Literature review

Throughout the world, water is the natural resource that is considered the most crucial and indispensable (Ashton, 2009). There can be no social and economic development and no environmental diversity without a sufficient supply of water (Ashton, 2009). Water sustains human, plant and animal life and plays an important role in maintaining human health and well-being (Goswami & Bisht, 2017). Water is important in the maintenance of public health, agriculture, the management of the environment and the ecosystem as well as the creation of jobs (Goswami & Bisht, 2017). Human water consumption has drastically increased to a level that is almost not sustainable which results in , decreased environmental flows in natural water systems, (Dolnicar, 2009). Countries today are growing in size and the challenges to meet the demands for water to satisfy the entire population are escalating (Ashton, 2009). There are various ways to sustain water supply including rainwater harvesting, desalination plants, and water reclamation.

This literature review looked at the water situation in South Africa and the various alternative solutions that are available to ensure a sustainable supply. Specifically, the use of reclaimed water for potable purposes (i.e. as drinking water) as an effective alternative solution was the focus of this research. The creation of meaningful environmental change is not only driven by its economic and environmental advantages but also by the public's knowledge, acceptance, and approval. As such, user acceptance will be discussed since the public is the driving force in achieving

environmental change and in order to understand the public, one needs to understand their decision processes and their behavioural thinking. Lastly, this literature review highlights the importance of understanding the public as it enabled the researcher to develop a decision pathway survey which can be used as an effective tool in understanding user choices regarding water resource alternatives.

## 1.5 The Water Situation in South Africa

The water issues have intensified by various water-related obstacles within South Africa (Siebrits and Winter, 2013). There is also an increasing strain on the water supply within South Africa owing to the rapid growth of the population, climate change, immigration, human migratory patterns, aging infrastructure, agriculture, urbanisation, industrial development as well as natural disasters such as droughts (Adewumi, 2011; Molobela & Sinha, 2011). When taking into consideration the above-mentioned factors that play a role in increasing the water demand in South Africa, it can be seen that the water crisis in South Africa is becoming more observable and a topic of concern for all South African's (Molobela & Sinha, 2011).

As mentioned above, South Africa is defined as a 'semi-arid' country as there are low volumes of rainfall (Adewumi, 2011). The limited rainfall is a major contributor to the scarce availability of fresh water for the population and it is also a factor that is uncontrollable and unpredictable. Access to clean water is a right that is enshrined in the South African Constitution. The National Water Policy, the National Water Act (Act 36 of 1998) and the Water Services Act (Act 108 of 1997) all provide the legalities regarding the government's responsibility to ensure clean water to all South Africans (Statistics South Africa, 2017). It is therefore the government's responsibility to provide clean water to the country. However, several African countries are approaching severe water shortages and by 2030 and some including South Africa, will exceed their available supplies (Gosling, 2018).

It is evident that the natural environment plays a crucial role in the delivery of clean water as although the constitution states that fresh and clean water is a right, the rate that water is replenished at is out of human control and is dependent on the weather and the environment. The above-mentioned issues emphasise the level of urgency that is required in sustaining water for the future and it is clear that the policies mentioned above cannot be successfully implemented if there is no water to distribute. It is important to note that with rights, come responsibilities and individuals also need to take initiative and responsibility in environmental issues through reflecting on their water use. It is therefore imperative that while countries prioritize water

security, that this is complemented by conscious effort from citizens to not only conserve existing supplies, but also be open to alternative water sources (Ashton, 2009).

It is theorized that if the water use patterns in South Africa do not change drastically, the country will be unable to keep up with the growing demand for water and the scarcity of water will worsen within 25 years (Adewumi, Ilemobade & Van Zyl, 2014). Water experts are continuously looking for alternative ways to provide water to the growing South African population efficiently and sustainably (Adewumi et al., 2014). Gauteng and its surrounding regions receive a large portion of the water supply from 14 interconnected dams of the integrated Vaal River System (IVRS) which include the Vaal Dam along with the Lesotho Highlands (Muller, 2019). If there is low rainfall, the water levels are continuously decreasing and with the population levels continuously increasing in Gauteng due to migration and urbanisation into the cities (Asano & Cotruvob, 2004), the water scarcity can worsen. The water shortages that are becoming more prevalent could be detrimental for one of Africa's largest economies and it is important to prioritize the water situation (Molvi, 2017). There are various alternative ways to sustain water and different solutions to decrease the likelihood of future water shortages. The most commonly known interventions are rainwater harvesting systems, desalination , and reclaimed water.

### 1.6 – Alternative Sources for Water Sustainability

This research will take a closer look at four water sustainability interventions in detail and their applicability to the water situation, namely: rainwater harvesting, desalination, as well as the use of borehole and reclaimed water. These alternatives will be further explored in order to understand their viability for ensuring water supply for South Africa

#### 1.6.1 - Rainwater Harvesting

Rainwater harvesting is an effective method of water conservation and water management and it is important when it comes to the efficient use of water (Abdullah & Al-Shareef, 2009). Rainwater harvesting can be further described as a water saving tool that collects rainwater from rooftops, land and road surfaces and rock catchments and the water is either collected through the use of basic techniques such as tanks, pots, and cisterns as well as more complex techniques such as underground check dams (Abdullah & Al-Shareef, 2009). Rainwater that has been harvested can act as a renewable (provided there is consistent rainfall) source of clean water that can be used for non-potable purposes and potable purposes (given that the water is exposed to a treatment process before use). Rainwater that falls on landscaping and rooftops does not filter into the soil, instead the rainwater runs into storm sewers and can become contaminated (Abdullah & Al-Shareef,

2009). Nevertheless, it is environmentally and economically beneficial to make use of rainwater harvesting systems as rainwater harvesting is considered to be a renewable source of water that is clean, harvested rainwater can be used for both industrial and domestic purposes, it is cost-effective and easily maintained industrial and household purposes (Abdullah & Al-Shareef, 2009). However, it is also important to note that the purpose of rainfall harvesting systems is to generate water for potable (i.e. drinking) purposes and the water may easily get contaminated (Thomas, 1998). Water collected from rainwater harvesting systems may require a treatment process to occur and the inclusion of a treatment process may characterise the rainfall harvesting process as more costly than treating water from a dam (Thomas, 1998). This is because the treatment of water from a dam can be centralised as opposed to rainwater harvesting treatment which would need to be treated at various sources. Alongside the monetary aspect, rainfall is unpredictable and unstable and rainwater harvesting is, therefore, not always easily accessible especially in arid areas ("RAINWATER HARVESTING ITS ADVANTAGES AND DISADVANTAGES | Save Greenery", 2020). It is therefore, difficult to be sure that rainwater harvesting will be effective because there may be a season of drought and the supply of water could be impaired.

### 1.6.2 - Desalination

Desalination is a process of removing salt and other minerals from a water source in order to produce water that is fresh, clean and consumable. The 'quicker process' of removing salinity from water is referred to as reverse osmosis. Reverse osmosis is similar to desalination but it makes use of differing techniques (Head, 2017). Hydraulic conditions are designed and created to squeeze water through microscopic holes in a membrane which will only allow the pure water to get through the spaces while contaminants and salt are left behind (Head, 2017). Desalination often occurs in areas where fresh water supplies are limited but seawater is available. Desalination plants are, however, extremely costly starting at around R2.1 billion as well as labour costs and materials (Head, 2017). Alongside the cost, desalination is energy-intensive requiring either thermal or electrical source of energy which is seen as its downfall in being a practical way to sustain water. Considering that South Africa already struggles with its electricity supply, energy consumption for desalination needs to be considered (Head, 2017). The environmental impact of desalination is two sided and although Desalination of seawater positively contributes to water supplies in water scarce regions and socio-economic development, it is important to acknowledge the potential negative impacts that it might have (Dawoud & Al Mulla, 2012). With the

Desalination process, there are chemical discharges which can impact coastal water quality and harm sea life (Lattemann & Höpner, 2008). The desalination plant extracts contaminants from the water and then provides clean water to the nation. However, throughout the desalination process, the desalination plants produce 'brine' which contains a high amount of salt making it harmful for the environment (Head, 2017). According to Dawoud and Al Mulla (2012), for every 1 m3 of desalinated water, 2 m3 of brine is generated and the common practice is to discharge the brine back into the sea. The 'brine' is harmful to the environment and the sea life and would need to be kept away from the drinking water supply. Further, the 'brine' from the desalination process should not be released back into the environment. There is an added maintenance of keeping this brine from the pipework that also needs to be acknowledged and infrastructure considerations that need to be taken into account so that the brine has its own pipe (Head, 2017). Alongside the environmental aspects and the cost, desalination plants take around two years to build and commission and there is a considerable energy cost.

However, since there is no seawater source close to Gauteng, it is not a viable option for this geographical region. Desalination along with water reclamation are the alternatives that are not rainwater dependent and therefore, their applicability and effectiveness are enhanced. The production time of a desalination plant is lengthy and it is therefore beneficial to turn to implementing water reclamation to deal with the water crisis while the plant is being built (Head, 2017).

### 1.6.3 - Borehole Water

A third alternative water source is borehole water or ground water. Johannesburg has entered a partnership with the Borehole Water Association and residents are encouraged to use boreholes to mitigate the drought (Troskie & Johnstone, 2016). Borehole water is essentially groundwater which is the result of rainfall percolation over long periods of time. (Howard, Bartram, Pedley, Schmoll, Chorus & Berger, 2006). Boreholes are small, open and narrow shafts that are drilled into the ground either horizontally or vertically. (Martinez-Santos, Martin-Loeches, Solera, Cano & Diaz-Alcaide, 2017). Borehole water systems are viewed as one of the most cost-effective systems as once the borehole is sunk, one's water supply are seemingly endless if the groundwater supply is adequate (Howard et al, 2006). Borehole water is considered to be highly suitable for non-potable purposes such as flushing one's toilets, washing clothing and watering the garden. It can also be seen as an effective way to decrease one's municipal water usage (Asano & Cotruvob, 2004). Many households in the 'wealthier' suburbs view borehole water as a popular way to save

water as they can afford to install their own private borehole (Sieff, 2018). Borehole water is considered safe to an extent for agriculture and domestic uses. However, it may need further purification for potable purposes (Saymaan & Adams, 2002). One of the biggest disadvantages to the use of borehole water is that although the groundwater is found below the surface, there is a chance that the water can be contaminated. This contamination limits one's ability to use the borehole water for cooking, watering vegetables and drinking and therefore, the water from the borehole would need to be tested and purified through a treatment system which would increase the costs (Saymaan & Adams, 2002). Moreover, groundwater, which is used for borehole can be polluted by acid mine drainage (AMD) as AMD is a large pollutant that impacts the surface and groundwater supplies (Grey, 1996). AMD is caused "by the oxidisation and hydrolysis of metal sulphides in water-permeable soil that is released on the surface" (Grey, 1996, pg 1). According to Dzwairo and Mujuru (2017), AMD is a significant threat to South Africa's environment and their groundwater sources. South Africa relies on surface water for consumption and AMD negatively impacts the livelihoods of many people within South Africa (Dzwairo & Mujuru, 2017). Alongside the impact of AMD, borehole water availability strongly relies on the rainfall patterns in South Africa. The sustainability of South Africa's current and future groundwater abstraction depends on groundwater recharge which comes from rainfall (Kotchoni, Vouillamoz, Lawson, Adjomayi, Boukari & Taylor, 2019). Rainfall patterns are unpredictable and if there is no consistent rain, the groundwater levels will decrease. It is therefore important to explore alternative solutions such as water reclamation.

### 1.6.4 - Water Reclamation

There are increasing concerns about the impact that wastewater has when disposed into sensitive environments and the environmental pollution that results (Adewumi, 2011). There is a rising interest in the treatment of wastewater to higher quality levels before releasing it back into water sources and wastewater reclamation is gaining attention as an alternative source of water (Adewumi, 2011). Through looking at the levels of pollution and the diminishing source of freshwater, in order to sustain water for the future of South Africa, it is important to manage the water demands through the use of treated wastewater for domestic, industrial, and institutional purposes (Adewumi, 2011).

Water reclamation, otherwise known as water recycling/reuse can be defined as "the direct use of treated sewage effluent to replace a proportion of the freshwater demand" (Grobicki & Cohen, 1998, p2). Water reclamation is the process of converting wastewater which is defined as "untreated liquid industrial waste and/or domestic sewage from residential dwellings, commercial buildings, and industrial facilities" into water that can be reused through various treatment processes for potable and non-potable purposes (Haering, Evanylo, Benham & Goatley, 2009, p 1). Reclaimed water can be utilised in order to fulfil certain needs in residential areas and businesses such as toilet flushing or garden irrigation. Reclaimed water can also be treated to reach sufficient drinking level standards and used for potable purposes. Water reclamation is considered to be a promising approach in reducing water scarcity, especially in countries with water shortages much like South Africa (Gulamussen, Arsénio, Matsinhe & Rietveld, 2019; Grobicki & Cohen, 1998). Water reclamation is seen as the most efficient way to preserve water as the costs involved are minimal and the infrastructure is already developed and ready for use. More so, due to the increasing population and industrial growth, water reclamation will aid in protecting the environment from high levels of pollution and simultaneously, relieve the pressure on natural freshwater sources (Adewumi, 2011). Water reclamation will decrease the degradation of freshwater sources that are a result of improper waste water disposal, keep up with the growth of the country, aid in positively impacting the demand for a 'greener' way to save water and ensure that the population has water for the future to come (Adewumi, 2011).

### 1.7 Reclaimed water as an alternative solution

There is an increased concern from the South African community regarding the environmental pollution that is a product of wastewater being disposed into sensitive environments. This concern created the idea to treat wastewater at a more effective level before discharging it back into receiving streams or rivers (Adewumi, Ilemobade & Van Zyl, 2014). The water shortages can be reduced or eliminated by the reuse of treated wastewater from domestic, industrial, and institutional sectors (Adewumi, 2011). Wastewater is released from the underground piping and it travels into a wastewater treatment plant (WWTP) where the water undergoes a treatment process, all toxins, chemicals, and hazardous materials are removed and the water is released back into the rivers and dams in order to prevent pollution from the dirty water. Once the wastewater has gone through the treatment plant, it is then referred to as 'reclaimed water'. Reclaimed water (also known as recycled water) "is water recovered from domestic, municipal, and industrial wastewater treatment plants that has been treated to standards that allow safe reuse" (Haering et al., 2009, p 1). Reclaimed water can be used for potable purposes which is defined as water that

meets the drinking water quality standards of the country, water that is safe to drink and does not cause any harm to health (Harris-Lovett, Binz, Sedlak, Kiparsky & Truffler, 2015). The main characteristic of potable water is that it can be used for cooking and human consumption whereas non-potable water does not meet the drinking water standards which means it is not fit for human consumption. However, non-potable water can be used for other purposes such as laundry, watering the garden and toilet flushing.

Although, when it comes to potable water reclamation, there is often doubt and opposition due to the health risks that people may think are involved with re-using water. These reactions can be further described as the 'yuck factor' which is a term that is used to describe the instinctive reaction of disgust and displeasure experienced by an individual when thinking about using reclaimed water (Hartley, 2006; Smith, Brouwer, Jeffrey & Frijns, 2018). The yuck factor is seen as a strongly recognized influence on the public's reaction towards using reclaimed water. This is because the feelings of disgust that are associated with the yuck factor are further connected with feelings of fear and those feelings combined are quite difficult to overcome (Schmidt, 2008). The reactions associated with the yuck factor are seen as a strong predictive factor in one's desire to accept or reject the use of reclaimed water (Smith et al., 2018).

Moreover, with the increased technological advancements and methods in wastewater treatment, water reclamation is understood as an effective key component of wastewater management and the opportunity for using reclaimed water is at its most viable (Po, Kearcher & Nancarrow, 2003). With an effective and high-quality wastewater treatment plant (WWTP), reclaimed water reclamation has become an efficient option in water conservation and securing water supply for the future (Adewumi, 2011). The use of 'reclaimed Water', will eradicate pollution, replenish soil nutrients in agriculture due to irrigation, enhance groundwater recharge and therefore benefit the state of the environment, but most importantly, it would be an effective solution for sustaining water for the future (Adewumi, 2011). The use of reclaimed water for potable purposes offers an environmentally friendly alternative for sustaining water and at the same time, reclaimed water usage will reduce various environmental impacts from wastewater which is released into sensitive environments (Adewumi, 2011).

There are two types of potable water reclamation processes. There is indirect potable reuse which involves an environmental buffer and the water goes through a river or dam before the water is treated at a wastewater treatment plant (Cotruvo & Bell, 2014). Direct potable reuse is when the

wastewater is treated without an environmental buffer as it goes directly from the pipe to the treatment plant (Cotruvo & Bell, 2014). This involves a 'pipe-to-pipe' process and the water is distributed directly to the consumer (Naroth, 2016). Furthermore, there is non-potable reuse which means that water is treated for reasons other than drinking or eating such as watering the garden, washing clothes, and agriculture (National Research Council, 2012).

### 1.8 Water reclamation and its success in other countries

Water is considered a limited resource and water professionals suggest that the process of reclaiming water once it has been treated is an underutilised alternative in solving the water scarcity (Hartley, 2006). Despite the viability of using reclaimed water, there are often negative connotations that come with the process of water reclamation however, it is important to note that water reclamation has been successfully implemented for both potable and non-potable uses in many semi-arid countries such as Israel, Spain, Jordan and Australia. These countries have all successfully implemented water reclamation in order to sustain water and therefore the use of reclaimed water is utilised and effective. In the United States (US), the practice of reclaiming water is seen as a growing industry and the estimated amount of water that is reused is around 2.6 billion gallons per day (Wade Miller, 2006). This water is used for golf course irrigation, edible crop irrigation, and ground water recharge (Wade Miller, 2006). Much like the US, water reclamation is highly prevalent in Australia, which is not only known as the direst occupied continent on Earth but Australia also experiences the most variable rainfall out of all the continents (Apostolidis, Hertle & Young, 2011). It is for this reason that these countries can provide some valuable lessons to South Africa who are looking to develop their wastewater management practices with the aims of sustaining the water supply (Apostolidis et al., 2011).

Los Angeles, California has been utilising reclaimed water to renew their groundwater potable water supply (Anderson, 2003). Orange County California has operated "Water Factory 21" (a water reclamation plant that produces recycled water of drinking standard) since 1976 (Anderson, 2003). Orange County has seen no change in their water quality that would cause a public health concern and the plant has been further developed since the success of water reclamation (Anderson 2003). In upper Occoquan, Virginia, the water that comes from the Upper Occoquan water reclamation plant is released into a reservoir which then supplies drinking water to one million residents in North Virginia. This water is directed into the pipelines and then used for potable and non-potable purposes. Furthermore, there has been no health concerns about the quality of the water (Anderson, 2003).

In 1998, The Singapore Water Reclamation Study (NEWater Study) was implemented and this study involved the idea that wastewater would go through a purification and treatment process and it would then be combined with the reservoir water and undergo further water treatment in order to produce drinking water (Leong & Lebel, 2015). The prototype wastewater treatment plant known as the Bedok Water Reclamation Plant (BWRP) was monitored for two years and after that two-year period, the plant produced clean water of acceptable quality (Tortajada, 2006). The quality of the water produced by the BWRP was in fact, better quality than the water supplied by the Public Utilities Board (PUB) in Singapore and met the water quality standards Environmental Protection Agency of the US and the World Health Organisation (WHO) (Tortajada, 2006). At the present moment there are three WWTPs operating in Singapore which provide water to the north-Eastern, Eastern, and Northern parts of Singapore. This suggets that water reclamation was a success and used for potable and non-potable purposes (WHO) (Tordajada, 2006).

Alongside Singapore and California, Australia has been one of the few proactive countries who have turned to water reclamation in order to sustain water supply. The beginning of the great millennium drought in Australia highlighted the value of reclaimed water and therefore encouraged Australian citizens to view reclaimed water as a valuable source instead of pure 'waste' (Apostolidis et al., 2011). The Council of Australian Governments (CoAG) supported the use of reclaimed water as a solution for urban water reform and it was further encouraged where it was cost effective (Apostolidis et al., 2011). Queensland Brisbane has one of the biggest water reclamation projects in the world where the Western Corridor Recycled Water Project (WCRWP) collects output from three primary treatment plants known as Bundamba, Luggage Point, and Gibson Island (Apostolidis et al., 2011). The wastewater that is collected is treated with the use of micro-filtration, reverse osmosis, and advanced oxidisation. The water that results from this treatment is used to supply power stations and industrial applications and the remaining percentage of treated water is released into the drinking water supply (Apostolidis et al., 2011).

São Paulo in Brazil also acknowledges the importance of effective wastewater collection and treatment of water in order to deal with water scarcity and alleviate water stress (Stepping, 2016). Brazil is considered a 'water rich' country however they are also challenged with water scarcity due to their population size (Stepping, 2016). In 2015, Brazils first system to produce potable reclaimed water was implemented in São Paulo in order to provide water for the population, this project is referred to as the Sanasa Project (Vasconcelos, 2015). Water reclamation is considered

a viable alternative in dealing with the water shortages that the country has been facing as the technology to treat wastewater and turn it into reclaimed potable water is present (Vasconcelos, 2015). The Sanasa Project was implemented to emphasise to the authorities the feasibility of using water reclamation for potable purposes in the future in order to effectively handle any water scarcity issues (Vasconcelos, 2015).

According to van Leeuwen, Pipe-Martin and Lehmann (2003), South Africa has also been involved in successfully implementing water reclamation plants. Water reclamation research was started as early as the 1960's in South Africa and this led to the building of the experimental 4 ML/d Stander Water Reclamation Plant in Pretoria as well as a Direct Potable Re-use Plant (DPR) situated in Beaufort West (Beer, 2016; van Leeuwen et al., 2003). Beaufort West which is situated in the Western Cape of South Africa, is home to the first direct water reclamation plant (Naroth, 2016). The water supply decreased when there was a drought between 2008 and 2010 which increased the need for water management strategies, one of them being a direct potable re-use plant. This DPR plant involves the processes of reverse osmosis, ultra-filtration, and advanced oxidation in order to remove any solids, toxins, and contaminants from the water in order for it to be deemed potable (Beer, 2016). The water goes through a thorough cleaning process allowing the water to meet drinking standards and it is the only direct potable re-use plant often referred to as a 'toilet-to-tap plant'. The DRP has been operating since 2011 and it has been providing 20% of the town's water (Gosling, 2018).

In Windhoek, Namibia, the nearest constant river is the Kavango which is 750 km away and owing to the severe water shortages that occur, the world's first potable water reclamation plant was developed in 1968 and has been successful in producing water of acceptable potable quality for 30 years (Anderson, 2003). Reclaimed water has contributed 4% of the total water supply in Windhoek, Namibia and it has made up around 31% of the total water during times of drought (Anderson, 2003). The water that is produced from the reclamation plant is combined with the treated water that comes from the Goreangab Water Reclamation Plant (GWRP) (Anderson, 2003). The GWRP has been the pioneer in direct potable reuse worldwide and the water is fed directly into the pipes that supply the city's potable water supply (Naroth, 2016).

Reclaimed water can be an efficient and cost-effective alternative water solution as mentioned above and potable re-use plants are familiar to South Africa. Water reclamation has been implemented in three different cities, and the reticulation systems are already in place and therefore little cost would be necessary (Van Leeuwen et al., 2003). Alongside the environmental,

social, and economic benefits that come with water reclamation, there are barriers that have the potential to impact successful water reclamation within South Africa.

### 1.9 Public Acceptance of Reclaimed Water as An Alternative Water Source

With water crises so close to home in South Africa (Cape Town almost reaching day zero), remaining proactive in water management and water sustainability is becoming an important topic of concern. The use of reclaimed water is seen as an attractive, unconventional way to sustain water for the future. The use of reclaimed water comes with various advantages for the environment. However, these advantages are not enough to ensure successful implementation of reclaimed water as there are certain challenges involved (Harris-Lovett et al., 2015). It is important to understand the impact that public opinion and public acceptance can have on the implementation of reclaimed water use project (Dolnicar, Hurlingham & Grün, 2011).

The use of reclaimed water for non-potable purposes is not as controversial as using it for potable purposes. The idea of drinking reclaimed water can be unsettling for some individuals. Public opinion will influence one's intention to 'accept' or 'reject' environmental policies and one's intentions in the end will influence their behaviour (Adewumi, Ilemobade & Van Zyl, 2014). Successful implementation of a water reclamation project in South Africa that focuses on potable drinking water depends not only on its economic and environmental possibility but the driving force in the successful implementation lies within the acceptance by the public (Friedler, Lahav, Jizhaki & Lahav, 2006). In projects such as Sydney's desalination plant and San Diego's indirect potable reuse plan, the strength of public opposition delayed the implementation for many years and water scarcity only increased (Dolnicar, Hurlimann & Nghiem, 2010). It is evident that public acceptance has the ability to completely delay or derail implementation and public acceptance or rejection of using reclaimed water depends on their attitudes and values towards the environmental policy. An attitude is defined as a psychological tendency which is portrayed through the positive or negative evaluation of a specific concept or concern and the degree to which an individual favours or disfavours this concept (Gawronski, 2007). Individual attitudes will drive their intentions to accept or reject an environmental policy and their intentions will drive their environmental behaviour (Gawronski, 2007). It is for this particular reason that public opinion is the most important component in the implementation of using reclaimed water as an alternative source of water as people are the ones who are affected the most by these policies (Adewumi, 2011). Public acceptance is understood as the glue that will hold a reclaimed water project together. However, due to the controversy that comes with the idea of using wastewater

that has been treated, there is bound to be some opposition and this opposition is often a result of prejudiced beliefs, fears, lack of knowledge, poor water management knowledge, and general distrust of public policy (Friedler et al., 2006).

There is a greater negative perception towards direct potable reuse often called 'toilet-to-tap' which often brings upon a sense of disgust and unease. According to Naroth (2016), individuals may experience a psychological barrier when faced with the idea of consuming reclaimed water. The public's first thought is that this water once contained, or possibly still contains, human waste and chemicals. This psychological barrier can be expressed through an emotion of disgust. Po et al., (2003) identified that the way reclaimed water is used will have an overall effect on people's perception and acceptance of water. Moreover, the closer the water is to human contact and consumption, the more opposition there seems to be (Po et al., 2003).

Public opposition to the notion of drinking reclaimed water can be linked to the 'yuck factor'. In this case, the yuck factor refers to the emotion of disgust that is experienced by the public when having to think about drinking reclaimed water (Schmidt, 2008). The yuck factor plays a role in hindering the implementation of water reclamation and water management projects. Municipal wastewater is received from various different sources such as hospitals, houses, schools and commercial facilities (Naroth, 2016). The quality and quantity of the effluent that is found in the wastewater treatment plant highly depends on the condition of the treatment system and therefore this water potentially contains pollutants and contaminants which have the potential to be hazardous to human health if not treated correctly (Naroth, 2016).

There are various aspects that all contribute to the public's lack of trust in the use of reclaimed water. The health concerns play a large role in the public's perceptions of reclaimed water. Reclaimed water needs to be safe for human consumption and meet acceptable water quality standards which means that the pathogenic organisms, organic micropollutants, and inorganic pollutants need to be removed completely (Naroth, 2016). Although the advancement in technology has allowed for high functioning, effective wastewater treatment plant processes, the negative perceptions around the use of reclaimed water still persist (Naroth, 2016). Waterborne diseases such as guinea worm disease, typhoid, cholera and dysentery are spread through the consumption of contaminated water and therefore reclaimed water may be perceived as even more unattractive. The improper management of water and water infrastructure may be a contributing factor towards the health concerns that the public face with regards to reclaimed water. In order

to overcome this health perception barrier, the proper and effective management of water is necessary.

Wastewater treatment plants are responsible for removing the solid effluents and contaminants from the water in order for the treated water to be deemed healthy to use. This means that the WWTPs need to function at their most optimal level and within South Africa there is the perception that water treatment is suboptimal. Due to population growth and economic expansion, the WWTPs operate under stress (Teklehaimanot, Kamika, Coetzee & Momba, 2015). Out of the 852 WWTPs in South Africa, around 60 plants release clean water and are complying with international standards. More than half of the 852 WWTP that are present in South Africa are in poor working condition and some are not even working at all (Kings, 2017). The Department of Water and Sanitation (DWS) have reported that there are high levels of sewerage pollution which could be due to the dysfunctional WWTP's which in many municipalities are in a state of deterioration because of poor maintenance and management (Kings, 2017). This can suggest that negative perceptions that are associated with reclaimed water are not entirely unfounded. The poor functionality of the infrastructure involved in reclaiming water may play a role in shaping the public's perceptions regarding the use of reclaimed water.

It is evident that communities in South Africa are continuously and rapidly growing, but the water infrastructure is not and there are wastewater overloads which lead to spillages and therefore lead to pollution (Kings, 2017). It is clear that although the infrastructure is there, it is not functioning at its optimal level and therefore this creates a feeling of distrust for the public users. According to Mangena (2019), The Stellenbosch Water Treatment Works is considered to be one of the contributing factors to the deterioration of water quality in the Eerste River. Furthermore, the town of Delmas in Mpumalanga was hit with an outbreak of typhoid that was caused by an overloaded sewage system (Mangena, 2019). Therefore, sufficient water quality monitoring is imperative and this is only possible if the infrastructure that is used to clean the water is able to perform optimally and efficiently. Alongside the performance of the infrastructure, the testing methodology needs to acknowledge organic compounds within the water alongside the physical parameters and the microbiological parameters. Wastewater can be rich in organic matter such as pesticides, personal care products, and pharmaceutical residues. Further, chemicals that arise from industrial processes such as detergents and petroleum mixtures are extremely harmful if not removed completely and subsequently consumed (Naroth, 2016). The technology used today is capable of detecting these harmful substances but the focus is more on the solid effluents rather than the compounds that are

not seen but may be just as harmful. Continuous exposure to the above-mentioned chemicals as well as endocrine disrupting compounds (hormones released by the human body) can result in behavioural, physiological, and reproductive impacts and disorders such as cancer (Naroth, 2016). Although the causes of the above-mentioned impacts could be caused by a variety of aspects both genetic and environmental, these chemicals have been detected in water tests and have been considered harmful. The South African National Standards Board has not provided limits for these substances within the water quality regulations which affects the public's trust in the water management system (Naroth, 2016).

It is beneficial to understand that the obstacles to water reclamation are not only technological. The WWTP may be working optimally and the testing done regularly and water produced by the process may be pure, however the public's perception may be that the water is not clean enough for them and this is where education plays a role. If the public are provided with proper education and a greater understanding of water reclamation for potable purposes, increased support and acceptance can be gained from targeted communities. The impact of a 'natural buffer' such as a dam, river, or reservoir that is used for indirect potable water reclamation seems to be a deciding factor as to whether or not the public will use that reclaimed water (Naroth, 2016). Education around 'direct' versus 'indirect' potable reuse needs to be acknowledged and dealt with. Research that was done by the United States Research Council in 2012 suggests that buffers do not have an advantageous cleaning property compared to engineered processes. This means that indirect potable reuse, although it sounds more attractive, does not ensure that the quality of water is greater than an engineered cleaning process (Naroth, 2016). Simpson and Stratton (2011) conducted a study in Queensland, Australia regarding water reclamation for potable purposes and the findings were as follows: Public perceptions of water reclamation positively increased when they were provided with an online information booklet regarding water reclamation. This is in agreement with a study done by Dolnicar et al. (2010) which found that the public were more accepting of using reclaimed water for potable purposes after being given adequate information about the water, the process, and the quality of the water. The above-mentioned findings highlight the importance of education in assisting the public to understand the water reclamation process and be assured that the water is not harmful.

A previous South African study on public perceptions regarding the use of reclaimed water for potable purposes was done by Wilson and Pfaff (2008) targeted in Durban. Kwazulu-Natal has been faced with drought and water scarcity problems over the past decade and water reclamation

for potable purposes was suggested by the eThekwini Municipality (Naroth, 2016). Findings suggest that the public were more comfortable with unplanned reuse as opposed to planned reuse. Further, public perceptions regarding water reclamation for potable purposes were fairly negative and oppositional however, it is something that would be worth considering if the sample had more education around the quality of the water as well as assurances that there would be no harmful health risks (Naroth, 2016). Previously published case studies also infer that the public is more accepting of water reclamation when a crisis is on the horizon and there is nothing else to do but use reclaimed water. Hurlimann and McKay (2007) found that education is highly necessary when it comes to the public accepting water reclamation for potable uses. The importance of using reclaimed water needs to be highlighted, not only as it is a viable source of water but it also holds environmental and health benefits as the discharge from wastewater can be hazardous and could pollute the environment (Germaine, 2017). The public needs to be informed about water reclamation and its suitability for potable uses.

The public can potentially accept or reject the use of reclaimed water as an alternative water source due to the various reasons mentioned above. However, according to Hartling (2001), there are three main measures that can be taken in order to increase public acceptance of reclaimed water. The first measure is for environmental policy makers to be completely transparent with all the details, good or bad, as individuals who feel highly informed might have increased trust (Dolnicar et al., 2015). The second is to present the project in a very clear and comprehensive way, without using big fancy words that often don't sound like English. The last measure involves understanding the public's decision-making processes (Hartling, 2001). Further, Germaine (2017) theorized various factors that can enable the acceptance of using reclaimed water for potable purposes. Much like Hartling (2001), transparency allows the public to feel informed, involved, and builds trust. The public wants assurances that their health is protected. The public are more likely to be accepting if they are educated and made aware of the water scarcity issues as well as the treatment processes that the water will go through (Germaine, 2017).

According to Germaine (2017), reclaimed water initiatives have been implemented mainly by engineers who follow a 'DAD' process, which stands for 'decide, announce, and defend'. This approach is considered inadequate as there is little or no consideration for the public when it comes to social and environmental decisions. This lack of consideration and involvement plays a role in hindering the trust between the public and decision makers and therefore will increase opposition towards using reclaimed water (Germaine, 2017). Public engagement can positively

contribute to the acceptance of water reclamation as the public are the driving force behind meaningful environmental change. Through engagement, the public need to be informed of why reclamation is the best, most viable option, the process of how water is reclaimed, assurances that it will not harm them in anyway and at the same time benefit the environment by reducing pollution (Germaine, 2017).

The public want to be made aware of all aspects pertaining to the water that they drink and complete transparency helps to build trust. Public decision-making processes, recognition and inclusion in the decision-making processes of environmental policies allows the public to feel involved, that their concerns and opinions matters and that will provide them with a sense of importance and in turn, increase public support (Friedler et al., 2006). It is therefore important to understand the decision-making process in its entirety

### 1.10 Behavioural Decision making

With the increased inclusion of the public in environmental policies, the public are being asked more questions that require them to give their own opinions about topics that are quite controversial, complex, and that they have thought very little about in the past (Gregory et al., 1997). Individuals make decisions every single day, however these decisions are often very basic and common to their daily lives. Decisions regarding what to wear to work or what to cook for family dinner are choices people make daily and require very little cognitive thought. Moreover, with regards to environmental policy-making, people are now being asked far more complex questions and individuals are often required to choose between different alternatives that differ according to their risks, benefits, costs, the certainty with which they will occur, their risks and/or benefits to human health and the environment (Gregory et al., 1997).

In order to understand how individuals make decisions and their decision-making processes when it comes to complex and unfamiliar situations, one needs to understand the concept of 'Decision-Making'. Decision-making is defined as "the study of identifying and choosing alternatives based on the values and preferences of the decision maker" (Fülöp, 2001, pg. 1). Decision making implies that there are a range of alternative choices to be considered and it involves the process of weighing up the pros and cons of the alternatives and making a choice based on the alternative that is the most appealing and practical as well as the choice that will help one to achieve their goals and meet their values and desires (Fülöp, 2001).

### 1.10.1 Decision making processes and the Multi-attribute Utility Theory

When individuals are required to make decisions regarding complex trade-offs as mentioned above, individuals often lack a well-rounded, holistic perspective of the entire situation at hand and find themselves placed in positions where they are unable to make an effective and rational choice (Gregory et al, 1997). Individuals are sometimes required to make complex choices that are unfamiliar to them. The complexity of these choices relates to the theory of behavioural decision-making as this theory's emphasis is on how individuals will attempt to simplify complex choices in order to better understand them and to make a sound decision (Gregory et al, 1997). Behavioural economics suggests that the public's environmental choices and actions regarding situations that are characterised by complexity, uncertainty, and risk taking are often dealt with using simplifying strategies such as rule-of-thumb and mental shortcuts. These are the most commonly used methods in complex decision making as they require very little effort and cognitive thinking which increases the speed of problem-solving and decision making (Fredricks, Stenner & Hobman, 2015). These common methods can reduce the complexity of decision making however, heuristics can introduce errors and biases that may prevent the environmental policy maker from fully understanding an individual's decision-making process (Dale, 2015).

Moreover, a more rigid and informative approach relating to understanding how individuals make decisions that are complex and unfamiliar is known as the Multi-Attribute Utility Theory (MAUT) which was developed by Keeney and Raiffa (1976). The MAUT provides a formal approach in which individuals begin to think about multidimensional decisions with multiple alternative solutions and the attributes that each alternative solution has (Jansen, 2011). This process requires individuals to weigh the alternatives on each 'attribute' (Jansen, 2011). Individuals therefore place higher levels of importance on specific alternatives based on the attributes that those alternatives have in order to align their choice with their values and attitudes (Jansen, 2011). The MAUT is therefore characterised by 'Value-Focused Thinking' which emphasises the significance of correctly identifying and structuring one's own values as an antecedent to making sound-minded choices (Gregory et al., 1997). There are six steps involved in the multi-attribute utility method which are listed below (Jansen, 2011):

1) Framing the decision
2) Defining alternatives and value-relevant attributes
3) Evaluating each alternative separately on each attribute
4) Assigning relative weights to the attributes

5) Aggregating the weights of the attributes and the single attribute evaluations of alternatives to obtain an overall evaluation of alternatives
6) Performing sensitivity analyses and make recommendations (Jansen, 2011).

The practical application of the Multi-Attribute Utility theory (MAUT) varies depending on the nature of the research (Jansen, 2011). Gregory et al (1997) utilised the MAUT when designing their forest vegetation management policy survey. They made use of three decision steps namely: Framing the decision, defining key objectives and making trade-offs among these objectives. However, for the purpose of this research, steps one to four will be the main focus (Jansen, 2011). The first step in the MAUT analysis is to frame the decision being proposed which involves the recognition of the key contextual elements of the decision situation (Jansen, 2011). This would involve specifying the proposed environmental policy implementation which would be the use of reclaimed water for potable purposes, the impacts that this implementation will have on the environment and the user such as various health risks and the costs and the probability that these will occur which directly links to the water scarcity problem that South Africa is facing (Gregory et al., 1997).

Once the decision is identified and understood, the next step is to look at the various alternatives that are available to the present decision and these various alternative attributes. An example would be alternative water solutions in sustaining water for South Africa. The public water users would need to be aware of using reclaimed water for potable purposes as a viable way to save water but at the same time they would also need to recognize that there are other water remediation solutions that will be available to them such as water restrictions, the development of desalination plants, and rainwater harvesting in order to sustain the water supply. In understanding the various options available to them, the attributes that stand out the most for reclaimed water as well as the other alternatives, will need to be identified in order for the public to reach their decision. The identification of the most significant attributes is highly necessary. However, it is noted that these attributes cannot simply be provided to the researcher due to the complexity of environmental decision-making and many of the attributes are currently unknown. Capturing the right attributes requires the researcher to look deeper into the aspects of the decision problem that are most important and most valuable to the user and understand these aspects holistically (Jansen, 2011).

Once the most important attributes are determined, the alternatives need to be analysed for each of these important attributes. This is seen as step three in the MAUT analysis. In this case, the question that must be asked is what value does the use of reclaimed water have for the

environment as well as the user? If reclaimed water was used how clean would that water actually need to be? Would using water restrictions be a more appealing alternative than the thought of using water that was once contaminated but is now clean? It is these questions that would be of importance when trying to understand how individuals place value on certain attributes of an alternative solution to saving water (Jansen, 2011). In understanding the various attributes that one considers when it comes to complex decision making, the researcher aimed to identify the common aspects that are of importance to the public as well as the uncommon aspect that are of importance to the public (Jansen, 2011).

Once all the attributes of an alternative are evaluated, the level of importance of each of the attributes is then determined and individuals will place a particular level of value on the different attributes so that they are able to make trade-offs. Individuals will be able to place a particular weight on each of the attributes for all the alternative water solutions and with this knowledge, they are able to identify which attributes are clearly most important to them and which attributes do not really matter. With regards to using reclaimed water, one might have placed a higher level of importance on the idea that they are not comfortable drinking water that was once contaminated and therefore the use of borehole water is the more appealing alternative as they placed a lower level of importance on the cost of installing a borehole. The higher the importance one places on an (attribute of) an alternative, the harder it is going to be to elicit acceptance of the proposed alternative. It is therefore of importance that environmental policy makers understand the public's attitudes and feelings towards sustaining the water supply and the various methods to do so (Jansen, 2011).

Furthermore, the MAUT is an effective and efficient theoretical framework in understanding the thought processes that an individual undergoes when having to deal with a complex decision that they are unfamiliar with. Individuals rank certain attributes of an alternative solution in saving water according to their values, attitudes, and feelings and these rankings can assist in the development of a water reticulation decision pathway survey (Jansen, 2011).

### 1.10.2 Using A Decision-Pathway Survey To Inform Decision Making Regarding Water Reclamation

With the use of the multi-attribute theory and understanding the underlying principles for water reclamation, the development and use of a decision-pathway survey was necessary in order to understand the public's perceptions regarding water reclamation. A common approach in collecting public input has been surveys in which participants' attitudes regarding environmental

policies are explained through the use of an individual's demographic background, values and beliefs (Gregory, Satterfield & Hasell, 2016). With regards to environmental decision making, it is important to address the more complex value trade-offs relating to water reclamation in order to take all the necessary steps to ensure its success. It is imperative that environmental managers take the time and consideration to listen to the attitudes, fears and preferences of the public as they are the ones who may potentially be affected by their actions (Gregory, Flynn, Johnson, Satterfield, Slovic & Wagner, 1997). Environmental decisions and policies are made by the experts and according to Gregory et al (1997), experts and laypeople view the world quite differently. Therefore, it is important that environmental decision makers are able to learn and understand the public's view regarding environmental decisions and the responses that are collected should be included into the decision making process.

Individuals are involved in decision making daily however these decisions usually involve familiar, everyday activities or choices such as what one should eat for lunch or what time they need to leave for work (Gregory et al., 1997). These decisions are usually made out of habit and do not require intense thought whereas choices that require a larger cognitive load such as environmental decisions can be unfamiliar to the individual and are far more complex than lunch agendas (Gregory et al, 1997). The use of a Decision Pathway Survey provides insight through capturing the underlying reasoning and thought processes regarding a complex decision that needs to be made (Gregory et al., 2016). A decision pathway survey is used to allow individuals to grow their factual knowledge foundation and reach a complete and holistic understanding of their values towards an environmental decision. This will aid individuals in thinking about a concept in its entirety and dive deeper into their own perspective and opinions towards the decision concept. Further, this also allows individuals to balance all the information accurately (Gregory et al., 2016). Survey results aid in opening up dialogue and communication channels and successful implementation of policies are likely to increase (Gregory et al., 1997). Decision pathway surveys are seen as an effective approach when it comes to incorporating the public's input regarding environmental decisions as it involves an iterative process (Gregory et al., 2016).

The design of a decision pathway survey facilitates a two-way interaction between the public and the environmental decision makers and the survey further provides opportunity for the public to reflect on their own thoughts throughout the process through iteration (Gregory et al, 2016). Gregory, Satterfield and Hasell (2016) made use of a decision pathway survey in order to further understand how individuals viewed a wide range of policies that are in place to deal with climate change (Gregory et al., 2016). Gregory et al (2016) began the survey with a tutorial which

introduced climate change science. The first questions of Gregory et al's (2016) Decision Pathway Survey identified the participants' position regarding climate change policies (i.e. degree of concern) and their preferred policy to implement policies and the second tutorial provided a background into climate change policies.

In order to create the climate change policy decision pathway survey, a generalized six-step decision-making approach was used which was based on the PrOACT framework presented by Jansen (2011). Gregory et al (1997) took part in designing a decision pathway survey for Ontario, Canada which helped provincial resource managers gain a deeper understanding of the public's views and opinions regarding alternative forest vegetation management policies (Gregory et al., 1997). The sequence of the decision pathway survey for alternative forest vegetation management policies was based on the results from interviews with key informants in the field as well as focus groups with laypeople (Gregory et al., 1997). The nature of the surveys mentioned above are similar as they both include environmental policies. The proposed water reclamation decision pathway survey includes decisions regarding environmental policies and therefore the water reclamation decision pathway survey will utilise the same framework of the climate change policy decision pathway survey as well as the forest vegetation management policy survey. It is important to include various tutorials within the decision pathway survey as well as extra information in order to aid the process. The lack of knowledge around water reclamation can impact the quality of the results and therefore in providing extra insight, this will help individuals in understanding the concept in its entirety.

### 1.11 Conclusion: The importance of the water reclamation decision pathway survey

In order to create meaningful environmental change, there needs to be a strong emphasis on the public. It can be concluded that the inclusion of the public in decision making of environmental policies is extremely important in order to ensure the successful implementation of reclaimed water usage for potable purposes. In order to provide the public with a sense of inclusion and importance, one needs to really know and understand their opinions, decisions that they make, but most importantly, one needs to understand why they make certain decisions and the decision pathways and processes that underlie their choices. Traditional survey designs are inadequate in capturing the complex cognitive and decision processes that the public bring to environmental policy choices (Gregory et al., 1997). Furthermore, it is necessary to understand the various decision pathways that the public water users embark on when making a choice regarding using reclaimed water as this will allow the policy makers to understand the public and make them feel important which will increase acceptance of environmental policies in the future. The

development of a draft water reclamation decision pathway survey uses the insights of the MAUT in order to clarify the reasoning processes of individuals (Gregory et al., 1997). The water reclamation decision pathway survey will allow policy makers to understand the different pathways that the public have when it comes to deciding if they are for or against using reclaimed water and it will also highlight the social and psychological barriers that people have towards reclaimed water usage. With this knowledge, environmental policy makers can assess the success of implementing reclaimed water to sustain water for the future and they can eradicate any fear, concerns or mistrust that the public has and be proactive in dealing with these barriers.

In view of these findings that came about from the literature,, this study will be guided by the following research questions:

## 1.12 RESEARCH QUESTIONS

- What are the psychological and social barriers that an urban, educated sample have towards using reclaimed water?
- What are the psychological and social barriers that water experts have towards using reclaimed water?
- How can these social and psychological barriers be utilized in order to develop a survey that policy makers could use?

# CHAPTER TWO - METHODS

## 2.1 Introduction

This chapter will present the study's aims, the research design, sample and sampling, method of data collection, procedure, ethical considerations, as well as the method of analysis. According to the information presented in the introduction and the literature review, the implementation of alternative water sources is seen as being the most sustainable option in managing the increased demand for water in the country. Reclaiming wastewater for re usage will play a role in eradicating water crises and water scarcity. The use of reclaimed water will contribute to overcoming the challenges that the current water shortages bring about. Moreover, using reclaimed water will aid the country in being proactive in utilising available resources and mitigating any future water shortages that South Africa will face.

## 2.2 Aims

The aims of this research were to take a 'people's perspective', to delineate urban, educated South Africans' attitudes towards reclaimed water. Public acceptance of environmental policies is the driving force to creating meaningful environmental change. Humans are a complex species that are full of feelings and emotions. People's behaviours in making decisions are often driven by their understanding, trust, values, and subjective norms. This research aimed to understand the sample of convenience of people from the Gauteng Province in order to understand their willingness in using reclaimed water for potable purposes and further inform the design of the Decision Pathway Survey

The main purpose of this research was to develop a 'Water Reclamation Decision Pathway Survey' in a South African context regarding reclaimed water which would be based on Gregory, Flynn, Johnson, Satterfield, Slovic and Wagner's (1997) Decision Pathway Survey. This tool can assist policy makers to understand the various social and psychological barriers that urban, educated South Africans have regarding the use of reclaimed water.

## 2.3 Research Design

This research design adopted a qualitative approach which was the most appropriate due to the emphasis on participants' perspectives. The design of this research allowed for a greater understanding and interpretation of individuals' experiences that are present within the social world (Leedy & Ormrod, 2005). It allows the researcher to gain deeper understandings of people's

emotive feelings, underlying reasoning, opinions, and motivations towards using reclaimed water (Denzin & Lincoln, 1994). The purpose of qualitative research is for researchers to study phenomena in their natural settings and then make sense of these phenomena by revealing certain themes and trends with a reference to how people bring meaning to them (Denzin & Lincoln, 1994). The focus was on understanding people's underlying feelings, values and emotions when making decisions about important environmental policies such as using reclaimed water that will impact them and the world, they live in. Qualitative research was deemed the most suitable as it allowed the researcher to collect data from a smaller sample and these participants were able to provide their own unique, specific insight into reclaimed water usage for potable and non-potable purposes (Leedy & Ormrod, 2005). In turn, this allowed the researcher to build a sizable description and understanding of Johannesburg water users' attitudes towards reclaimed water.

This research was located in the interpretivist research paradigm as the main concern was to understand the world as it is from subjective experiences of individuals living in Gauteng who are affected by environmental choices (Richie & Lewis, 2003). This approach allowed for the understanding of complex phenomena through the researcher-participant interaction and the researcher began to take on the role of a subjective observer (Smith and Osborn, 2007). The interpretivist paradigm made use of meaning instead of numerical measurement methodologies and it assumed that the knowledge people have about the world comes from understanding the social world. Research located in the interpretivist paradigm derives its constructs through in-depth analysis of the phenomenon of interest which aligns with the aims of the study in gaining deeper understanding of water users' attitudes and feelings towards reclaimed water usage (Myers, 2009).

This research adopted an interpretative phenomenological approach (IPA) to enquiry which emphasises individuals' personal realities. The research aim was to understand the meaning that several individuals place on a certain real-life phenomenon, therefore the use of IPA was appropriate as it looked at the subjective realities of the individuals participating in the study, described what these participants have or don't have in common and then compartmentalised individual experiences to a more universal understanding (Creswell, Hanson, Clark Plano & Morales, 2007). Furthermore, the phenomenological approach allowed the researcher to better understand the subjective meanings that are imbedded in human behaviour and the researcher was able to further understand participants' attitudes and feelings towards using reclaimed water (Larkin & Thomson, 2012). The data consisted of interview and focus group transcripts and were

therefore treated to rigorous, iterative analysis. This research design encouraged the necessary flexibility and open-mindedness needed in order for the researcher to be fully immersed in the topic of concern. This immersion allowed the researcher to gain more information and a better understanding of individuals' feelings, values, and emotions towards the implementation of water recycling and water reticulation systems which is a difficult trade-off for people to comprehend.

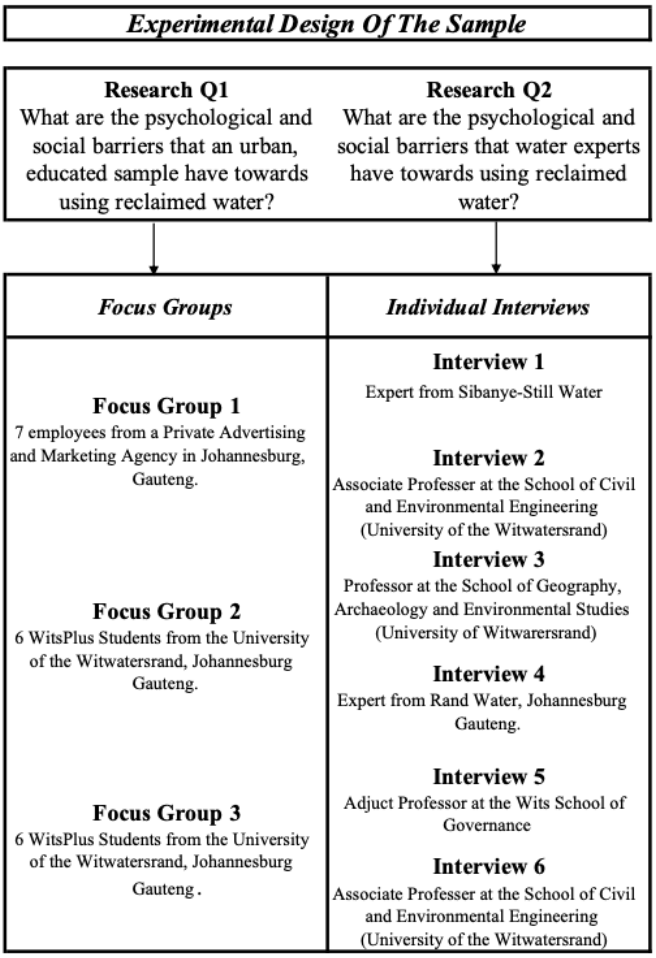
## 2.4 Sample and Sampling

With the implementation of environmental policies, those most affected are often the public. In order to have understood the various decision pathways that the public embarked on when making decisions regarding the acceptance or rejection of using reclaimed water and in order to have developed the water reticulation and recycling decision pathway survey, it was crucial to prioritize the public as public acceptance is viewed as the driving force in achieving environmental change.

### *2.4.1 - Participant recruitment*

The sample was made up of laypeople for the focus groups and experts for the interviews. Both these samples were obtained through a non-probability sampling strategy as the sample population chosen was not of random nature and not everyone had an equal chance of being asked to participate.

For the purpose of this research, the sample consisted of laypeople as well as experts working in the area of water in Johannesburg, South Africa. Below is a diagram of the sample for focus groups and for interviews. The diagram represents the sample selected for each research question.




### *2.4.2 – Laypeople*

Purposive sampling was utilised at the private advertising and marketing agency as certain individuals were selected by the Human Resources Manager at the organisation to ensure that the sample consisted of suitable participants who will provide valuable and necessary information regarding reclaimed water (Fossey, Harvey, McDermott & Davidson, 2002). Convenience sampling with the use of volunteers was used as the laypeople from WitsPlus were recruited conveniently, and they chose to volunteer to participate whereas the key informants will be purposively approached based on their knowledge and expertise in the water sector. The private advertising and marketing agency and WitsPlus were chosen as one institution (WitsPlus) represented individuals who had a history of tertiary education whereas the other (advertising and marketing agency) included individuals who have little or no tertiary education background. Both institutions were made up of racially diverse individuals which allowed the sample to become slightly more generalisable.

The public laypeople sample was made up of 12 part time students recruited from WitsPlus centre for part-time studies, and seven employees at a private integrated advertising and marketing agency based in Johannesburg, Gauteng, South Africa. This target population was most appropriate as WitsPlus students were easily accessible and convenient. Both WitsPlus students and employees of the advertising and marketing agency are mature in age, they are homeowners, they live in urban areas where water is easily accessible, they are domestic consumers of water, they make use of water from a municipal system, and they take part in environmental decision making. The employees at the advertising and marketing agency were also utilised in order to diversify the focus group sample and not only include students.

The sample included 19 participants in the focus group (fourteen females and five males seen in Table 1). All participants are currently employed but less than half had tertiary education. All participants resided in an urban area and had regular access to running water. Focus group discussions were conducted in English.

**Table 1 - Sample Descriptive for Laypeople**

Table 1

*Sample Descriptives for Laypeople*

| **Gender** | **Frequency** |
|---|---|
| Female | 14 |
| Male | 5 |
| **Age** | |
| 21 - 30 | 3 |
| 31 - 40 | 7 |
| 41 - 50 | 3 |
| 51 and above | 6 |
| **Race** | |
| African | 10 |
| Indian | 0 |
| Coloured | 2 |
| White | 7 |
| **Highest Level Of Tertiary Education** | |
| Undergraduate | 4 |
| Post-Graduate | 1 |
| Working towards an Undergraduate | 14 |
| **Employment status** | |
| Employed | 19 |
| Unemployed | 0 |
| **Monthly Income** | |
| R5000 or less | 1 |
| R10 000 - 15 000 | 2 |
| R15 000 - 20 000 | 4 |
| R20 000 - 25 000 | 3 |
| R25 000 and above | 9 |
| **Area of Residence** | |
| Urban | 19 |
| Rural | 0 |
| **Acess to runnung water** | |
| Yes | 19 |
| No | 0 |

### *2.4.3 - Experts*

The experts in the water sector were made up of 6 individuals from Sibanye-Stillwater, Rand Water, Centre in Water Research and Development at the University of the Witwatersrand, Faculty of Engineering and the Built Environment at the University of the Witwatersrand and the Wits School of Governance. Purposive sampling was utilised as these participants were chosen based on their level of skill and knowledge within the water sector and the in-depth insight that they would be able to provide regarding water reclamation. The participant pool consisted of water engineers in order to gain insight into the different alternative water sources as well as water policy makers which will allow the researcher to understand certain water policy requirements when it comes to implementing reclaimed water usage and the various practicalities involved such as the cost and time needed in implementing reclaimed water systems. The sample did not include policy decision makers in the public sector and the reason for this is that the aims of this study was to design a Decision Pathway Survey for water users in Gauteng, not for policy makers. The inclusion of experts was to further understand various psychological and social barriers in place and to see if there were any other possible decision paths that users could take but that weren't immediately available to them. The use of experts played an important role in confirming the pathways that were found by the laypeople and therefore policy decision makers in the public sector were not necessary.

The use of experts and laypeople was beneficial for the purpose of this study as laypersons and experts often have differing views regarding environmental choices and policies due to their knowledge and expertise, and lack thereof. It is useful to maintain a holistic perspective regarding the acceptance or rejection of using reclaimed water as this will ensure the generalizability of the water reclamation pathway survey. Therefore, this sample included both regular water users from the public as well as water experts in order to adopt a multifaceted lens of water reclamation.

The sample included 6 experts (three females and three males, Table 2). All participants had a Master PhD level training within the water sector. They all resided in an urban area and all of them had regular access to running water. The interviews conducted by the researcher were done in the English language.

**Table 2 – Sample Descriptive for Expert**

Table 2

*Sample Descriptives for Experts*

| Gender | Frequency |
|---|---|
| Female | 3 |
| Male | 3 |
| **Age** | |
| 21 - 30 | 1 |
| 31 - 40 | 1 |
| 41 - 50 | 2 |
| 51 - 60 | 0 |
| 60 and above | 2 |
| **Race** | |
| African | 1 |
| Indian | 1 |
| Coloured | 0 |
| White | 4 |
| **Highest Level Of Tertiary Education** | |
| PhD | 3 |
| MBA | 1 |
| MSc | 2 |
| **Job Title** | |
| Associate Professor | 3 |
| Environmental Coordinator | 1 |
| Process Manager | 1 |
| Various | 1 |
| **Area of Specialty** | |
| Environmental Engineering | 1 |
| Water Research | 1 |
| Fresh Water management | 1 |
| Water, Energy and Climate Development | 1 |
| Water Treatment | 1 |
| Water Conservation | 1 |
| **Monthly Income** | |
| R31 000 - 40 000 | 1 |
| R40 000 and above | 5 |
| **Area of Residence** | |
| Urban | 6 |
| Rural | 0 |
| **Acess to runnung water** | |
| Yes | 6 |
| No | 0 |

The sample size for both the interview and the focus group participants was relatively small and some might argue that it would be better to have sampled participants until reaching saturation. Reaching saturation would ensure that the data is comprehensive and complete however this was not a viable option as running a large number of focus groups and interviews is not time and cost effective (Fossey et al., 2002). Moreover, this study adopted a smaller sample size in order to gain deeper understandings of participants' thoughts and experiences regarding reclaimed water. Creswell (1998) suggests that five to twenty-five participants is a sufficient amount that will allow

the researcher to capture the constructs that were studied as it is the quality of the data that is important, not necessarily the quantity.

### 2.5 Procedure and Instrument

Due to the research being qualitative in nature, focus groups and face-to-face semi-structured interviews were used as the primary research approach for primary data to be collected. The focus groups and interviews were guided by a schedule that was developed by the researcher beforehand.

Data collection began when the researcher obtained ethical clearance from the University of the Witwatersrand, Human Research Ethics Committee (non-medical) protocol number **MORG/19/007 IH** (please see appendix L). The researcher then proceeded to gain permission and cooperation of the WitsPlus centre for Part-time studies and a private integrated advertising and marketing agency in Johannesburg, Gauteng. The part-time student focus group participants were then approached during one of the WitsPlus lectures. The researcher briefly explained the purpose of her study and a sign-up sheet was sent around requesting the names and email addresses of those interested in participating. The participants were contacted electronically inviting them to participant and providing them with a Participant Information Sheet (PIS) (Please see appendix E) and a convenient date, time and place was arranged for the focus group to take place. The researcher approached the Human Resources manager at a private integrated advertising and marketing agency in Johannesburg requesting access to the organisation. The researcher explained that she was in the process of collecting data for her master's research and she was interested in running a focus group with some of the advertising and marketing employees in order to diversify her sample and attached a PIS (Please see appendix E) and an access request letter. The Human Resources manager provided access (please see appendix A) and selected 6 employees who were invited to participate.

In order to contact the experts, the email addresses and telephone numbers of the potential water expert participants were collected. The water experts were contacted via telephone as well as electronically inviting them to participate and they were provided with a PIS in order to give them a more informative description regarding the aims and the purpose of the study (Please see appendix B) and a convenient date, time and place was arranged for the interviews to take place. Data collection began once ethical clearance was granted to the researcher from the University of the Witwatersrand Human Research Ethics Committee.

Focus groups were conducted for the laypeople of Johannesburg and one-on-one semi-structured interviews were conducted with the water experts and key informants. The interview and focus group schedules were designed by the researcher beforehand. The schedules provided a specific layout that helped guide the participants in the focus groups and interviews and the schedule ensured that each interviewee and focus group provided data on the same set of questions. (Doody & Noonan, 2013). The use of an interview and focus group schedule created order and consistency; however participants were allowed to expand or elaborate on any other opinions and perspectives if they felt that they wanted to do so which allowed for a guided and focused, yet semi-flexible discussion to take place. The focus group schedule consisted of four main questions pertaining to laypeople's opinions regarding the water situation in SA, their thoughts on how to deal with water scarcity, how they felt about reclaimed water usage, and their willingness (or lack thereof) to use reclaimed water. The interview schedule also consisted of four questions related to the expert's thoughts regarding reclaimed water, the advantages and disadvantages that are associated with reclaimed water, the barriers and enablers that are present regarding reclaimed water usage, and ways to overcome these barriers.

Before the start of the focus groups and interviews, the participants were asked to fill out a brief demographic questionnaire in order for the researcher to gain a deeper understanding of the sample's characteristics (please see appendix J & K). This was done along with the signing of the consent form to participate in the study (please see appendix C & F) and a consent form that provided the researcher with permission to audio record the interviews and focus group sessions that were utilised in the researchers write up and to assure confidentiality (please see appendix D & G).

There were three focus groups discussions which lasted approximately 60 minutes each. Before commencing the focus group session, the researcher laid down a few ground rules. Participants were asked to not discuss details of the content discussed in the focus group once it had ended. Participants were asked to respect one another and not interrupt, intimidate, single out or make other participants feel uncomfortable during the process. Participants needed to feel comfortable and free to express their views in the focus group space. In order to build rapport, the focus groups began with a 'check-in' activity which consisted of each participant stating their name, their choice of study/area of work, and one fun fact about themselves. The focus groups were informal, open-ended and in conversational style. Focus group one consisted of 7 participants, focus group two consisted of 5 participants and focus group 3 consisted of 6 participants. There were two focus groups conducted with the WitsPlus students and one focus group with the staff at the

integrated advertising and marketing agency. Focus groups are seen as highly effective in capturing information regarding social norms as well as a range of perspectives that exist within a given population (Mack, Woodsong, MacQueen, Guest & Namey, 2005). Focus groups allowed the researcher to gain greater insights regarding the public perceptions of reclaimed water for potable/non-potable purposes. Focus groups also assisted in meeting the needs of the population regarding water sustainability (Mack et al., 2005).

There were six interviews that were conducted which lasted between 15 and 30 minutes each. The longest interview lasted 28 minutes and the shortest interview lasted around 15 minutes. The interviews took place in a comfortable environment, more often than not the interviews took place in the key informant's office or place of work in order to make it convenient and easily accessible for them. In order to build rapport and start off the sessions, the interview commenced with a friendly introduction. Interviews are seen as beneficial as they allow the researcher to learn the in-depth perspectives and views of individuals instead of the generalized group/community norms (Mack et al., 2005). Further, the use of interviews allowed the researcher to observe behavioural cues as well as build rapport with participants (Babbie & Mouton, 2001). Interviews allowed the researcher to understand specific attitudes from the experts which helped guide the direction of the focus groups as well as helped clarify certain ideas and aspects regarding reclaimed water.

The interviews and focus groups were recorded using an electronic voice recorder in order to capture all the relevant information needed for data analysis to take place. Once the focus groups and interviews were closed, participants were thanked for their participation and the insights that they provided and were invited to ask questions or raise any queries with the researcher. The researcher informed the participants that her and her supervisors' contact details were on the PIS if there were any further questions after the session. Lastly, the researcher ended off the focus group and interview sessions with informing the participants that a summary of the results would be provided to them if requested. The focus group and interview sessions were completed and the researcher electronically transcribed the recordings verbatim and began her analysis.

It is important to ensure the rigour of qualitative research studies in order to make sure that the research findings maintain 'integrity' to make an impact on practice and to produce trustworthy, reliable and valid results (Golafshani, 2003). The researcher was the primary data collection instrument and describing the experiences of others in the most honest way is one of the most critical responsibilities of a qualitative researcher (Walker, 2007). The researcher made use of a self-reflexive journal in order to remain entirely reflexive throughout the research project and

ensure that her own biased preconceptions or values did not impair the process (Walker, 2007). With the use of a self-reflexive journal, confirmability was maintained throughout the research process which ensures that the data and the interpretations of the data and the findings are not a subjective viewpoint or a figment of the researcher's imagination, but they are derived from the data (Tobin & Begley, 2004). The researchers transcriptions were checked by a random third party where a random check of five of the transcriptions was done. This was done in order to make sure that researcher's transcriptions were accurate, logical, and clearly documented which allowed dependability to be achieved (Tobin & Begley, 2004). Dependability is important as it prevents the researcher from missing any important information and ensures that if another researcher had to look over these results, they would come to similar conclusions (Tobin & Begley, 2004). Transferability was maintained throughout the research project as the core aim was to understand and identify individual's decision pathways when making trade-offs for reclaimed water usage. These water crises are a topic of concern for many countries, not only South Africa.

## 2.6 Data Analysis

The demographic questionnaire was transferred into a descriptive table explaining the sample demographic characteristics for both the interview and the focus group participants. The use of a descriptive table allowed the researcher to understand any plausible rival explanations for the results of the study. This study utilised an interpretative phenomenological analysis (IPA) in order to analyse the interview and focus group transcripts. The IPA approach was the most effective as there is a strong focus on the way that people make sense of their experiences in their social world (Smith & Osborn, 2007) and therefore, how people utilise the various different decision pathways when it comes to understanding and making a choice for using reclaimed water or not. IPA allowed the researcher to identify and interpret participants' meanings that they place on their social world which assisted in identifying themes that helped the researcher make sense of the participants' experiences (Smith & Osborn, 2007).

In order to conduct an interpretative phenomenological analysis, Thematic Analysis was the chosen method. According to Maguire and Delahunt (2017), "Thematic analysis is the process of identifying patterns or themes within a qualitative data set" (Maguire & Delahunt, 2017, pg. 3352). The identified patterns and themes allowed the researcher to contrast and compare differences across the set of data collected as well as provide a comprehensive description of the participants' experiences in the form of recurring themes and patterns (Braun & Clarke, 2006). The main focus was to identify emerging themes that fall outside the preconceived framework,

themes that are uncommon or unusual, and that stand out regarding alternative water sources. More familiar and common themes were also noted in order to provide a well-rounded, holistic framework for the decision pathways. The researcher followed the 6 steps proposed by Braun and Clarke (2006):

1) Familiarisation with the data

The analysis began with the researcher playing the interview audio-recordings, listening to the recordings and transcribing the data. The same process was followed for the focus group audio-recordings. The accuracy of the interview and focus group transcripts was ensured by comparing the transcriptions to the original recordings and checking them against one another. A third party was also utilised in reading through the transcripts and comparing them to the recordings. Once the transcripts were accurately checked, the researcher began reading through them repeatedly in order to gain an understanding of the responses and become familiar with the nature of the focus group and interview sessions. IPA requires a continuous interaction with the data and therefore the researcher repetitively read the transcripts and was able to develop new insights each time which were noted down (Braun & Clarke, 2006; Smith & Osborn, 2007).

1) Generating initial codes

At this step, the researcher will understand the data and arrange it in a meaningful and systematic way (Maguire & Delahunt, 2017). Throughout the process of familiarising one's self with the data, the researcher was able to pick up recurring patterns. The researcher identified and labelled any significant and common sentences, phrases, and words that related to the research questions. These sentences, phrases, and words were then colour-coded into different 'codes' and listed in the findings.

2) Searching for themes

The colour-coded 'codes' that were identified and labelled in step 2 were further analysed. Through this analysis, the researcher was able to identify emerging correlations between the codes (Braun & Clarke, 2006). The correlations between the codes were then developed into broader themes that said something specific about the research question (Maguire & Delahunt, 2017). These themes were typed up with their corresponding codes in the form of a table.

3) Reviewing themes

During step 4, the researcher needed to modify the themes developed in step 3. The researcher needed to make sure the themes were prevalent and that they made sense (Maguire & Delahunt, 2017). The researcher analysed the transcripts again and coded any information that was not picked up in the first 3 steps.

4) Defining and naming themes

At this stage, the researcher refined all of the themes and then aimed to identify the nature of each theme. The researcher dived deeper into questions such as 'what the theme was saying?' and 'are there any sub-themes present?' (Maguire & Delahunt, 2017). A detailed analysis of each individual theme was written and the researcher provided participant phrases that fell under each theme and supported the choice for the theme. The main themes were finalised and the researcher created titles for each main theme (Braun & Clark, 2006).

5) Producing the report

At this stage, the researcher began to analyse the themes and link them to the research questions. This was done in order to see if the research questions that this research was founded on were answered through the thematic analysis process. Moreover, the researcher answered the research question with the themes that were developed and her argument was strengthened with the use of empirical and theoretical evidence. Through-out the write up, the researcher included direct quotes relating to the themes in order to allow for transparency for the readers (Fossey et al., 2002).

The thematic analyses resulted in the development of two sets of themes from the experts and the laypeople which focused on individuals' attitudes towards using reclaimed water. The thematic analysis assisted the researcher to identify recurring themes as well as themes that were uncommon. These themes were translated into a decision pathway survey which then allowed the researcher to understand the various decision pathways that individuals took when making a choice regarding using or not using reclaimed water. This data analysis assisted the process of

developing a decision pathway survey and at the same time, provided insight to the existing social and psychological barriers that water users/experts had when it came to water reclamation. These themes will be further discussed in the next chapter.

## 2.7 Ethics

Ethical clearance was obtained from the Human Research Ethics Committee at the University of the Witwatersrand. The participants were recruited and asked to participate in focus groups and the WitsPlus interviews voluntarily. The participants who attended the focus group at the private advertising agency were selected in a non-voluntarily way by their HR manager. However, they were allowed to withdraw from the study at any time or to refuse to answer any question. The sample of participants was not characterised as at 'risk' or 'vulnerable' and no harm was posed to them. They are therefore protected (Vanclay, Baines & Taylor, 2013). Participant information sheets (PIS) and consent forms were provided upon arrival and were signed by each participant. The PIS informed the participants that the study was conducted for the purpose of completing a Master of Arts degree in Organisational Psychology at the University of the Witwatersrand. The PIS highlighted the main objectives of the study which were looking at the various decision pathways that people used when making environmental choices and identifying the various social and psychological barriers regarding reclaimed water usage. The PIS also clarified that participation was completely voluntary and there were no advantages or disadvantages if they chose to participate or not to participate (Vanclay et al., 2013). In order to adhere to the ethical principle of 'informed consent', participants were asked to sign a consent form upon arrival at the focus group/interview in order for the researcher to utilise the data collected. Participants were also required to fill out another consent form granting the researcher permission to voice record their focus group/interview (Vanclay et al., 2013). The consent form allowed participants to provide the researcher permission to utilise their responses for the research study. The researcher assumed that each participant would have read the PIS and was aware of the aims and purpose of the study, thus providing their consent to take part.

Due to the nature of the data collection, the ethical principle of anonymity could not be assured, however the information collected from the focus groups and the interviews was cleaned and all identifying information regarding the participants was removed. Identifiers that are more easily recognized such as participants' names were replaced with pseudonyms (Kaiser, 2009). In the WitsPlus sample, student numbers were collected in order to reward the first year psychology students who participated with an added 1% towards their grade for research participation. When

the student numbers had been noted and handed over to the relevant course co-ordinator, they were removed from the data set.

The voice recordings and transcripts were confidential and were kept in a password protected file that only the researcher and her supervisor had access to therefore meeting the ethical principle of data protection (Vanclay et al., 2013). The focus group participants' were only assured partial confidentiality as the other respondents in the focus group would also have heard what other people say. Therefore, the researcher only had control over what she would report on and therefore there was no reporting on individual responses, only group responses. The interview participants were ensured confidentiality as only the researcher was present during data collection and the participant's identity was kept strictly confidential (Babbie & Mouton, 2001 ). The completed research report will be stored in the University's online repository (WIReDSpace) and with the permission of the research participants, data may be stored for the purpose of future research. Furthermore, in order to meet the principle of feedback and debriefing, contact details for the researcher and her supervisor were provided for any major concerns, queries, and discrepancies that any participant may have and they were able to contact the researcher or her supervisor and arrange a debriefing session if required (Vanclay et al., 2013).

## 2.8 Conclusion

We need to start thinking about water in a different light. More specifically, we need to think about water as an invaluable resource that is even more valuable than gold. Water is understood as the valuable resource that makes the earth extraordinarily unique. The water future of South Africa is rapidly changing and the crises and shortages are becoming closer to home every day. Pro-environmental behaviour depends not only on the economic and environmental feasibilities but it highly depends on the attitudes and opinions of the public who are deeply impacted by environmental decisions. There are a myriad of factors that influence one's attitudes and opinions when it comes to accepting or rejecting reclaimed water. These myriad of factors are identified and this allows the researcher to identify the social and psychological barriers that are present in water reclamation. Furthermore, the development of the water reclamation decision pathway survey will serve as a tool for environmental policy makers in understanding the public's views, understanding the factors behind environmental consciousness and in the end, making a conscious effort to ensure public acceptance when it comes to environmental policies that are imperative in sustaining the water for the future of South Africa.

# CHAPTER 3 - RESULTS AND DISCUSSION

## 3.1 Introduction

This chapter will discuss the common themes that arose from the data analysis in more detail. Further, this section utilised existing knowledge and theory in order to explore these dominant themes and this knowledge and theory will be presented in order for the researcher to adequality capture the participants statements. The researcher included direct quotations from the participants in order to provide evidence for the points that have been presented. The results from the thematic content analysis will be reported in two parts. The first part will report the themes that emerged from the focus groups with laypeople with a summary which can be seen in table 3 below while the second part of the results will report on themes that emerged from the interviews with water experts. These themes provide some insight into the decision-making processes that the participants went through when considering whether or not they would drink reclaimed water, and the similarities and differences that the expert and the laypeople have. Further, this chapter discussed the themes in light of previous literature that was presented in chapter 1 as well literature that was found based on the themes.

**Table 3 - Themes from the Laypeople and the Experts**

**Table 3**
***Themes From the Laypeople and the Experts***

| Laypeople | Water Experts |
|---|---|
| Buffer | Reclaimed water as a viable source to save the environment |
| Trust in the Government/Municipalities | Trust in the Government/Municipalities |
| Infrastructure and Technology | Infrastructure and Technology |
| The health Perceptions and the Aesthetics of Reclaimed Water | The Health Perceptions of Reclaimed Water |
| Awareness of Reclaimed Water | Awareness of Reclaimed Water |
| Costs Implications | Cost Implications |
| Other Incentives to Save Water | Personal Perceptions |
| The Role of the Media and Advertising | The role of the Media and Advertising |
| Ignorance is Bliss | Maintenance |
| Reclaimed Water as the Only Option | Politics vs Science |
| | Water Scarcity and Crisis |

### 3.2 Research Question 1 : What are the social and psychological barriers that laypeople have towards using reclaimed water for potable purposes?

The analysis conducted allowed the researcher to identify common themes that laypeople shared. These themes represent the various social and psychological barriers that are in place when it comes to the use of reclaimed water for potable purposes.

### 3.3 Themes identified from laypeople in the Focus Groups

#### 3.3.1 - Buffer

Throughout this study, the participants expressed their willingness to use reclaimed water for potable purposes with the condition of there being a buffer. Before any verbatim data is provided, it is important to understand what the term 'buffer' means. An environmental 'buffer' refers to something that is in place in order to lessen the impact of reclaimed water. An environmental buffer provides opportunity for any contaminants to be further removed before human consumption (Drewes, 2015). Participant 12 said that *"I would drink the reclaimed water only if I used the energized oxygen machine which connects to your tap and it cleans the water. I would only drink reclaimed water using this machine as a buffer because I've seen that it works and I've tested the product and even when you smell the water, it's very clean and pure".* Participant 13 shared a similar opinion: "*If they come out with a green tap attachment that filters water and that's approved and nation-wide and it costs next to nothing but it does the job perfectly then I will consider it".* Participant 10 and 11 expressed their tendency to boil their water before consuming it even though the water is presumably already purified. This suggests that these two participants were not comfortable consuming the water that comes out their taps presently and always feel the need to boil it before use. This is in line with the work of Larson and Gnedenko (1998) as they found that in Russia, many individuals boil their water, filter water or purchase bottled water in an attempt to avoid any potential health risks. The use of avoidance measures such as boiling water or using a water filtering system highlights the water quality concern that the participants experienced and their attempt to affect the final quality of the water (Larson & Gnedenko, 1998). The use of reclaimed, water with the condition of there being a buffer, highlights the lack of trust in the water treatment process.

#### 3.3.2 - Trust in the government/municipalities

Trust in authorities to provide safe reclaimed water played a critical role in the level of public acceptance of reclaimed water usage (Po et al., 2003). The work of Po et al (2003) is similar to

the responses of the participants. Participant 13 initiated this thus: *"They always come too late to the party. It's always reactionary and they are not paying enough attention to the water scarcity issues"*. Participant 8 discussed this statement further and said *"Government's role needs to be that they need to let us know how to take responsibility and get on top of the water issues. When it is becoming a crisis, call it a crisis and don't cover it up and make it seem less than it is. Maybe they don't want to create mass panic but the government needs to be proactive as well"*. When the participants were informed about the fact that the water that comes through the taps is partially reclaimed, participant 7 says *"I think we drink this water only because we are told that is it safe. If we are not told that it might be harmful, we won't even question it. We don't even consider the cleaning process"*. Commenting on this, Participant 9 said "*I think the government needs to be transparent with us. If we know what goes on, where the water comes from, the cleaning process, how much it cost. I think the government plays down things. They need to be upfront and transparent about where the water is sourced from. We want to know what's going on at all times"*.

In a study done by Kearcher et al (2003), focus group participants said that the main reason that they would be willing to use reclaimed water is if they trusted the water authorities. When asked about the use of reclaimed water in order to ensure water security, participant 4 stated that *"Money is misappropriated, it is misspent and you've seen, the Vaal hasn't been kept up and there's been no focus on the maintenance at the Vaal. I also think there's a lack of responsibility and accountability when it comes to the water management that is in place"*. According to Beierle and Konisky (2000), decreased trust in the individuals who have power represents public scepticism that arises due to government scandals and mismanagement. Participant 18 mentioned the issue of corruption and his concern regarding the intentions of those in power by saying *"think about the people who run Joburg City Water or Rand Water. Are they pure people with pure intentions? Do they want us to hold back on our spending? It is also a question on who is running the place I mean corruption comes back to that"* which is in agreement with the work of Beierle and Konisky (2000). The use of reclamation involves a reliance on wastewater treatment plants to do their job well. Participant 1 raised concerns regarding the current state of waste water treatment plants: "*They are old. A lot of them are old and have not been kept up so its huge costs now. The municipality is kind of oblivious or chooses to be"*.

As Beierle and Konisky (2000) state, building trust with the public is challenging and participant 17 further expressed her lack of trust by stating that *"I don't know if I would trust the water*

*reclamation process to, I'm not sure if they would do it properly".* Further, participant 18 summed up the discussion regarding trust and confidence and stated that *"it comes down to trust, I don't trust the government or current water quality at the moment. So why would we trust it if they said they would reclaim it and we would have to use it. I will stick to bottled water".* Participant 16 concluded with "*It's the reliance that we have on the state and we just know they will fail us".* Furthermore, in order to successfully implement water reclamation projects, there needs to be a strong level of trust between the public and the government/municipalities as trust drives acceptance (Beierle & Konisky, 2000).

It is clear that there were trust issues with several stakeholders which are summarized below:

1. The government
2. Water Authorities (Rand Water)
3. Vaal Maintenance of Treatment Plants

### 3.3.3 - Infrastructure and technology

The trust issues that the participants have expressed lead into a third theme: the infrastructure and technology in place. Previously the participants mentioned the lack of responsibility from the government and the municipalities and their concerns regarding the quality of the infrastructure that is in place for water processing. Participant 11 provided personal insight from her place of work and said, *"the building where I work, they always tell us to bring our own water because of the old infrastructure and the bad quality of water"* which suggests that the current infrastructure is not to the required standard and even business owners do not want their employees drinking from their taps which is in agreement with Participant 16 as she says *"I actually don't even know how clean our tap water is to drink. My personal preference is to use bottled water or a filtering system and I am worried about the pipe maintenance".* Participant 11 and 16 mention the quality of the piping systems and that they might have bad pipes in their households or places of work which impact their intentions to consume the current water that comes out of their taps. The issue of poor piping is not the responsibility of the municipalities, it is the responsibility of the homeowner or business owner. Moreover, the issue of poor piping systems should reflect the public's level of trust towards the government/ municipalities. Participant 16 explores the state of the infrastructure by saying *"Keep in mind that our infrastructure is not well maintained at all. We have burst pipes almost every week, we have people who dump their waste and rubbish into the water and it isn't cleaned well because the wastewater treatment plants are not fully*

*functioning".* According to Giorgis, Teklehaimanot, Kamika, Coetzee and Momba, (2015), the WWTPs in South Africa are under stress and out of the 852 WWTP's, only 60 of them function optimally. The participants acknowledge that the infrastructure needed to treat the reclaimed water is in place but the WWTPs are not functioning at an optimal level and this creates room for feelings of distrust in the government/municipalities. The Green Drop Certification Programme was designed to establish motivation and leadership in the water sector with regards to wastewater services (Burgess, 2019). The aim of the Green Drop Programme is to establish effective management of wastewater services in each municipality. Municipalities will receive a green drop status when they maintain scores of 90% or higher for each wastewater system, the wastewater quality monitoring and the maintenance and management of the wastewater system (Burgess, 2019). This Green Drop intervention is an incentive-based regulation much like the Blue Drop Certification Programme and it is in place to ensure optimal functioning of the WWTPs. The municipalities are responsible for maintaining a Green Drop status as this ensures that the wastewater that is treated to reclaimed water is done well. Each province will receive a Blue and Green Drop score that will reflect their performance according to the set water standards (Mangena, 2019). A study done by Mangena (2019) states that the highest performing provinces that have adhered to the Blue and Green Drop requirements were the Western Cape (WC), KwaZulu Natal (KZN) and Gauteng (GP). According to Naroth (2016), wastewater can be rich in organic matter such as pesticides and pharmaceutical residue which is harmful if consumed and participant 16 view regarding the water not being treated properly aligns with Naroth (2016). These responses suggest that the participants not only have a lack of trust in the government and the municipalities but they are aware of the poor infrastructural systems in place and if those systems were to be used to produce reclaimed water, the acceptance levels of using reclaimed water are bound to decrease. If the infrastructure and technology needed in order for reclamation to run smoothly and efficiently does not function properly, the trust and confidence from the public will decrease drastically and the acceptance of reclamation for potable uses will not materialize.

### 3.3.4 - The Health Perceptions and Aesthetics of Reclaimed Water

The low levels of trust in the water management systems, the municipalities and the government feed into the fourth prevalent theme. An important factor that influences public acceptance is the perceived risk when it comes to the use of reclaimed water for potable purposes (Po, Kertcher & Nancarrow, 2003). According to Schmidt (2009), individuals may experience a strong emotion of 'disgust' when they think about consuming reclaimed water and he labelled this concept 'the yuck

factor'. The yuck factor has been cited as a barrier to water reclamation since the 1970s (Po et al, 2003). The participants expressed concern regarding the potential quality of the reclaimed water and the impact it could have on their health which is in line with Schmidt (2009) and the yuck factor experience. Participant 4 began the discussion with *"I wouldn't drink that water; it will make me so sick. I would rather buy bottled water".* She mentioned that she always boiled her water or purchased filtered water. She further elaborated: *"I am already pedantic about the water coming out of the tap so for me, drinking reclaimed water will be a huge problem as I am worried about the health risks associated"*. Participant 5 agreed with her, saying: *"There is a huge fear that it will make me sick".* This fear of illness was shared by a few other participants. Participant 11 gave insight into her attitude towards drinking reclaimed water and she said that *"I am actually worried to consume reclaimed water, especially knowing there may be black water in there, I have seen instances in Hammanskraal where people were getting sick".*

The Responses from participants regarding the health impact of consuming reclaimed water is similar to the responses collected in a study in Sydney, Australia where participants consistently reported their concerns and opinions regarding the safety of the reclaimed water and when those participants were asked what they thought were the disadvantages of reclaimed water, the most common responses were directly related to health concerns as well as their fears of falling ill if consuming the reclaimed water (Po et al, 2003). Evidently, the yuck factor as mentioned by Schmidt (2009) manifested quite strongly within the participants' opinions and shaped their attitudes towards consuming reclaimed water as an alternative water solution. Alongside the health concerns and the yuck factor, participants also brought up the aesthetics of the water and the strong impact it had on their opinion. Participant 3 stated *"It just seems like it couldn't be cleaned enough. What if there was something wrong with the taste of the water? Or what if it smells funny? I would also be concerned that it will make me sick. The taste and smell are enough to put anyone off immediately".* Participant 9 voiced her concern regarding where the water would come from and *"whether it has been cleaned well enough. What if there are particles in it? There is E. coli which can come from faeces so I would not want me or my family to drink it because my family will get sick".* Not all participants were entirely against the use of reclaimed water, though. Participant 18 suggested that *"it's unknown territory, the health aspect is unknown and there's a stigma towards it. I just think it's not a developed enough point and a lot of people feel that it will make us sick. There are sceptics and systems are not trusted and this influences our perceptions of the health risks.".* Participant 18 pointed out that *"I want assurances on the drinking quality. If I have assurances regarding the quality of the water and if I am assured that I won't get sick*

*then it would be a consideration for sure".* The response of participant 18 suggests that he is aware of the health perceptions that people may have but with the right assurance and awareness of reclamation and the processes that are involved, there may be more accepting individuals like himself.

Participant 18's response is similar to the responses collected from a study done by Jeffrey and Jefferson (2002) in the United Kingdom where 89% of the respondents stated that they would not object to using reclaimed water as long as they are assured that the water is of good quality and it is safe to drink. Participant 18 expressed his concern regarding the reclaimed water quality and the need for some type of assurance that the water is safe however, participant 18's lack of water management knowledge precedes him as there are in fact interventions in place in South Africa that monitor the quality of one's drinking water and assure that it is acceptable. The Blue Drop Certification Programme (BDCP) as an incentive-based regulation for drinking water was introduced in 2008 by the Department of Water Affairs and Forestry (DWAF) which aimed to maintain and improve the drinking water quality in South Africa (Ramodipa, 2017). The BDCP aims to hold municipalities and water service providers accountable for the water that the public are consuming through monthly municipal engineering meetings with the drinking water quality management team (Nealer & Mtsweni, 2013). The participants expressed their concern regarding the quality of the reclaimed water and its potential health risks and participant 18 suggested that he would need to be continuously assured that the reclaimed water that he will consume is of drinking quality. The Blue Drop Certification Programme has been in place for 11 years and one of the main aims is for the municipalities to be transparent with the public about the quality of drinking water and ensure that credible information regarding the water quality is published consistently and the public are able to access that information (Nealer & Mstweni, 2013). Furthermore, participants have expressed their high levels of concerns regarding the health implications that may come with consuming reclaimed water. The participants also voiced the importance of being assured that the reclaimed water will be of a safe drinking standard. Therefore, an intervention such as the Blue Drop Certification Programme needs to be advertised more as it is in place but not many individuals are aware of this regulation.

### 3.3.5 - Awareness of Water Saving

The participants expressed the aspect of awareness on two different levels. Firstly, participants felt strongly about the need for education and awareness regarding water conservation in order to use available sources effectively so as to avoid having to turn to reclamation. Participant 17

expressed her thoughts regarding awareness and said that *"I think the problem is a lack of awareness among the general population. People waste water because they don't know better and when water saving needs to be implemented, we have no idea what it entails".* Participant 5 elaborates on this point saying *"There needs to be a focus on the educational aspect around conservation of water. We need more information on conservation, how to use water sparingly. This is very important"*. Participant 9 provided insight into the lack of awareness and suggests that *"One of the issues might be that the education around water scarcity in South Africa is not necessarily very good or accessible".* Participant 3 further mentioned that *"There is an education perspective and it is important to make people more conscious and aware about the clean water that we do have, and to use that water more wisely so we don't get to that point quickly".* Further, participant 13 concluded the issue of awareness of water security by saying *"If education happens and greater awareness comes about, it will bring everyone on the same page and if everyone is on the same page, we all hold each other responsible to save our water and recognize that this is a nationwide issue. Everyone will be involved in doing their part to save water and it will be in everyone's best interest".* These participants expressed their concern for awareness regarding water security in general and these perspectives are in line with the work of Hartley (2001) as they laypeople felt that they did not have enough knowledge and awareness of water reclamation and they mentioned the fact that if the nation was better informed, they would not need to turn to reclaimed water so quickly.

The second level of awareness was related to the process of water reclamation. Environmental decision making with regards to water reclamation is a topic that is not very familiar to most individuals. Hartley (2001) states that information and context are important factors involved when trying to gain public acceptance and participation of reclaimed water use. Many of the participants in this study also had limited knowledge about water reclamation, how it works, the processes involved, and general facts about the quality of the water. This lack of awareness has the potential to impact their perceptions regarding water reclamation and their willingness to accept or reject it. Participant 3 discussed her concern regarding this and said that *"I also think there is an awareness and education requirements that needs to be done in order to educate the public that reclaimed water will be okay to drink and you won't get sick from it".* This view was shared by participant 5 and 11, both of whom mentioned the need for education around the process of wastewater treatment to generate reclaimed water. They reckoned that placing greater emphasis on the fact that the water was safe to drink after the treatment process could lead to greater acceptance. However, other participants felt that they need more than just awareness, they

need proof that the water is safe to consume. Participant 8 said "*I feel like if I knew the cleaning process of reclaimed water and I saw that they use it and people are not falling ill or dying, I will have greater confidence in using it myself but I need to see it with my own eyes*". This suggests that evidence would speak louder than words and it is not enough to just provide information regarding the cleaning process, authorities would need to demonstrate, through evidence, the safety of the water, in order for people to be confident about reclaimed water. The views of participants 5,8 and 11 are in line with the work of Hartling (2001) who states that transparency allows the public to feel informed, involved and they will therefore build trust. Hartling (2001) mentioned that the public need assurances that their health will be protected and the public will be more likely to accept reclaimed water if they are made aware of the treatment processes. Further, Dolnicar and Hurlimann (2009) found in recent research that the public have limited knowledge about alternative water sources and they would like to be more informed of these alternatives which highlights the importance of greater education and awareness for the public. Participant 11 further mentioned the need for continuous awareness and education. She says, *"the drive for water education must be continuous even if there is more than enough water, it will help mould the mindset and if you pay for it, you must be aware that water is money."* This highlights the need for constant awareness and education, even when the water scarcity situation has improved. This is in agreement with the work of Germaine (2017) who believed that acceptance levels of environmental policies are likely to increase if the public are made aware of the water scarcity issues continuously. The need to conserve water should be a mindset that the entire public have and this mindset can only be strengthened with continuous awareness, constant updates on the water availability, and constant education regarding water conservation. According to Zhu, Wang and Li (2019), positive information and educational activities have the power to increase the public acceptance of using reclaimed water for potable purposes. It is important to acknowledge that although knowledge and greater awareness can influence water reclamation acceptance, it is limited. There has been limited research done in order to understand what communication factors affect people's attitudes towards water issues

### 3.3.6 - Costs

The financial implications of decisions made by a consumer is considered to be a priority and this element presented itself throughout the focus group discussions. Beierle and Konisky (2000) found that people generally expect to pay less money for reclaimed water as they feel that reclaimed water is of a lower standard. In line with this statement, when participants were asked

about using reclaimed water for potable purposes, the financial element was popular . Participant 3 said *"cheaper cost for reclaimed water services would play a role in my acceptance"*. Participant 13 agreed saying, *"if it was cheaper it would be a done deal"*. The participants were interested in the idea of paying less money for reclaimed water. Participant 2 said that *"if reclaimed water was cheaper, I think a lot of people would go for that"* whereas participant 1 said that *"if you got charged less on your water bill when using reclaimed water, it would be a plus"*. In a study conducted by Marks, Cromar, Howard, Oemcke and Zadoroznyj (2002a), the participants opted to pay less for using reclaimed water and they felt that reclaimed water should be at a much lower cost in order to encourage acceptance. Participant 2 and 3 are in agreement with the work done by Mark et al (2002a) and Beierle and Konisky (2002) as their intent to accept reclaimed water increases if the price decreases. However, participant 11 does not agree with the work done by Marks et al (2002a) as he/she said that *"personally, I would not want to consume reclaimed water even if it was cheaper"* suggesting that he/she feels strongly about not using reclaimed water even if it was cheaper. In fact, participant 10 contradicts the work of Marks et al (2002a) and Beierle and Konisky (2002) and said *"I think the best thing is to increase the water tariffs, I think it might cause chaos in South Africa but at the same time you would know that the more water you use, the more you will pay and then you will be mindful when using water"*. Some participants felt that currently, water is being misused and that in order to secure water and potentially avoid having to turn to reclamation, there should be consequence management. Participant 16 said *"I think the only way that we will learn and change our behaviour is if there is a consequence attached to it"*. This suggests that finances will play a role in creating awareness and facilitating an attitude of water saving as participant 6 concluded: "*Until we feel the water problem ourselves directly, we might not change. If there are certain criteria in place or if we exceed a certain amount of water per month, we need to pay a fine. This will allow people to feel it directly because it will impact your pocket so you will want to preserve"*.

### 3.3.7 – Other Incentives to Save Water

Participants also expressed their views regarding incentives from the government and municipalities that would be directed at water conservation, in order to avoid the use of reclaimed water. It was clear that the attitudes towards the use of reclaimed water were conditional and many of the participants felt that there were other ways to stretch available resources before turning to the use of reclaimed water. Participant 4 said "*A while back, there was a free drive in my complex to implement energy saving bulbs and I think initiatives like that will help begin the small*

*incremental changes needed to secure water. Maybe free water saving shower heads will help start the conversation."*. Participant 5 was in agreement : *"I think it's also beneficial to make materials like the water saving shower heads and the sink gadgets more cost effective and possibly implement them for free so more people can partake in saving water"*. The theme of incentives contributes to the existing literature on extrinsic and intrinsic motivation. Extrinsic motivation relies on external incentives that would encourage an individual to change their behaviour which usually involves monetary incentives (van der Linden et al., 2015). Throughout the discussions with the laypeople, the use of JoJo tanks in collecting rainwater was mentioned and participant 16 asked *"do I get a discount if I put in a JoJo tank and collect rainwater? I think the government and the municipalities should reward people who are doing the right thing for the environment and who are trying to play their part"*. This statement made by participant 16 is in line with what van der Linden et al (2015) said about extrinsic motivation and how monetary rewards have the power to change behaviour. Moreover, van der Linden et al (2015) further acknowledges that the predominant assumption that many environmental policy makers have is that people are always going to be motivated by money however, It is possible that people have an intrinsic drive to conserve the environment and recent studies done by Bolderdijk, Steg, Geller, Lehman, and Postmes (2013) have shown that it is more beneficial and longer lasting for environmental policy makers to appeal to the public's intrinsic motivational needs in order to increase pro-environmental behaviour. Extrinsic incentives will only last for as long as they can be maintained and they can also challenge people's intrinsic motivation to change their behaviours or ways of living (van der Linden, Maibach and Leiserowtiz, 2015).

### 3.3.8 - The role of the Media and Advertising

Participants voiced their views on the role of the media and how this may be an important channel when it comes to building awareness of water security and facilitating the conversation on reclaimed water. Participant 4 suggested that social media was a very powerful channel that could be used to provide awareness and promote water saving attitudes. Participant 13 further suggested that we should *"make water saving instagrammable and get the right role models such as Kwesta and the Springbok captain Siya Kolisi to advertise their water saving initiatives"*. According to van der Linden et al., (2015), environmental issues are global problems and therefore, the public's sense of personal efficacy can be quite low. It is considered more effective to focus on the social context in which people make decisions in order to promote a collective efficacy which is where individuals feel that group actions make a difference to the environment

(van der Linden et al., 2015). The influence of social norms further relates to this theme as individuals who are part of social groups validate the correctness of their decisions with reference to others in their social group and with the media influencers, water reclamation can be considered a group norm that people would want to adhere to (van der Linden et al., 2015).

Large organisations could also act as role models as participant 2 said that *"you also need endorsements from large organisations who can act as role models".* Organisations can implement water reclamation in their buildings which can be advertised and also play a role in their corporate social responsibility. It is important to recognize the competitiveness of reclaimed water in relation to conventional water sources and reclaimed water sources need to be clearly portrayed to the public (Bixio et al., 2006). Bixio et al. (2006) further suggested that marketing strategies need to be used in order to secure user commitment as public acceptance is of great importance. As participant 5 also said *"If there was advertisements and reinforcements through the media, it would possibly make people feel more comfortable to drink reclaimed water and more people might want to change their mindsets".* This would provide some sort of observation to the public and therefore plant a seed in their minds that reclaimed water is being used and it might be okay for them to use it too. Further, Leong and Lebel (2020) found that people are more willing to accept reclaimed water for potable purposes if they know that others are also accepting and using it which further highlights the participants view regarding the role of the media and having role models who encourage the public to conform to the social norms of being environmentally friendly and using reclaimed water as people conform to the majority behaviour (Leong & Lebel, 2020).

Participant 10 and 11 both suggested marketing strategies such as using pamphlets to spread awareness of water reclamation, what it is, how it works, the cleaning process, and assurances that it is tested and that it is safe. Lastly, participant 13 mentioned an interesting point. She says, *"It might be unethical, but I would use the media to create a 'fake crisis'. Imagine one day all the taps are switched off and through the media, the public is informed they were warned about saving water and now there is no water and they didn't listen".* On the other hand, the media is a powerful tool but one that is not utilised to its full potential as participant 18 mentions that "*The water crisis isn't prioritised enough on the TV and on Carte Blanche and when it is aired, it is not portrayed as a crisis, it has been downplayed."* The media was seen as a powerful platform and a useful tool to get the message across that water is being taken for granted, and that measures were required to conserve it.

### 3.3.9 - Ignorance is Bliss

The ninth theme was not shared by many participants but it is interesting to further explore. It is common that there will be individuals who outright reject the use of reclaimed water for potable purposes while others willingly accept it. There is, however, a category of individuals who prefer not to know if the water is reclaimed or not and would just like to carry on with their lives being totally unaware of the water source. Participant 3 was one of those individuals who perceived that 'ignorance is bliss' which can be further seen through three quotes. When asked how they felt about the use of reclaimed water for potable purposes, Participant 3 responded thus: *"I almost would not want to know about it. I feel that if it didn't taste any different to what we have now, and if it was clean and purified and I was not going to get sick, I would be okay to drink it but on the condition that I don't want to know about where it came from".* This participant's desire to be in the dark came through further when the group was informed that the water that they drink currently is actually partly reclaimed to which he abruptly replied, *"I try to be oblivious, it's better".* Lastly, participant 3 expressed the importance of obliviousness when he said *"no one questions the quality of the water that comes out the tap right now. We just drink it because we assume it is fine since no one tells us any different. I think the oblivious aspect to that is much better".* Participant 3's responses suggest that maybe the psychological barrier of water reclamation only comes about when the public is informed about it. This statement can be represented in participant 18's concluding remarks. When the group was asked if their perceptions of reclaimed water had changed after the discussion, participant 18 said *"I came into this discussion thinking that I would trust reclaimed water and I was willing to use it but now I feel like I would maybe use it, with certain terms and conditions attached".* This is a prime example of participant 3's point about being ignorant and participant 18 came into the discussion with little knowledge about reclamation and he was willing to drink it. There is little to no research that supports the theme of 'Ignorance is Bliss' as many authors such as Harley (2001), Dolnicar and Hurlimann (2009), Germaine (2017), and Zhu, Wang and Li (2019) highlight the importance of information and communication in gaining public acceptance and participation. These authors all encourage greater collaboration between water institutions and the general public. However, there is very limited research that has been carried out in order to understand what factors of communication influence people's perceptions towards water related matters and therefore, this is where this theme 'Ignorance is Bliss' can be of value. It is important for environmental policy makers to acknowledge this theme when it comes to implementing reclaimed water for potable purposes. Research done by Dolnicar and Hurlimann (2009) suggest that in some cases, the public know very little information about alternative water sources. Unplanned water reclamation might

be a viable option if more individuals in the public feel as strongly about not knowing where their water comes from.

### 3.3.10 - Reclaimed water and the only option

The above-mentioned themes lead to the final theme emerging from the focus groups. Reclaimed water would be considered as an option when it is the only viable option available. The participants have expressed their views regarding the use of reclaimed water for potable purposes. There was mention of health issues and the fear of getting sick, they spoke about the level of awareness and need for education and how they felt that they did not know enough about water conservation. They also spoke about the costs and incentives that may be involved and how this might lead to greater support for reclamation, and their (lack of) trust in the government and the municipalities. All of these themes allowed the researcher to gain a deeper understanding of the reasons people had for accepting or rejecting reclaimed water. According to Leong and Lebel (2020), where the necessity of using reclaimed water is perceived by the public as crucial for survival, there is greater acceptance. Individuals will be less affected by the 'yuck factor' when the need to use reclaimed water to survive (Leong & Lebel, 2020). This statement leads to the explanation of the concluding theme which is the use of reclaimed water if it was the only available option. Participant 4 said, *"If it was the only source of water, you would drink it, survival would take over"*. Seemingly, reclaimed water would be accepted if there was no other option . As Participant 3 said, *"reclaimed water is better than no water by far so if it ever got to that, there wouldn't be a choice and I would 100 percent jump at it"*. participants raised a point of potentially reaching a water situation much like Cape Town and participant 4 said *"if we reach a Cape Town situation, if we have to drink reclaimed water then we will"* and *"if we hit a huge problem here and we didn't have water, I think I would be grateful that water reclamation processes can be utilised and they are available to us"*. Enqvist and Ziervogel (2019) found that in Cape Town, the fastest reduction in water usage did not occur when there were restrictions or higher tariffs announced. In fact, the public's water use behaviours only changed when the likelihood of 'Day Zero' was communicated and the public were informed of the consequences that would come with 'Day Zero'. These findings from Enqvist and Ziervogel (2019) support the theme 'Reclaimed water as the only option' as much like the citizens of Cape Town changed their water usage behaviours when they were aware that they might not have any water, if reclaimed water was the only water available to the public, their perceptions might be more positive towards using reclaimed water as they would need to survive.

### *3.4 Research Question 2: What are the psychological and social barriers that water experts have towards using reclaimed water?*

## 3.5 Themes identified from the Experts from the Interviews

### 3.5.1 – Reclaimed water usage as a viable source to save the environment

Attitudes towards the environment play a critical role in the level of acceptance when it comes to reclaimed water (Beierle & Konisky, 2000). When the experts were asked what would enable the public to accept the use of reclaimed water, Expert 6 said *"people are generally very keen to preserve the environment. The survey we did two years ago proved that people want to save the environment and they want to save water. They also want to release less polluted water into the environment. There is a big positive green consciousness among people and that is a good place to start when it comes to reclamation".* In the study done by Jefferey (2002), individuals who had been involved in water conservation measures in their homes and who had developed a 'green consciousness' already were more willing to use reclaimed water for activities such as toilet flushing. Further Hurlimann and McKay (2002) found that residents that lived in the Mawson Lakes area in South Australia agreed that the potential to do something positive for the environment was their motivation to utilise a dual water supply. The work presented by Jefferey (2002) and Hurlimann and McKay (2002) is in line with the view of Expert 6, as people are generally keen to preserve the environment and those who maintain a stronger level of 'green consciousness' might be more accepting of reclaimed water projects.

Amongst the various alternative ways to sustain water, reclamation is seen as one of the better solutions. Expert 1 voiced her opinion and said that water reclamation for potable purposes is *"brilliant, it is one of the best ways to take the load off of the government. It works extremely well".* Expert 2 shared this enthusiasm and said *"at the moment, the advantages of reclamation is that we really need the water. There is pure advantage to the use of reclaimed water for potable purposes and I don't see any disadvantages".* The opinions of Expert 1 and 2 are in agreement with Leong and Lebel (2020) as they say that experts suggest that reclaimed water is cost-effective, safe, climate-resistant, and a sustainable solution to combat water shortages. Furthermore, results from The Sydney Water Study (1999) reported that the individuals had a strong level of 'green consciousness' and they wanted to preserve the environment in any way that they could. They supported the need to save water through reclamation as they believed that they could make a difference in saving the environment (Po et al., 2003).

As mentioned above, reclamation is viewed as one of the better options but it is not necessarily every expert's first choice. Expert 3 expressed her advocation for water reclamation but also indicated that it would not be her first choice. She implies that there is not enough water for 70 to 80 million people at a consumption level that is more than double the global average. She mentions that *"there are other alternatives that may be better, but because the water is scarce, reclaiming it is the only possible option for now".* Expert 6 shared a similar view in that he feels that *"reclamation should be seen as a last resort. Fifty percent of the high-quality water that we are producing is wasted and lost, we need to look at achieving zero leakage. If we can get our leakage down, we would not need to turn to reclamation as the source of water".* The experts have their own views on the use of reclaimed water and although they all recognized the need for an alternative water source, they did not all agree that reclamation should be the first choice.

### 3.5.2 - Awareness

Although many of the experts view water reclamation as a viable source of potable water, they acknowledged that public opposition regarding the use of reclaimed water may still arise due to limited awareness and education around water conservation. Studies done by Dishman, Sherrard and Rebhum (1989) found that psychological and educational obstacles such as a lack of awareness and personal perceptions need to be overcome in order for water reclamation to be accepted and successfully implemented. According to Dishman et al. (1989), the only way that the public's perceptions regarding reclaimed water can be changed is through awareness and education. Much like the work of Dishman et al. (1989), expert 2 believed that the biggest barrier towards water reclamation for potable purposes was people's perceptions of reclaimed water and that *"the best way to address these perceptions is through creating better awareness and education at all levels".* Expert 1 shared the same view and said *"we need to educate the people about reclamation and the ins and outs of it. Once they are educated and aware of the process, it might change their mindsets and open a dialogue for its use".* A study done by Wester, Timpano, Çek, Lieberman, Fieldstone and Broad (2015) found that individuals in their study lacked knowledge regarding their water resources and this impacted their desire to accept reclaimed water usage. In order to gain acceptance of reclaimed water usage for potable purposes, Wester et al. (2019) suggested that the public need to be given a better understanding of their water supply and the water quality of reclaimed water. Attitudes towards using reclaimed water for potable purposes and acceptance can increase when the public are provided with enough information. The work of Wester et al. (2019) is similar to the responses from the experts above. Experts 1 and 2

expressed their opinions about strongly educating the youth as their mindsets might be easier to change and their generation might be more open-minded. Expert 1 said *"teaching it in schools and universities and targeting the youth is the best because you actually still change their opinions on things and how they see it"* and Expert 2 said *"It is interesting to target children and get the children to really drive the process"*. Experts 1 and 2 fall in line with the work of McKay and Hurlimann (2003) who predicted that one of the strongest challenges to water reclamation schemes is acceptance from people aged 50 years or above as they have the most amount of scepticism. The work of Wester et al. (2019) can support the work of McKay and Hurlimann (2003) as they found that older people are able to see more risks with the use of reclaimed water which might explain why their acceptance levels could be low. Further, education and information campaigns regarding the use of reclaimed water for potable purposes should target the youth (Beierle & Konisky, 2000). A survey in California and Colorado found that older women were less supportive of potable water reclamation which further highlights the importance of educating the youth and bringing greater awareness to schools and universities.

Expert 3 further mentioned that he strongly believed the drive for education needed to be stronger, saying *"if we had invested more money into education upon independence, we would be a more developed country and these processes may be easier to implement"*. Experts 1 and 2 highlighted the need for education and possibly targeting the youth. However Expert 3 highlighted the lack of attention that education on all levels has received since independence and how South Africa was an under-developed country because of it. With higher levels of education and awareness, reclamation could become more socially acceptable. It is important to note that although many of the experts believed education and awareness was necessary, they also felt it had the potential of being a double-edged sword . Expert 2 suggested that "*reclamation is a very common process and the fact that the public are not fully aware of it was most likely also a good thing"*. Expert 2's point can be further explained by what expert 5 says which was "*is lack of knowledge a good thing? Apparently it is. If you ask people if they are satisfied with their water quality, most will say yes. This is because they are unaware of the reclamation that is already happening"*. Expert 5 was suggesting that with greater awareness may come greater problems.

### 3.5.3 - Health perceptions

The health perceptions of drinking reclaimed water that were held by the laypeople can be further explained by the experts. There is a stigma attached to the idea of 'reclaimed water' and many

individuals (laypeople) held negative perceptions regarding the health impacts it may have. Expert 1 shared her view that reclaimed water is good quality water that has been treated. However *"many people think it's going to cause cancers or make them sick when in fact, the water is perfectly potable".* The water experts were fully aware of the negative stigma that comes with reclaimed water which can impact one's intention to accept or reject it. Expert 2 said *"I know that there are a lot of people who have a complete phobia of reclaimed water. There is this 'threat' that it's going to be contaminated, people are going to die from all sorts of diseases and so on. But in my own knowledge, I know it is possible to do it and treat water to drinking standards".* Expert 4 suggested that with the right education and awareness, when the public are able to see the numbers and be assured of the quality, they may accept reclaimed water. According to Leong and Lebel (2020), the use of reclaimed water has been found to be one of the safest water alternatives both as a potable and non-potable water source. It was interesting that while some experts (Experts 1, 2, and 4) agreed that reclaimed water was a viable source of drinking water, other experts were slightly sceptical about drinking reclaimed water. Expert 3, for example, said *"reclamation is done already in Windhoek and Beaufort West, I have not seen the ongoing studies and I don't have any issues with the use of reclaimed water. However I am slightly cautious of it. I am cautious of using reclaimed water in a society where we don't have great quality control".* Expert 3 further elaborated and said *"unless you can outright guarantee that it is safe, I am not excited about it and I work a lot with the laboratories and I am not excited about the analyses of the water quality either".* Expert 3's concerns align with the work of Beer (2016) as she mentions that one of the main concerns regarding wastewater reuse/water reclamation is the health risk. Beer (2016) further mentions that wastewater that is not appropriately treated can be harmful when consumed and therefore, the perception of expert 3 is relevant as he expresses his concerns for quality control in South Africa when it comes to water reclamation. When exploring this point further from a health perspective, Expert 3 was asked what he was cautious about. He mentioned that he is *"worried about the viral load in the water in a society that is not especially healthy. A lot of our population are very ill, they live in poverty and they carry diseases which aren't great. A lot of those diseases can be viral so detecting them and sterilizing for viruses is a different story to bacterial diseases and it can be a problem".* As Beer (2016) mentions, the health risks or diseases associated with human consumption of potable reclaimed water from wastewater are more than likely caused by waterborne micro-organisms. Enteric pathogens include protozoa, viruses and bacteria and these pathogens spread through the ingestion of contaminated water from one person to another (Beer, 2016). Therefore, Expert 3 is in agreement with the work of Beer

(2016) and Expert 3 fell on the other side of the spectrum where his concern of the health risks that may come from consuming reclaimed water were the same as the laypeople.

### 3.5.4 - Trust in the Government and Municipalities

The health perceptions that the experts held can be linked to the level of trust towards the government and the municipalities. Expert 1 indicated that the psychological barrier that the public may have towards reclamation stems from trust. He said *"it's more about a trust factor, I suppose from a psychological barrier it's about the trust that comes in and the trust that the public has towards the people in charge of water management"*. The perceptions that people hold towards a concept such as reclaimed water can be managed by "*what they know and what we tell them*" says Expert 5 which suggests that people's trust can be affected by how well-informed about the water management systems they consider themselves to be. Trust and confidence in the systems can be further developed and strengthened through managing the current water availability and water systems well. Expert 6 indicated that *"the issue of trust and confidence comes in because we are not doing well with what we currently have. Our monitoring systems are not even doing what they are supposed to be doing. You have got to assure your users that your water is pristine quality".* Expert 6 highlighted the poor maintenance of water treatment infrastructure and how this could have an impact on the implementation of reclaimed water in the future. In Singapore, the public viewed reclaimed water for potable purposes as safe and they were willing to consume it as they believe that it was good quality (Leong & Lebel, 2020). The residents in Singapore also showed a high level of trust in their water authorities which could have influenced their willingness to accept reclaimed water for potable purposes. Expert 6 further stipulates that *"It is systematic that if we do what we are currently doing well and manage the systems properly, we could gain confidence from the users, then when we are faced with dire water scarcity, the conversations about water reclamation become easier"*. It is therefore necessary to manage these negative perceptions by starting with building trust and confidence in the water users. It is also better to promote reclaimed water for potable purposes in regions that are suffering from water shortages as the high acceptance levels found in Singapore may be due to the long term effort from the authorities to educate the public about water conservation and promote the use of reclaimed water (Leong & Lebel, 2020).

### 3.5.5 – Personal Perceptions

The majority of the experts shed light on one of the main barriers that are in place when it comes to the use of potable reclaimed water, which is one's personal perceptions and the impact these perceptions can have. These perceptions relate to a psychological barrier in which individuals have their own mental models about what reclamation is and where the water comes from. Many people will outright reject reclaimed water as the common perception is that it is most likely a 'toilet-tap' process and therefore the water is full of urine, faeces, and other contaminants. According to Dolnicar and Hurlimann (2010), not taking into account the personal perceptions of the public can inhibit water-related initiatives from being successfully implemented. Expert 2 further indicates the importance of understanding public perceptions and said that *"At a city level, there is a huge potential for potable water reclamation but it is only possible providing that one can overcome the psychological barriers in place".* One of the biggest contributing factors is the 'yuck factor' says Expert 3. He mentions that *"there is a psychological barrier around perceptions and the 'yuck factor'. This is worth more than all of the other barriers that may be in place".* This is in agreement with the work of Dietrich (2013) as he states that environmental problems are not only issues of science but they are also issues of individual's attitudes, emotions, and behaviour (Dietrich, 2013). The emotions and attitudes that individuals feel towards reclaimed water will not only impact their experiences with the environment, but it may also impact their willingness to engage in pro-environmental behaviours (Dietrich, 2013). Individuals experience the yuck factor when thinking of reclaimed water as their initial thought is that they will be consuming human waste. As Expert 6 mentions, *"perceptions are not really founded on scientific facts, they are usually perceptions of smell, perceptions of sight, and those are the major barriers to potable water reuse".* This highlights the importance of managing these perceptions in a way that will provide greater awareness of reclamation processes and help facilitate acceptance as one's emotions can strongly impact the implementation of an environmental policy. Some experts believe that these perceptions can be managed by what the public is informed about and how much information is given to them. Expert 5 mentioned that reclamation was happening all the time and that it has not caused any great problems. He does mention that *"information about reclamation can create a problem, particularly when, for some reason, people become worried about their water and ask why it is bad. If they are then told that its reclaimed, that causes problems of perception"* Expert 5 suggests that problems arise when the public gets to know that they have been consuming reclaimed water and these negative perceptions are developed and strengthened. Dolnicar et al. (2015) states that environmental policy makers need to be completely transparent with the public about all the details, both good and bad, when it comes to

implementing environmental policies such as the water reclamation project. This theoretical piece of evidence can be contrasted to the opinion of Expert 5 as he believes that the negative perceptions associated with reclaimed water only arise once the public are aware that the water is reclaimed or they are given too much information. Dolnicar et al. (2015) further states that individuals who feel highly informed might have an increased level of trust and therefore a higher intention to accept the use of reclaimed water. These perceptions, whether they are factually correct or not, can strongly sway one's intention to accept or reject reclaimed water for potable purposes and it is important to manage them through informing the public.

### 3.5.6 - Cost Implications

Water reclamation is technically possible, but it is often not one of the cheapest options (Bixio et al., 2006). One of the biggest considerations regarding water reclamation is the cost (Beer, 2016). When it comes to the implementation of reclamation for potable purposes, Expert 2 felt that *"the costs would be high".* These costs would likely be from purchasing the advanced technologies needed to detect the contaminants. The direct water reclamation plant that is currently operating in South Africa in Beaufort-West, Northern Cape was carried out during a prolonged period of water scarcity (Beer, 2016). The total cost to treat the wastewater, which includes the personnel, chemicals, maintenance, capital and energy, was R16.25/kl (Beer, 2016). This cost to treat the wastewater is over and above the cost of building the plant which landed up costing R24 million in 2010 (Beer, 2016). It is possible to treat wastewater up to any standard that is required although, the higher the quality of the reclaimed water, the more treatment processes will need to be involved, and the higher the treatment cost (Beer, 2016). Further, Expert 2 felt that the cost of potable reclamation would be extremely high and his opinion is further supported by the cost of the treatment plant that was installed in Beaufort-West. Expert 1 felt that cheaper water tariffs were also thought to have the potential to increase acceptance and one's intention to utilise reclaimed water for potable purposes. As she said, "*if you introduce something positive and cost friendly, everyone will take hold of that".* The costs to implement water reclamation are often high due to the infrastructural requirements and the need to develop the distribution system (Bixio et al., 2006). Further, although decreased costs for water reclamation seems like a feasible possibility, the actual costs are relatively high.

On the other hand, some experts felt that the cost of water was currently too low. Expert 3 said "*I would change the costing of water and I would make it really expensive. I don't think it's expensive*

*enough".* It is possible that the cost of water is so low that the level of water savings are not as heightened as they should be. Expert 3 believes that in order to instil this consciousness into the public "*you can have your free allocation every day on a tapered fee structure. The more you use, the more you need to pay, and you should be paying a lot for what you use".* Although some of the experts believed that a lower cost would increase acceptance, others felt that the cost of water was far too low and if it was increased, people would have greater awareness and not abuse the water and therefore reclamation would not need to be implemented.

### 3.5.7 - Media and Role Models

It was felt that the use of water reclamation for potable purposes needs to be advertised well and there needs to be greater awareness and increased education. According to Wester et al. (2019), the media are responsible for distributing information about water resources and they can build awareness through advertising the quality and benefits of using reclaimed water. Wester et al. (2019) thoughts were similar to the opinions of the experts. The experts believed that greater awareness can be promoted through the use of the media. Expert 1 believed that *"media, activists, and organisations need to take a stand and through this, individuals will be more aware".* According to Leong and Lebel (2020), there is a need to consider ways in which information about reclaimed water can be enhanced and framed in a certain way to increase the public's response. Expert 1 further spoke about how effective social media can be in promoting reclamation and spreading awareness, which is in line with the work of Schultz and Fielding (2014). An empirical study done by Schultz and Fielding (2014) found that there is greater acceptance towards reclaimed water usage and reduced risk perceptions when the information comes from a scientist who shares a regional identity. This is also in line with what Expert 2 said about the role of the upper class and respected input from certain professors when it comes to increasing acceptance. Expert 2 said *"the upper middle class have a huge role to play in any type of green initiative and that is because they make things 'cool' and 'sexy'. Just simply having role models, TV personalities, musicians, people from respected professions, doctors, engineers etc. Those people will say 'this is cool, this is the way to go, this is what I do' and then they will lead by example".* Expert 2 specifically mentions 'people from respected professions' which is similar to that of Schultz and Fielding (2014) as they found that acceptance increased when information about water reclamation came from a scientist in the field. Experts 1 and 2 viewed the media and aspirational public figures as powerful platforms to promote awareness. When the public sees that their celebrity idols use reclaimed water, this might persuade them to do the same and their friends

would follow suit which further brings in the importance and the impact of social norms. According to Dean, Fielding, Lindsay, Newton, and Ross (2016). "social norms exert a strong influence on environmental behaviours and support for pro-environmental policies" (p. 2). Social norms play a part in increasing acceptance of reclaimed water usage. According to Leong and Lebel (2020), feelings of disgust are socialized and if the water decision makers are perceived to be 'part of the community', there is a chance that acceptance levels will increase and public perception will be more positive. However, in the study by Dean et al. (2019), the relationship between enhanced social norms and community involvement for water reclamation was significant, but very weak. This positive, weak relationship tells us that interactions with friends, families, and influence from social media role models that promote the use of reclaimed water can influence acceptance levels, however only to a certain extent and there has been very little research to examine this correlation (Dean et al., 2016).

On the other hand, the media is a powerful platform and they have the ability to selectively choose what they would want the audience to see or hear. Expert 3 raises his concerns for the media and says "*they don't always get it right and they oversimplify, they don't always state things correctly which worries me because, if you misrepresent a fact, I get touched because I think to myself 'if you are going to lie to me about that then what else are you lying about'".* This suggests that there is a need for honest representation of the water situation in South Africa as well as the water reclamation process. The media channel is a powerful tool, but its effectiveness depends on how accurately the message is portrayed and where the message is coming from. Although Expert 3 views the role of the media as limiting, Wester et al. (2019) believes that the media can take actions to help build trust in the public regarding the use of reclaimed water. Actions such as direct site visits to the WWTPs that can be aired on television so the public are able to see the process in more detail. This will allow the public to see the outputs from the facilities and make them feel more secure in how reclaimed water is treated and then used, and this might help increase public acceptance (Wester et al., 2019). Building this trust will play a role in balancing the scepticism of Expert 3 and the powerful platform that the media represents. Further, it is also important to acknowledge how the water crisis is portrayed in the media and in policy discourse. Policy discourse around environmental issues such as the water crisis continuously raises the idea of 'loss'. The water crisis, when it is aired on media, often refers to how Gauteng will have no water by a specific time period and this highlights a loss for society (van der Linden et al., 2015). Individuals analyse losses and gains in different ways and they might feel that it is 'worth the risk'. What van der Linden et al. (2015) are stipulating is that it might be useful to carefully

consider the nature of the water crisis campaigns and instead of reinforcing the loses people will experience as the water is running out, rather reinforce the benefits they will experience if they partake in pro-environmental behaviour and get on board with water reclamation. Reinforcement of the positive benefits of pro-environmental behaviour are likely to increase public support (van der Linden et al., 2015).

### 3.5.8 - Infrastructure and Technology

The successful use of reclaimed water for potable uses relies heavily on functioning wastewater treatment plants and contaminant detection technologies. According to Expert 1: *"our sewage treatment systems work at the most basic level and many of the wastewater treatment plants are not even functioning at all"*. According to Masindi and Duncker (2016), water and sanitation facilities (i.e. WWTPs) can inevitably be misused or can break down and the monitoring of service quality has started through the implementation of the 'blue drop, green drop' system as mentioned in the previous themes 'Infrastructure and Technology' and 'Health Perceptions towards Reclaimed Water' for the laypeople. This Water Quality Regulation Strategy is highly dependent on the data that the municipalities submit although in the work of Masindi and Duncker (2016), 63% of the municipalities are unable to confirm whether or not they have met the drinking water standards. Further, this highlights the barriers in place when it comes to water reclamation. Although the technology and infrastructure for water treatment is in place, poor management and enforcement increases these barriers.

Alongside the state of the wastewater treatment plants, the detection of contaminants such as bacteria and viruses needs to be effective. Expert 4, who is a chemist in the field of water, informed the researcher that currently the treatment methodology is strongly focused on the removal of colloidal suspended matter. Moreover, when you are considering reclamation for human consumption, Expert 4 says *"there are a lot more contaminants that come through the system that you cannot physically see and therefore the treatment methodology needs to change in order to be able to detect these unseen contaminants".* According to Schoeman, Dlamini and Okonkwo (2017), the impact of endocrine disrupting drugs (EDC) that seem to be more environmentally persistent can be a threat to one's health when they are in the drinking water supply. Pharmaceutical compounds and degradations contribute to water toxicity as found in a study on the impact of WWTPs in Spain (Schoeman et al., 2017). Pharmaceutical compounds are found in solid waste landfill sites or wastewater treatment plants and therefore support Expert 4's

opinion regarding the concern around the "invisible tons" in wastewater that can cause harm to an individual if not cleaned properly. South Africa currently does not have the technology and detection methods that would "*be needed to detect these pharmaceutical degradations and we would not know if we are removing them efficiently"* (Expert 4). WWTPs are designed in such a way that they remove solid waste but were not designed to remove pharmaceuticals and WWTPs do not remove these degradations efficiently (Schoeman et al., 2017). The pharmaceutical compounds are considered to be highly water soluble and resistant to biodegradations which results in them never completely being removed from waste water (Schoeman et al., 2017). Pharmaceutical degradations are reduced or removed through an advanced oxidation processes such as ozonation. However, these processes are costly and are more likely found in WWTPs in countries that are developed (Schoeman et al., 2017). However, Brazil which is a developing country has the technology in place to effectively treat wastewater to potable standards with no health risks and therefore, water reclamation in Brazil is considered a viable option in dealing with the water crisis (Vasconcelos, 2015). Therefore, the health risks associated with reclamation were not only shared by the public, but by the experts too and further supported by the work of Schoeman et al. (2017).

### 3.5.9 - Maintenance

Expert 4 reckoned that *"The state of our wastewater treatment plants is bad, one would know the huge fiasco and how the army had to come in and take care of the wastewater plants for a period of a year. That already creates a perception in the minds of any individual that the plants are not functioning at their most optimal level and therefore you cannot even conceive clean drinking water".* He was referring to the recent situation where the state of the Sebokeng Waste Water Treatment plant at the Vaal Dam were so poor that its management had to be transferred to the South African National Defence Force (SANDF) for the last year where they had to perform basic maintenance functions on the water supply (Gana, 2019). Democratic Alliance (DA) spokesperson, Makashule Gana said that they DA conducted an inspection to the Sebokeng Waste Water Treatment Plant which was found to be neglected due to financial mismanagement by the government officials (Gana, 2019). The state of the Sebokeng Waste Water Treatment Plant was dismal and raw sewage was running through the municipality's streets due to lack of maintenance on the pipes and the treatment plants (Gana, 2019). The raw sewage entered into the Vaal River and Dam which according to Gana (2019), was so polluted that the water was harmful to consume. This situation suggests to the public that trained water treatment authorities are unable to perform

their duties and this poor maintenance has contributed to the fear of using reclaimed water as experienced by experts. Expert 3 expands on what Expert 4 said and mentions that *"we have very poor municipal maintenance of the water services. We lose a lot of water through burst pipes and leaks and we also have a lot of contamination of the water that's already here because the services are so poorly maintained".* Further, the conditions of the dams and rivers are also of concern as according to Masindi and Duncker (2016), there are some rivers that have unacceptably high levels of pollution in them which is caused by poor municipal infrastructure. If the current state of water and water infrastructure and technology is so poor then the idea of reclamation will have higher rejection rates due to a lack of trust and confidence in the abilities of government and municipalities to maintain the existing infrastructure. This situation is further reinforced by the government and the municipalities not taking responsibility for infrastructure maintenance as expressed by Expert 3 *"there are broken sewers and pollution of the Jukskei and there is no sense of responsibility or taking ownership".* Expert 3 suggests that the poor maintenance and the water issue is possibly being ignored by those in charge when in fact it is their job to provide 'services, infrastructure and stability' as mentioned by Expert 3. So, Expert 3 concluded and said "*I think our quality control mechanisms are too poor due to the lack of maintenance and the implementation of reclamation should only be done if it is absolutely necessary and the last resort.*" One key role of municipalities and water treatment authorities is to ensure that water treatment and reticulation infrastructure is well-maintained.

### 3.5.10 - Politics vs Science

It is normal for the public to assume that the individuals who are in charge of water, are well educated and extremely knowledgeable in the field of water. Much like going to the dentist, you want someone qualified and experienced to be working on your teeth to ensure no accidents. The same logic applies to water management. The concept of 'social capital' refers to the networks of relationships between people who work and live within a specific society and one of the experts expressed his concern for the political connections that are in place when it comes to appointing people to be in charge of Departments that provide basic needs. Beierle and Konisky (2000) highlight the importance of building trust between the public and the authoritative groups and the fact that trust increased when the authoritative group has pure and genuine intentions and there were no political drives involved. Expert 3 is in line with the statement by Beierle and Konisky (2000) as he said *"your Director General of Water Affairs is not a politician and should never be a politician. He/she should be a professional within the field of water and currently, it's an*

*accountant because that person is politically connected".* In Durban South Africa, Wilson and Pfaff (2008) found that a portion of residents had a growing concern around the technological competence of water officials as well as the operation and maintenance of water infrastructure which supports the view of Expert 3 as he further spoke about the knowledge gap that exists between our scientists and engineers and our politicians. He said *"My problem in our society is that our scientists and engineers don't talk English or politics and our politicians don't have a clue what science and engineering are".* This highlighted the level of concern for those who hold the power when it comes to water management, and some may question their level of expertise considering the existing poor management of water within the country. According to Mema (2010), the state municipal wastewater and sewage treatment infrastructure has been in a decline and is considered one of the largest contributing factors to health problems in South Africa. Moreover, the efficiency of the blue drop/green drop regulations that are in place have been questioned as 63% of municipalities cannot confirm whether or not the water in their district is meeting drinking water standards. Muller (2009) suggests that although these problems can be due to financial constraints, it is also evident that there is an absence of sufficiently skilled personnel to oversee and operate the services. This further highlights the competence of the individuals who are in charge of water management and service delivery. There are various reasons for this lack of technical competence regarding the personnel in the water sector. However, Muller (2009) infers that there could also be inappropriate appointments by municipalities due to patronage with political and community pressure to hire individuals even though they are not qualified for the job. Further, Muller (2019) suggests that water is shared by everyone and therefore needs to be some rules in place that will govern and manage the way that the water is used. When something goes wrong with the water, the problem is neither the water nor the rules but in fact the problem lies with the people who are concerned and who are in charge of water management (Muller, 2019). Expert 4 shared this view on the potential political barrier that may be in place when it comes to water reclamation and says "*I think the only political aspect in this regard is enforcement of the management of the wastewater plants".* Muller (2019) further implies that when there is an issue with the water supply in a country, the water laws are not the problem, they are simply not implemented and managed correctly which supports the statement made by Expert 4 above and suggests that Expert 4 acknowledges the poor maintenance and management of the technologies needed to reclaim water and that could lead to the low levels of acceptance of water reclamation for potable purposes.

### 3.5.11 - Water Scarcity and Crisis

South Africa's population has been expanding rapidly and the population size is currently 57 million people (Giorgis et al., 2015). Gauteng is considered to be the most populated province within South Africa however, Gauteng also has the smallest geographical area which poses a problem as there is increased pressure placed on the freshwater supply (Giorgis et al., 2015). Despite the various barriers in place described above, there are some enablers that could promote the use of reclaimed water such as a water crisis. As Expert 6 said *"the most immediate enablers, the most effective enabler for reclamation has been water scarcity and a fear of crisis".* Some of the experts were under the impression that desperate times would call for desperate measures. Expert 3 agreed with Expert 6 saying *"the enablers are scarcity, when you need something, you will make a plan to get it [water] no matter what it takes".* Expert 3 highlighted the impact that this reactionary response could have on the overall success of water reclamation. Expert 3 mentioned "*crisis always drives a response, we always watch things getting worse and worse until we precipitate a crisis and at that point, we make things work very quickly and very well as a species".* Crisis was, therefore, seen as an enabler of acceptance of reclaimed water (i.e. its acceptance is likely to increase if it is the only option available). Many people would choose reclaimed water over no water and behavioural changes would occur quicker when the fear of having no water at all increases as Expert 3 stated: "*The doom and gloom scenarios never really come to pass because by the time we get to doom and gloom, people have woken up and changed things. I think the doom and gloom is needed in order to get to a point where people stand up and say 'no more'. This initiates a groundswell movement"*. Trying to implement water reclamation in a society where water conservation behaviour is poor will not be successful and therefore the fear of having no water at all could play a role in increasing acceptance. Expert 5 provided greater insight as to this outcome: *"Durban tried potable reuse and they ran into trouble because it wasn't communicated well and they ended up generating opposition, it is also much easier to implement water reclamation for potable purposes when there is a crisis".* It is therefore necessary for the public to experience the fear of a crisis, the fear that one day, water will not come out of their taps when they open them and this in turn will instil a willingness to turn to an alternative water source such as reclaimed water. A prime example would be to look at the case of the Western Cape, Beaufort West. In 2011, Beaufort West faced a severe water shortage where their primary reservoir completely dried up (Zondi, 2017). Therefore, Beaufort West implemented South Africa's first direct water reclamation plant that supplies water to the citizens (Zondi, 2017).

Zondi (2017) found that there was opposition towards the use of reclaimed water. However, the plant provides 20% of the town's water and it allows the city to survive. The important point to acknowledge is that a water crisis can strongly influence an individual's acceptance of reclaimed water much like the town of Beaufort West. The individuals living there had no other option but to use the reclaimed water and the reclaimed water project has been successful (Zondi, 2017).

### *3.6 Research Question 3: Is there a difference between laypeople's perceptions and experts' perceptions?*

## 3.7 Comparison Of The Novice Water User Themes And The Expert Themes

### 3.7.1 Similarities

**Table 4 - Similar themes from the laypeople and the experts represented by a quote**

**Table 4**

***Similar Themes From the Laypeople and the Experts represented by a quote***

| *Theme* | *Quote from Layperson* | *Quote from Expert* |
|---|---|---|
| Trust in the Government/Municipalities | *"It comes down to trust, I don't trust the government or current water quality at the moment. So why would we trust it if they said they would reclaim it and we would have to use it"* | *"The issue of trust and confidence comes in because we are not doing well with what we currently have. Our monitoring systems are not even doing what they are supposed to be doing. You have got to assure your users that your water is pristine quality"* |
| Infrastructure and Technology | *"Keep in mind that our infrastructure is not well maintained at all. We have burst pipes almost every week, we have people who dump their waste and rubbish into the water and it isn't cleaned well because the wastewater treatment plants are not fully functioning"* | *"Our sewage treatment systems work at the most basic level and many of the wastewater treatment plants are not even functioning at all"* |
| The health Perceptions and the Aesthetics of Reclaimed Water | *"I wouldn't drink that water; it will make me so sick. I would rather buy bottled water".* | *"I know that there are a lot of people who have a complete phobia of reclaimed water. There is this 'threat' that it's going to be contaminated, people are going to die from all sorts of diseases and so on. But in my own knowledge, I know it is possible to do it and treat water to drinking standards"* |
| Awareness of Reclaimed Water | *"I feel like if I knew the cleaning process of reclaimed water and I saw that they use it and people are not falling ill or dying, I will have greater confidence in using it myself but I need to see it with my own eyes".* | *"we need to educate the people about reclamation and the ins and outs of it. Once they are educated and aware of the process, it might change their mindsets and open a dialogue for its use".* |
| Costs Implications | *"Cheaper cost for reclaimed water services would play a role in my acceptance"* | *"If you introduce something positive and cost frienaly, everyone will take hold of that"* |
| Reclaimed water as the only source of water | *"If it was the only source of water, you would drink it, survival would take over"* | *"The enablers are scarcity, when you need something, you will make a plan to get it [water] no matter what it takes"* |
| The role of the Media | *"Make water saving instagrammable and get the right role models such as Kwesta and the springbok captain Siya Kolisi to advertise their water saving initiatives"* | *"Just simply having role models, TV personalities, musicians, people from respected professions, doctors, engineers etc. Those people will say 'this is cool, this is the way to go, this is what I do and then they will lead by example"* |

As seen in Table 4, both the laypeople and the experts expressed a lack of trust in the government to effectively manage the water treatment system. This mistrust arose from perceptions that

treatment and reticulation infrastructure were not optimally managed and that the government and municipalities were not performing their function. Both groups felt that it was the government's/municipality's job to make sure that the treatment plants were functioning well and if they were not, to fix them. There was a perceived lack of accountability and responsibility from the government/municipalities and the public were aware of this shortcoming. Both the laypeople and experts expressed their concern for this lack and they felt as if the government and the municipalities would continue to let them down if reclamation on a larger scale for potable purposes had to be implemented.

Secondly, the laypeople and the experts spoke about the infrastructure and technology. Both groups mentioned the poor functioning of the wastewater treatment plants and their concern for consuming reclaimed water when the technology used to clean the water was not working at its best (or is not available in the country). Further, the experts mentioned that the current methodology used to detect contaminants only focused on the physical matter and ignored the harmful substances that were not seen by the naked eye. Therefore, the technology needed to successfully and efficiently implement potable reclaimed water was not adequate which further leads to the health perceptions that both groups shared. Both laypeople and experts associated reclaimed water with health risks, expecting to suffer some form of illness from drinking the water and were hesitant to accept reclamation for potable purposes due to the health risks and the yuck factor that both groups immediately associated with potable water reclamation.

There was also the perception that reclaimed water would have an undesirable smell and "look" which would lead them not wanting to consume it. Moreover, the experts had differing views on the health risks of consuming reclaimed water. Some of the experts shared their lack of concern regarding the water and how they know that 'reclaimed water can be treated to drinking standard' and it would be perfectly potable and no diseases would be spread. There was one expert who agreed with the laypeople and expressed his concern regarding the quality of reclaimed water and that we live in a society where there is a lot of illness and diseases which can be spread through water. He further mentioned that he was not excited about potable reclaimed water and his perceptions were fairly negative.

The lack of awareness and education around water conservation and the processes involved in reclamation was yet another theme shared by both groups. The laypeople expressed their lack of awareness and knowledge around reclamation and the processes involved in reclamation and they

said that this could also be why they have such negative perceptions around health as they were completely unaware of what goes on in the reclamation process. The majority of the experts further mentioned that the need for greater awareness and education was vital as much of the public were not aware of water conservation and what this might involve and if they had greater insight into the process, their trust might increase and therefore their acceptance might increase too. One of the experts expressed his viewpoint on the effect that greater awareness can have. He believed that if the public knew too much, their acceptance might be at risk (i.e. become more negative) and he felt strongly that greater awareness would bring about the negative perceptions of reclamation. It is important to note that just because the experts are specialists in the field, does not mean that they will promote the use of potable reclaimed water and these differing perceptions helped understand the viewpoint of the laypeople.

The cost implication was a theme shared by both groups. The laypeople as well as some of the experts suggested that if reclamation was cheaper, there would be a higher acceptance rate, whereas one expert mentioned that he felt the cost of water generally currently was too low and the public needed to be paying more for their water in order for them to be more conscious of their usage. When both groups were asked about potential enablers that might promote water reclamation, both agreed that the media and advertising was an important component in spreading awareness. Both groups felt that a media forum of influencers and celebrities advertising their use of reclaimed water would be beneficial in promoting the use of reclaimed water. However, Expert 3 further mentioned that the social media forum was powerful and effective but only when the correct information was provided and often the media oversimplifies the water situation and the public were not fully informed of the state of water affairs and how serious it was. This was in agreement with Participant 18 as he said that the water situation was very rarely aired and when it was, it was made out like it was not a problem at all so as much as the media is a powerful tool, it needs to be used correctly.

Lastly, both groups touched on the aspect of reclamation as being the only source of water and the role that a water crisis can play. The laypeople said that they would accept and use reclaimed water for potable purposes if it was the only option available and they would much rather have reclaimed water as opposed to no water at all which was in line with the experts' thoughts. The experts said that a driving force for the use of reclaimed water was a crisis. When there was no other option and no other water to use, reclamation would be accepted very quickly and the public would wrap their heads around it faster than usual.

### 3.7.2 Differences

**Table 5 - Different themes from the laypeople and the experts represented by a quote**

**Table 5**

***Different Themes From the Laypeople and the Experts represented by a quote***

| ***Laypeople*** | |
|---|---|
| ***Theme*** | ***Quote*** |
| Buffer | *"I would drink the reclaimed water only if I used the energized oxygen machine which connects to your tap and it cleans the water. I would only drink reclaimed water using this machine as a buffer because I've seen that it works and I've tested the product and even when you smell the water, it's very clean and pure".* |
| Ignorance is Bliss | *"I almost would not want to know about it. I feel that if it didn't taste any different to what we have now, and if it was clean and purified and I was not going to get sick, I would be okay to drink it but on the condition that I don't want to know about where it came from".* |
| Other Incentives to Save Water | *A while back, there was a free drive in my complex to implement energy saving bulbs and I think initiatives like that will help begin the small incremental changes needed to secure water. Maybe free water saving shower heads will help start the conversation."* |
| ***Experts*** | |
| ***Theme*** | ***Quote*** |
| Politics vs Science | *"Your Director General of water affairs is not a politician and should never be a politician. He/she should be a professional within the field of water and currently, it's an accountant because that person is politically connected".* |
| Maintenance | *We have very poor municipal maintenance of the water services. We lose a lot of water through burst pipes and leaks and we also have a lot of contamination of the water that's already here because the services are so poorly maintained".* |
| Personal Perceptions | *"perceptions are not really founded on scientific facts, they are usually perceptions of smell, perceptions of sight and those are the major barriers to potable water reuse".* |
| Reclaimed water as a viable source to save the envrionment | *"People are generally very keen to preserve the environment. The survey we did two years ago proved that people want to save the environment and they want to save water. They also want to release less polluted water into the environment. There is a big positive green consciousness among people and that is a good place to start when it comes to reclamation".* |

As seen in Table 5 above, one of the themes that was only derived from the laypeople was the use of a buffer. Many of the participants expressed their willingness to use reclaimed water for potable purposes on the condition that there would be a filtering system on the tap or the water could otherwise be treated (e.g. boiled) beforehand. On the other hand, a theme derived from the experts was 'personal perceptions' and how one's personal perceptions could impact their intention to accept or reject reclamation which were not based on scientific facts, just on one's own mental models. An interesting theme that came about from the laypeople which was not found within all of the experts is the theme 'ignorance is bliss'. Some of the participants felt that their willingness to accept the use of reclaimed water for potable purposes would be higher if they were unaware that the water was reclaimed. When made aware that there was a natural reclamation process that

occurs before the water comes into one's tap, the participants still expressed their need to 'not know' or to 'be oblivious' because knowing too much instils a fear in them and they would therefore rather not know. It is important to note that there was one expert, Expert 5 who noted this theme in his interview and he shared similar opinions to the laypeople. He mentioned that if you ask any individual if they were happy with their water quality, most would say that they were because they were unaware of the reclamation that was already happening and the water they are consuming has most likely been reclaimed. Expert 5 was potentially suggesting that overly informing the public regarding reclamation might in fact create a psychological barrier that wasn't there already and this supported the theme 'ignorance is bliss' that was shared by the laypeople. This was not a shared theme as only one of the experts expressed his view regarding the omission of information from the public. Expert 5's statement played a vital role in confirming that being ignorant toward water processes happening in Gauteng might be a potential enabler that will increase the acceptance of reclaimed water usage from the public.

'Science vs Politics' is a theme that was derived from the experts. This theme highlighted the individuals who were in charge of water management and their technical level of expertise and knowledge. Expert 3 felt that the Director General of Water Affairs was an accountant whereas he should be an expert in the field of water with experience and expertise. This leads to a communication problem and the Director General of Water Affairs speaks politics not science and therefore the state of water in South Africa was hindered due to the wrong people being placed in these positions based on political connections. This theme may have only come about from the experts as the laypeople were not necessarily aware of the educational background of people placed in charge of Water Affairs or they were aware of this level of political appointment within the country and chose to ignore it as there was nothing that they can do. The laypeople further suggested that incentives should be implemented such as free water saving shower heads and money deducted from your water bill if you were collecting rainwater from JoJo tanks.

The experts further mentioned the poor state of the wastewater treatment plants and how this could impact one's attitudes towards using reclaimed water. Experts 3 and 4 highlighted the importance of proper maintenance of the infrastructure needed to produce reclaimed water and how the state of the WWTPs are not up to standard currently. The state of the WWTPs was so poor that the army had to intervene at the Sebokeng Waste Water Treatment Plant in order for it to function well. The experts felt that the poor maintenance of the infrastructure was the government/municipalities responsibility and they needed to be held accountable.

The laypeople showed an interest in taking part in other water reuse activities before having to turn to reclaimed water. The laypeople suggested the use of a JoJo tank to collect rainwater and water saving shower heads. The laypeople mentioned these alternative solutions as they felt that maybe reclaimed water use could be avoided if other water saving activities were done. The experts highlighted the theme of reclaimed water being a viable source to save the environment. The experts felt that individuals were usually very keen to preserve the environment and take part in projects that would sustain the future water supply for themselves and their families. Experts believed that individuals want to decrease pollution in the environment and there was a strong level of green consciousness. Further, opening a conversation regarding the use of reclaimed water and then implementing reclaimed water might be more effective with these high levels of green consciousness.

It is important to acknowledge the contrasting responses from different participants of the study. This suggests that this field of study is a contested space and it is not linear. Perceptions are complex as they are personalised to one's own thoughts and feelings and are reliant on one's exposure and knowledge within the field of water reclamation. These diverse perspectives may pose a challenge when implementing water reclamation which is why this study was valuable as opened up a dialogue about water reclamation and whether or not it will be accepted by the laypeople and it also highlighted various enablers that could help implement the process and various barriers that may hinder the process and can therefore be tackled one by one.

## 3.8 Conclusion

Twenty one themes were identified during the data collection from experts and laypeople; Ten themes emerged from the laypeople namely a buffer, trust and confidence in the government/municipalities, infrastructure and technology, the heath perceptions and the aesthetics of reclaimed water, awareness of reclaimed water, costs, incentives, the role of the media, ignorance is bliss and reclaimed water as the only option. There were eleven themes from the experts namely reclaimed water as a viable source to save the environment, infrastructure and technology, the health perceptions, awareness of reclaimed water, cost implications, personal perceptions, the role of the media and advertising, maintenance, politics vs science and water scarcity and crisis. These themes represent the various psychological and social barriers and enablers towards the use of potable reclaimed water and have therefore further been used in the creation of the 'Water Reclamation Decision Pathway Survey' in Chapter 4.

# CHAPTER 4 - IMPLICATIONS, RECOMMENDATIONS AND CONCLUSIONS

## 4.1 Introduction

The present study aimed to assist environmental decision makers in understanding the various The present study aimed to assist environmental decision makers in understanding the various social and psychological barriers and enablers that exist when it comes to using reclaimed water for potable purposes. The results from this study presented interesting themes that were analysed and were worth exploring further in Chapter 3. These themes have played a role in the development of the water reclamation decision pathway survey presented in this chapter. This chapter will discuss the practical implications of the development of the water reclamation decision pathway survey. Further, this chapter will highlight the theoretical contributions that this study has made as well as the limitations of the present study and some directions for future research on this topic.

## 4.2 Practical Implications

### 4.2.1 - The Development of the Decision Pathway Survey

The thematic analysis provided the most prevalent themes shared by the laypeople and the experts which were then reported as the results in Chapter 3. The practical outcome of this study was to inform the various choices in the Decision Pathway Survey and therefore, based on the results mentioned in the previous chapter, the practical implications of this research was the development of the water reclamation decision pathway survey that will aid environmental decision makers in understanding public perception regarding the use of reclaimed water for potable purposes. The themes found in chapter 3 can be identified in figure 2. These themes are highlighted in red and this allowed the researcher to point out how these themes were utilised in the design of the survey. The ‘Pr0ACT’ framework was used to develop the decision pathway survey which is a framework which falls under the multi-attribute utility theory as mentioned in the literature review chapter. Further, this chapter also highlighted the theoretical contributions of this research, the limitations of the study as well as directions for the future if this research had to be conducted again.

### 4.2.2 Pr0ACT Framework for Decision making

When individuals are required to analyse unfamiliar topics such as water conservation, their preferences may not be entirely formed. What happens is that both an individual’s values and

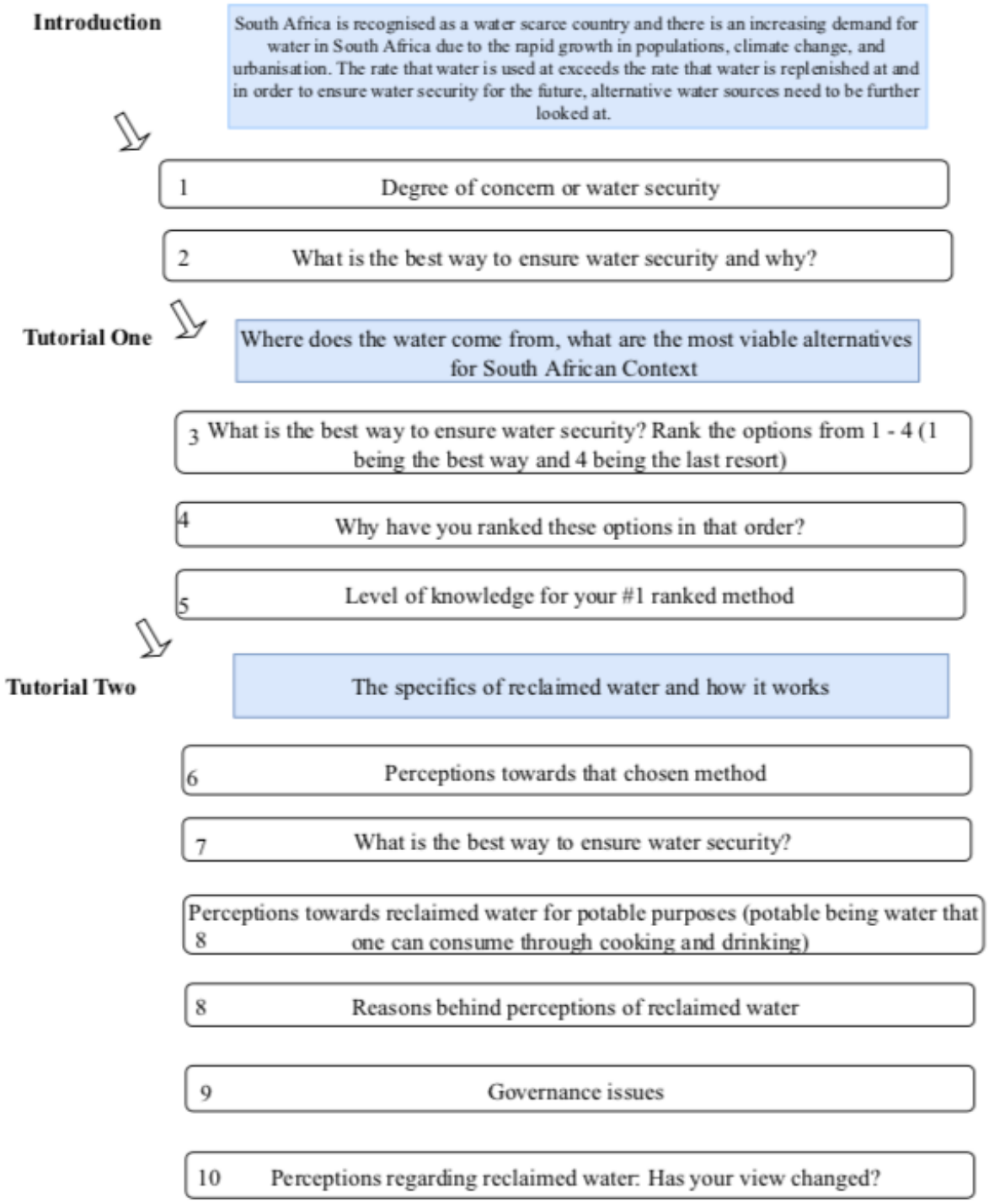
choices will be formed based on their current mental models as well as the information and cues provided to them. This falls under the behavioural decision theory known as 'constructed preferences' (Gregory et al., 2015). Constructed preferences suggest that one's attitudes and values towards a concept are built through an elicitation procedure that recognizes the role of fast thinking which allows an individual to think almost automatically but also recognizes the role of slow thinking which involves more complex choices that require deeper thought (Kahneman, 2011). These two systems together will allow for thoughtful decision making based on the necessary information. The 'Pr0ACT' model was utilised as it allows for an individual to 'think through a problem' through 5 steps. These five steps are:

1- Understand the problem context
2- Clarify objectives
3- Define alternatives
4- Identify consequences
5- Highlight key trade-offs

This model is an 'iterative' process where individuals are allowed to revisit previous questions once they have been given new information relating to facts or values (Gregory et al., 2015). The use of iteration allows the researcher to fully understand the decision making processes that individuals go through when faced with an unfamiliar decision to make.

### 4.2.3 The proposed survey design based on the Pr0ACT framework

***Figure 1 - Proposed survey design based on the Pr0ACT Framework***

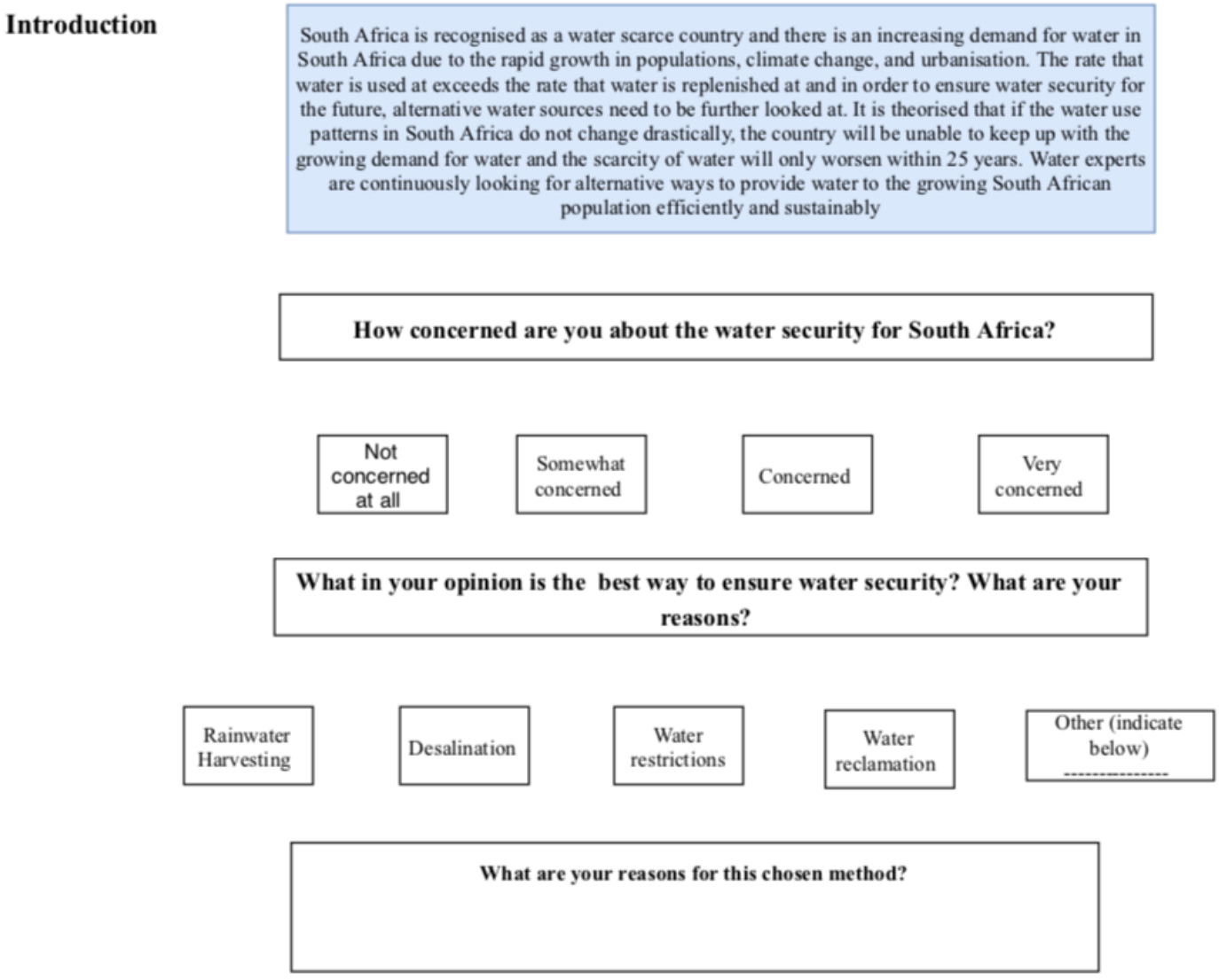



The Pr0ACT framework that falls under the Multi-Attribute Utility Theory (MAUT) as mentioned in the literature review was used to create the outline of the survey. As seen in the diagram above,

the participants would be asked ‘what is the best way to ensure water security’, following their answer they would be provided with information on possible solutions for South Africa. Afterwards, the participants would be asked ‘what is the best way to ensure a stable water supply for the future’. They would then be provided with more information. It is expected that their answers would be more influenced by the facts, not only on their mental models and perceptions. The process therefore, proceeds by asking participants questions, providing a tutorial with information, and then asking the same questions again, and checking whether the provided information influences their choices as shown in the figure above.

***Figure 2 - The Decision Pathway Survey***

### 4.3 The Decision Pathway Survey



**Tutorial One**

**Viable Alternative Sources of Water For a South African Context**

The Gauteng province receives its water supply from the Vaal Dam along with the Lesotho Highlands. The water shortages that are becoming more prevalent could be catastrophic for one of Africa's largest economies and it is important to get ahead of the situation. There are various alternative ways to sustain-water for the years to come.

**Rainwater Harvesting**
***What is it?*** A water saving technology that collects rainwater from rooftops, land surfaces, road surfaces as well as rock catchments. The water is collected through tanks, pots and cisterns as well as more complex techniques such as underground check dams.
***Advantages:*** A renewable source of clean water that can be used for non-potable purposes and potable purposes given that the water is exposed to a treatment process before use.
***Contraints:*** Rainfall is unpredictable and rainwater harvesting is therefore not always easily accessible, especially not in arid areas.

**Desalination Plants**
***What is it?*** Process of removing salt as well as other minerals from sea water in order to create fresh water that is drinkable.
***Advantages:*** The more common methods of removing salinity and it often occurs in areas where fresh water supplies are limited but there is a large amount of seawater that is available.
***Constraints:*** Desalination plants are extremely costly starting at around R2.1 Billion as well as labour costs and materials. Desalination plants use a lot of energy.

**Water Restrictions**
***What is it?*** Water use is limited and monitored and therefore individuals should refrain from lengthly showers and baths and make use of grey water for toilet flushing.
***Advantages:*** Water restrictions can be used to secure water and monitor the usage in order to ensure that each household stays within their allowance.
***Contraints:*** This alternative is tricky as there is little power over the monitoring of a households water usage. The public of South Africa are not in a 'water saving' mindset.

**Water Reclamation**
***What is it?*** The process of converting wastewater which is defined as "untreated liquid industrial waste and/or domestic sewage from residential dwellings, commercial buildings, and industrial facilities" into water that can be reused through various treatment processes for potable and non-potable purposes.
***Advantages:*** Most efficient way to preserve water as the costs involved are minimal. Water reclamation will aid in protecting the environment from high levels of pollution and simultaneously, relieve the pressure on natural freshwater sources. Wastewater is labelled as an 'untapped' resource that can be used for many purposes when it is treated correctly which emphasises the positive impact reclaimed water can have on the country of South Africa

**What is the best way to ensure water security? Please rank the options from 1 - 4 (1 being the best and 4 being the last option)**

| Rainwater Harvesting | Desalination | Water restrictions | Water reclamation |
|---|---|---|---|
| | | | |

**Why have you ranked these four methods in that order?**

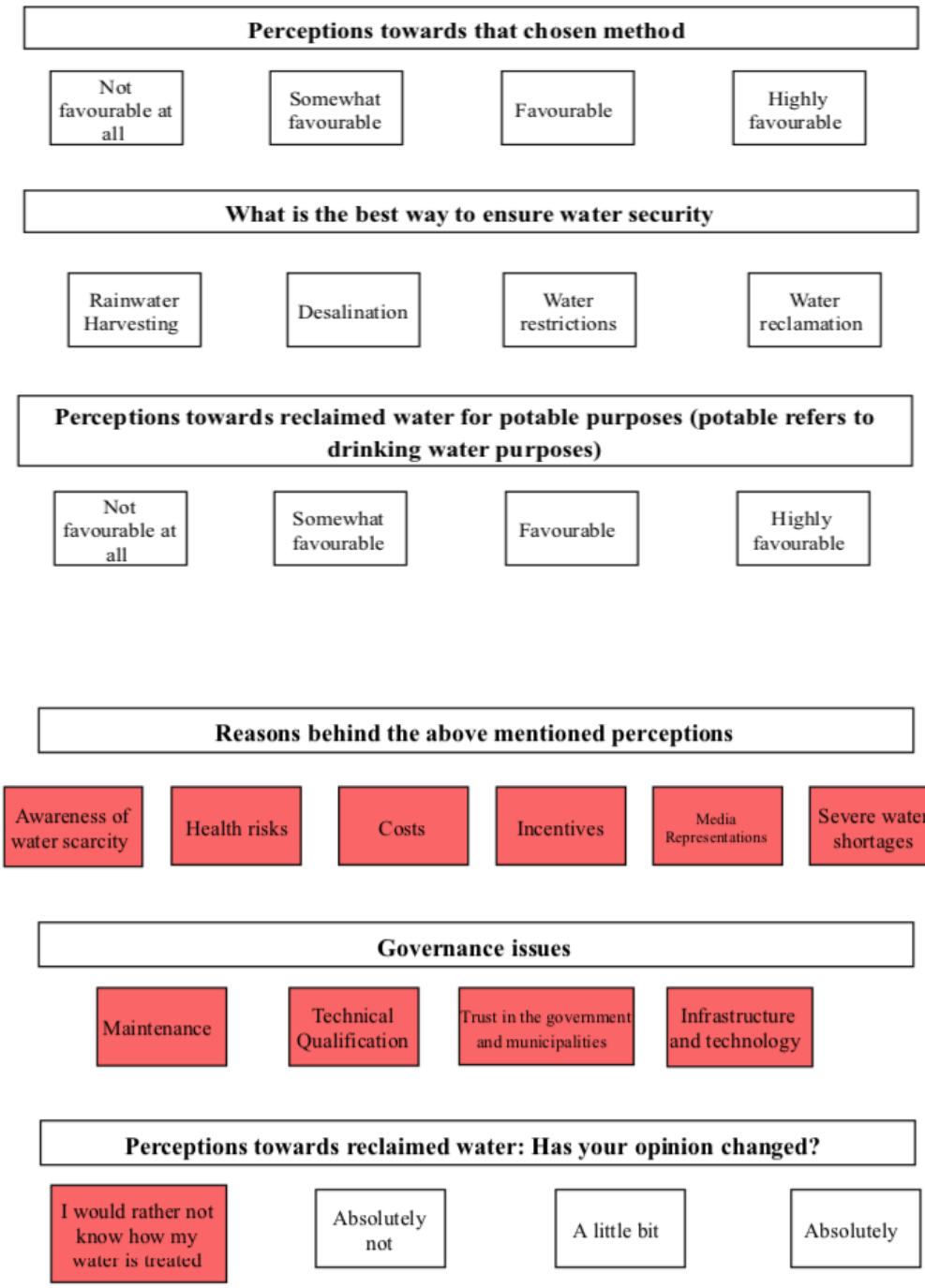
**Level of Knowledge for your #1 ranked Method**

| No knowledge | Some knowledge | Highly knowledgeable |
|---|---|---|

**Tutorial Two**

**Water Reclamation and how it works**

Water reclamation, otherwise known as water recycling/reuse can be defined as "the direct use of treated sewage effluent to replace the proportion of the freshwater demand". Water reclamation is the process of converting wastewater which is defined as "Untreated liquid industrial waste and/or domestic sewage from residential dwellings, commercial buildings, and industrial facilities" into water that can be reused through various treatment processes for potable and non-potable purposes. Reclaimed water can be utilised in order to fulfil certain needs in residential areas and business's such as toilet flushing or garden irrigation. Reclaimed water can also be treated to reach the sufficient drinking level standards and used for potable purposes. Waste water is released from the underground piping and it travels into a waste water treatment plant (WWTP) where the water undergoes a treatment process, all toxins, chemicals and hazardous materials are removed and the water is released back into the rivers and dams in order to prevent pollution from the dirty water. Once the waste water has gone through the treatment plant, it is then referred to as 'Reclaimed water'.



As seen in the Figure above, the water reclamation decision pathway survey was designed using the themes that were reported in chapter 3. The themes can be identified from the question 'Perceptions towards reclaimed water for potable purposes?' and they are highlighted in red. The reason why the themes have only been included at this stage of the survey is because of the decision pathway survey being an iterative process. Once the reader has gone through the previous questions, they should have developed a greater knowledge about water reclamation and then they are asked what their perceptions towards water reclamation are. The purpose of this sequencing is for the reader/participant to be informed about the process of water reclamation as well as the other alternative water conservation solutions. This allows them to highlight the trade-offs. The themes emerge at the next stage which is the 'reasons behind your above-mentioned perceptions' as when the laypeople and experts were asked why they had a positive/negative perception towards using reclaimed water for potable purposes, these were the themes that came about. These themes have been used as generalised barriers/enablers towards using reclaimed water for potable purposes and have therefore been placed in the survey at this stage.

## 4.4 Theoretical and practical contributions

Wastewater reclamation for potable use is seen as an underdeveloped but very viable water alternative in South Africa (Beer, 2016). This research has shed light on the fact that the use of water reclamation for potable purposes has been successfully implemented in other countries and it has the potential to be successfully implemented in South Africa. Understanding the social and psychological barriers and enablers that the public hold and then using these barriers and enablers to develop a water reclamation decision pathway survey was the main focus of this study. As mentioned in the literature review of this research, water reclamation is considered to be a viable solution that can be used to enhance South Africa's limited water resources (Beer, 2016). The applicability of water reclamation on a potable scale is viable but further investigation is needed before implementing it. Focus groups and surveys were conducted in order to understand public perceptions toward reclaimed water for potable purposes and from this, the various social and psychological barriers and enablers were identified. This study therefore made a valuable contribution to the body of knowledge about environmental decision making and the impact of public perceptions, the barriers and enablers of a potable water reclamation project in South Africa, as well as decision pathway surveys as a valuable tool to collect meaningful data regarding an environmental decision.

One of the biggest challenges that will affect the implementation of potable reclaimed water usage is public opinion and public acceptance (Dolnicar et al., 2011). This study has highlighted the importance of public acceptance when it comes to implementing an environmental intervention that will impact the public directly. As said by Friedler et al. (2006), successful implementation of potable water reclamation in South Africa depends not only on the economic and environmental benefits, but the driving force in achieving environmental change is gaining acceptance from the public. This was seen in the Sydney desalination plant and the San Diego indirect potable reuse plant, where public opposition delayed the implementation for a number of years and the water scarcity worsened. This research aimed at understanding why (or why not) the public will accept or reject water reclamation for potable purposes which will help environmental decision makers understand the needs of the public. The themes presented in Chapter 3 represented the various barriers and/or enablers that the public have towards reclaimed water and this information can be further utilised by environmental decision makers. As mentioned in the literature review, individual attitudes drive one's intention to accept or reject an environmental policy and therefore, one's intentions will drive one's behaviour (Gawronski, 2007). Public acceptance is seen as the 'glue' that will hold a reclaimed water project together and this research can therefore be beneficial for the future of water conservation in South Africa, as although the sample cannot be generalised to the wider population, it has opened up a dialogue with the public and has started an understanding of their attitudes towards water reclamation. With this information, the necessary steps can be taken to promote positive attitudes towards water reclamation and increase acceptance.

This research took a deeper look into the opinions and attitudes of the public when it came to implementing a water reclamation project for potable purposes. Through this process, the researcher was able to identify the barriers and enablers that the public hold towards using reclaimed water for potable purposes. These various barriers and enablers (which can be identified in Chapter 3) contribute to the body of knowledge around water conservation, particularly water reclamation in South Africa. As mentioned above, the driving force of environmental change is public acceptance and in order to gain public acceptance, environmental decision makers need to understand the public's view of water reclamation. Due to the expected controversy that comes with using reclaimed water, there is bound to be some opposition which is often as a result of prejudiced beliefs, one's own fear, lack of knowledge, poor water management, as well as general distrust of public policy (Friedler et al., 2006). This research identified 21 themes that were highly prevalent within a sample of the public as well as experts in the field of water.

With these barriers and enablers revealed, the present study developed a 'Decision Pathway Survey' for water reclamation as an alternative solution in sustaining the water supply. In order to develop this decision pathway survey, this study referred to work by Gregory et al. (2015) who developed a decision pathway survey to inform climate engineering policy choices. Gregory et al. (2015) designed this survey in the United States and there has not been a decision pathway survey designed in South Africa until this present study. Decision pathway surveys represents a helpful way to incorporate public input that focuses less on the outcome itself and more on helping the public to understand environmental policy trade-offs. Decision pathway surveys are instruments utilised in data collection and they aid an individual in making a decision based on all the knowledge necessary through an iterative, engaging process.

## 4.5 Limitations of the present study

While this study yielded some important findings that have contributed to the body of research on water reclamation in South Africa as well as made room for a conversation regarding water reclamation to sustain water for the future, there were a few limitations that need to be acknowledged.

One shortcoming is that the sample was made up of a group with very specific characteristics. The focus group participants were either students or workers with tertiary education backgrounds and the experts were specialized in the field of water. Therefore, replicating this study with individuals that are not students nor do they have a tertiary education background might be useful in collecting a holistic perspective on water reclamation. It is also important to acknowledge the gender composition of the sample. The total sample of participants (both focus group and interview) consisted of more females than males and therefore there may be limitations to the transferability of the study and the range of responses might have been more diverse had there been more males in the sample.

This research fell within the qualitative paradigm and one of the limitations of this paradigm is that the research findings cannot always be extended to a wider population (Atieno, 2009). The sample size was small, and the results were based on the participants' own, personal accounts of water reclamation. Therefore, the results collected may not be applicable to a wider population as

the findings were not tested to discover whether they were statistically significant, representative of the population, or purely due to chance (Atieno, 2009).

The method of data collection for this research can also be seen as a limitation. The use of focus groups always runs the risk of there being dominant voices even with a moderator such as the researcher. Within this present research, there were dominant voices who spoke more often and could have possibly made the other members feel overpowered and scared to speak. In order to try and deal with the dominant voices, the researcher tried to ask specific people if they would like to comment and this also has the potential to make members feel insecure or shy to speak out. The dominant voices could have also swayed the opinions of the other members. Moreover, group discussions can be difficult to control and time may be lost due to spending too much time on a discussion on an irrelevant topic. Data were also collected through the use of one-on-one interviews with the water experts. This method of data collection can influence the truthfulness of the responses as participants might not be entirely truthful in their accounts as they might provide information that they think the researcher would like to hear (Barriball & While, 1994). The water experts were all employed at a company and they might have to protect confidential information. Therefore, the experts might have not been entirely truthful as they might have had to withhold information when being asked certain questions relating to water in south Africa or water service management.

The design of this study was cross-sectional in nature and that means that the data was collected at only one point in time from the laypeople and the experts. Water reclamation is a topic that might not be extremely familiar to most of the public and therefore their perceptions might have been based on the little knowledge that they have. It would have been beneficial if the laypeople had more knowledge about water reclamation and alternative water sources. With a longitudinal study, the researcher could have taken some time with the laypeople in order to increase their awareness regarding the water situation in South Africa, informing them about the various alternative water sources that are available as well as providing greater education regarding water reclamation and the processes that are involved. With greater knowledge, the laypeople could have provided insight on their perceptions that are highly informed and based on factual knowledge.

The design and use of a decision pathway survey aids an individual in making better, more informed decisions. It is possible that the survey process, when implemented, might unintentionally influence the direction of an individual's thinking that might possibly favour the

researcher/environmental policy maker and their own personal values and opinions (Gregory et al., 1997).

Moreover, the researcher was the instrument used to collect primary data and it is important to acknowledge that the researcher's observations and interpretations of the data may have been impaired by her own personal beliefs and knowledge of research in the field of water reclamation (Babbie & Mouton, 2001). The researcher did however try to avoid this limitation to a certain extent through the use of a self-reflexive journal where she developed an awareness of her own personal beliefs and biases throughout the research process (Fossey et al., 2002).

### 4.5 Directions for Future research

In order to build a comprehensive understanding and account for all potential barriers that exist towards the use of reclaimed water for potable purposes within a South African context, future research could explore a more diverse sample of focus group participants. The current focus group sample was made up of individuals who more often than not, have a tertiary education background. It would be interesting to include participants who did not attend university in order to understand their perceptions towards water reclamation. Further, the focus group sample was also made up of individuals who resided in urban areas and had access to running water daily and therefore, their water conservation mindset may be different from those individuals who do not have access to running water daily. Future research could explore the perceptions of individuals in the rural areas where water is considered a luxury and water scarcity issues impact their living. Their mindsets may be different, and in order to take account of all social and psychological barriers in place, a more holistic perspective may be necessary.

Throughout the focus groups, the participants expressed their lack of knowledge regarding water reclamation which could have impacted the quality of the results and the accurateness of their responses. Future research should include a brief educational program that would look at the various alternative water solutions with close focus on the potential that potable water reclamation has in sustaining water for the future. Many individuals were not aware of water reclamation and the processes that are involved in reclaiming water so they might be asked how they feel about reclaimed water for potable purposes but their opinions might not be entirely valid as their level of knowledge is limited. Future research could make use of educational programmes or activities that will increase awareness on what water reclamation is, and how it works and then elicit a conversation with participants in order to understand their attitudes towards it.

In the previous chapter, experts as well as supporting literature suggested that gaining acceptance for the use of reclaimed water for potable purposes might be more easily accessible when targeting the youth (Beierle & Konisky, 2000). Wester et al. (2019) found that older people were able to see more risks with the use of reclaimed water which might hinder their level of acceptance. Further, some of the experts in this research mentioned the age component and that it was easier to change the mindsets of the youth as opposed to the older generations. Although this study made use of part-time students for the laypeople, the majority of these students were grown adults above the age of 30. It might be beneficial to conduct this study with a sample of young adults between the ages 18 – 25 in order to see if the statements made by Beierle and Konisky (2000) and Wester et al. (2019) are in fact applicable in a South African context.

Lastly, the Decision Pathway Survey has not been empirically tested. It might have been useful to have tested the survey in order to remove any ambiguities and to understand if the survey reads well however this study was purely about the development of the item bank for a pilot survey and was not going to be administered on any sample in this study. Before being administered in future studies, the Decision Pathway Survey should be piloted. This will allow all discrepancies to be ruled out and to ensure further reliability.

## 4.6 Conclusion

This research is considered to be a valuable contribution to water conservation in South Africa. It can be considered a first step in understanding the psychological and social barriers that are in place when it comes to water reclamation for potable purposes. The water scarcity is a national issue that South Africa is currently facing and the need for alternative water solutions is becoming more necessary. With this information, a dialogue can be opened up between the public and the environmental policy makers. This dialogue can allow the public to feel included in the decision making process when it comes to implementing a potable water reclamation project. This study has provided greater insight into the perceptions regarding water reclamation for potable purposes. These perceptions allowed the researcher to identify the potential psychological and social barriers that are in place and expand on these barriers in greater detail. Alongside the barriers, this study allowed the researcher to identify the possible enablers that will promote the use of reclaimed water for potable purposes and these enablers may be able to increase acceptance of potable water reclamation. In understanding the public's perceptions and the various barriers and enablers that are in place as well as the development of the water reclamation decision pathway

survey, moving forward with a potable water reclamation project may be easier and more achievable.

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# APPENDICES

## A – Access Letter and Consent from Organisation

**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 Genavieve Levin. I am currently completing my Master's degree in Industrial/ Organisational Psychology at the University of the Witwatersrand. As part of my degree, I am required to conduct research. I am conducting research with the intent of developing 'A Water Reclamation Decision Pathway survey' which is an instrument that will look at decision making and it will allow one to understand the various different decision pathways that individuals use in order to come to a decision regarding environmental policies. In order to do this, I will be conducting research on people's feelings and values towards using/not using reclaimed water for potable (drinking) and non-potable (cooking, washing, garden maintenance) purposes. With water crises being so close to home, experts are constantly looking for ways to sustainably supply water as the recent water crises in cape town opened our eyes to the harm that a water crises can have on the social and economic life of a country. In order to avoid future water crises, the use of reclaimed water is a viable option for sustainably supplying water to south Africa and the generations to come. The largest issue that a country faces when it comes to the implementation of new environmental policies is the public opinion and acceptance. Public acceptance of environmental policies of is seen as the driving force in achieving meaningful environmental change and it is no different for South Africa. The successful use of reclaimed water depends highly on the public and their acceptance or rejection of it. Furthermore, this study aims to understand water users attitudes towards using or not using reclaimed water and if they will use it for potable purposes only, non-potable purposes only, all of the above or none of the above. This will assist in identifying the different decision pathways that people use in order to come to a decision regarding using reclaimed water. at the same time, it will allow me to identify the various social and psychological barriers that are present regarding reclaimed water as an alternative water source.

My study will make use of one on one, semi structured interviews. The interviews will be recorded to ensure accurate transcriptions. In order to carry out my research, I would need about 6 experts who have experience in the water sector such as water policy makers, water managers or water engineers. Ethical clearance has been obtained in order to conduct this study from the University of the Witwatersrand. The

interviews will be organised at a time which suits the participant best, assuming your organisation grants the necessary access.

Non-participation in the survey will result in no negative consequences for any employee. Similarly, no benefits will be given to those who do participate in the study. Demographic variables will be collected to help describe the sample, however no identifiable characteristics will be discussed in the write-up of the study. Participants will be given pseudonyms to ensure this. For example, Participant A or B. Anonymity cannot be ensured due to the nature of the data collection. However, confidentiality of all participants will be kept. A participant information sheet will be given to all participants which will include contact details should the participants require any further information or a brief summary of the findings. This feedback will be emailed to participants upon request. Furthermore, any major discrepancies will be addressed in the form of a debriefing.

It would be greatly appreciated if you could assist me contacting these participants. Should your organisation wish to participate in this study, please complete the attached consent form which can then be emailed to either myself or my supervisor. If this is not convenient, I can collect it from the organisation directly. Please contact us if you need any more information.

Thank you for taking the time to consider my study, I look forward to hearing from you.

Kind regards,


_____

Miss Genavieve Levin

Cell: +27 82 954 6765

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_____

Professor Andrew Thatcher (supervisor)

Tel: +27 11 717 4533

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

**Psychology**
School of Human & Community Development
**University of the Witwatersrand**
Private Bag 3, Wits, 2050
Tel: 011 717 4503 Fax: 086 553 4913

I, _____ (insert name here), representative of _____ (name of organisation), grant consent for Genavieve Levin to conduct research at this organisation. I agree to assist Miss Levin by contacting the relevant potential participants. I understand that employee participation in this study is voluntary and that all details will be kept confidential at all times. The organisation's name and any identifiable characteristics of the participants will not be mentioned in the study, thus, preserving the anonymity of responses. The organisation will / will not (circle the appropriate answer) require a summary of the results of the study once analysis is completed.

Name: _____ Signature: _____

Date: _____

**B - Participant information sheet for interview participants**


**Psychology**
School of Human & Community Development
**University of the Witwatersrand**
Private Bag 3, Wits, 2050
Tel: 011 717 4503 Fax: 086 553 4913


Dear Participant,

My name is Genavieve Levin and I am currently completing my Master's degree in Organisational Psychology at the University of the Witwatersrand. As part of the degree requirements, I am conducting research with the intent of developing a questionnaire that will look at decision making In order to do this, I will be conducting research on people's feelings and values towards using/not using reclaimed water for drinking, cooking, washing, and garden maintenance purposes. South Africa is labelled the 30th driest country in the world and water is becoming a scarce resource. In order to avoid future water crises, the use of reclaimed water is a viable option for sustainably supplying water to south Africa and the generations to come. The successful use of reclaimed water depends highly on the public and their acceptance or rejection of it.

I would like to invite you to an interview of approximately one hour on your attitudes and values towards using reclaimed water as an alternative water source as well as gain insight on water reclamation and the costs, benefits, infrastructure and policies in place regarding water in South Africa. There are no risks or benefits associated with participation in this study. Even though I will know you as I will interview you, your responses will remain confidential. Your identity will not be reported in my research report or any other resulting publications. Upon completion of the study, I will be able to provide you with a summary of the findings if requested. It would be much appreciated if you could assist me by participating in the study or by referring me to another key informant in the water sector who has the experience to reflect and contribute towards the use of reclaimed water.

Should you wish to participate in this study, please complete the attached consent form and email it to my supervisor, Prof. Andrew Thatcher or myself. Alternatively I can collect it from you on the day of the interview. My contact details and those of my supervisor appear below.

I look forward to hearing from you. Please detach and keep this letter.

Kind regards,


Miss. Genavieve Levin
Cell: 082 954 6765
E-mail: genlevin@gmail.com

Prof. Andrew Thatcher
Tel: 011 717 4533
Andrew.Thatcher@wits.ac.za

C - Consent form for interview participants

**Psychology**
School of Human & Community Development
**University of the Witwatersrand**
Private Bag 3, Wits, 2050
Tel: 011 717 4503 Fax: 086 553 4913

I, _____ consent to being interviewed by Miss. Genavieve Levin for her questionnaire development. I understand that:

- Participation in this study is voluntary.
- The tapes and transcripts will not be seen or heard by anyone other than the researcher and her supervisor.
- No identifying information will be used in the transcripts or the research report.
- Although direct quotes from my interview may be used in the research report, I will be referred to by a pseudonym (Respondent X, Respondent Y etc.)
- I may refrain from answering any questions.
- I may withdraw my participation and/or my responses from the study at any time.
- All information provided will remain confidential, although I may be quoted in the research report.
- If I am quoted, a pseudonym (Respondent X, Respondent Y etc.) will be used.
- None of my identifiable information will be included in the research report.
- I am aware that the results of the study will be reported in the form of a research report for the partial completion of the degree, Masters in Organisational Psychology
- The research may also be presented at a local/international conference and published in a journal and/or book chapter.

Signed: _____ Date:_____

**D - Recording consent form for interview participants**

**Psychology**
School of Human & Community Development
**University of the Witwatersrand**
Private Bag 3, Wits, 2050
Tel: 011 717 4503 Fax: 086 553 4913

I, _____ (insert name here), give consent for this interview with Genavieve Levin to be recorded for the study that will involve a questionnaire development of decision-making. I understand that this recording will be confidential where only Miss Levin and her supervisor will be able to access. I understand that the write-up of my responses will make use of a pseudonym, for example Participant A or B, and no identifiable characteristics will be discussed. I understand that the transcripts and recordings of my interview will be stored in an encrypted folder on Miss Levin's personal protected computer.

Name: _____ Signature: _____

Date: _____

## E - Participants information sheet for focus group participants

**Psychology**
School of Human & Community Development
**University of the Witwatersrand**
Private Bag 3, Wits, 2050
Tel: 011 717 4503 Fax: 086 553 4913

Dear Participant,

My name is Genavieve Levin and I am currently completing my Master's degree in Organisational Psychology at the University of the Witwatersrand. As part of the degree requirements, I am conducting research with the intent of developing a questionnaire that will look at decision making In order to do this, I will be conducting research on people's feelings and values towards using/not using reclaimed water for drinking, cooking, washing, and garden maintenance purposes. South Africa is labelled the 30th driest country in the world and water is becoming a scarce resource. In order to avoid future water crises, the use of reclaimed water is a viable option for sustainably supplying water to south Africa and the generations to come. The successful use of reclaimed water depends highly on the public and their acceptance or rejection of it. I would like to invite you to participate in a focus group discussion of approximately one hour regarding your attitudes and values towards using reclaimed water as an alternative water source. There are no risks or benefits associated with participation in this study. You will be accompanied by five/six other participants. Even though there is no anonymity, confidentiality is ensured as I will only report on group responses, not on individual responses and any identifying information will be removed from the transcripts. Your identity will not be reported in my research report or any other resulting publications. Upon completion of the study, I will be able to provide you with a summary of the findings if requested. It would be much appreciated if you could assist me by participating in the study as your insight is highly valued.

Should you wish to participate in this study, please complete the attached consent form and email it to my supervisor, Prof. Andrew Thatcher or myself. Alternatively I can collect it from you on the day of the interview. My contact details and those of my supervisor appear below.
I look forward to hearing from you. Please detach and keep this letter.

Kind regards,

Miss. Genavieve Levin
Cell: 082 954 6765
Email: genlevin@gmail.com

Prof. Andrew Thatcher
Tel: 011 717 4533
Email: Andrew.Thatcher@wits.ac.za

F – Consent form for focus group participants

**Psychology**
School of Human & Community Development
**University of the Witwatersrand**
Private Bag 3, Wits, 2050
Tel: 011 717 4503 Fax: 086 553 4913

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I, _____ consent to participating in a focus group discussion run by Miss. Genavieve Levin for her questionnaire development.

- Participation in this study is voluntary.
- I may refrain from answering any questions.
- The tapes and transcripts from the focus groups will not be seen or heard by anyone other than the researcher and her supervisor.
- No identifying information will be used in the transcripts or the research report.
- Although direct quotes from the focus group may be used in the research report, I will be referred to by a pseudonym (Respondent X, Respondent Y etc.)
- I may withdraw my participation and/or my responses from the study at any time.
- All information provided will remain confidential, although I may be quoted in the research report.
- If I am quoted, a pseudonym (Respondent X, Respondent Y etc.) will be used.
- None of my identifiable information will be included in the research report.
- I am aware that the results of the study will be reported in the form of a research report for the partial completion of the degree, Masters in Organisational Psychology
- The research may also be published in a journal and/or book chapter.

Signed: _____ Date:_____

**G – Recording consent form for focus group participants**

**Psychology**
School of Human & Community Development
**University of the Witwatersrand**
Private Bag 3, Wits, 2050
Tel: 011 717 4503 Fax: 086 553 4913

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I, _____ (insert name here), give consent for this focus group discussion with Genavieve Levin to be recorded for the study that will involve a questionnaire development of decision-making. I understand that this recording will be confidential where only Miss Levin and her supervisor will be able to access. I understand that the write-up of my responses will make use of a pseudonym, for example Participant A or B, and no identifiable characteristics will be discussed. I understand that the transcripts and recordings of the focus group will be stored in an encrypted folder on Miss Levin's personal protected computer.

Name: _____ Signature: _____

Date: _____

**H - Interview schedule**

## INTERVIEW SCHEDULE FOR WATER RECLAMATION DECISION PATHWAY SURVEY

The aim is to design a survey that would be able to inform environment decision makers about the publics attitudes and opinions concerning using reclaimed water for potable and non-potable purposes. The use of reclaimed water is an efficient alternative in sustaining water and therefore alternative water sources for South Africa are important to prevent water crises in the future. public opinion leads to understanding the acceptance or lack thereof regarding using reclaimed water and in order to understand the publics opinion, the researcher would like to understand the various decision pathway surveys that people work through that brings them to accept or reject reclaimed water as an alternative water source and the reasoning behind these decisions.

### *INTERVIEW SCHEDULE*

***Demographic questions –*** *A very brief demographic survey will be provided just to gain an understanding of who the sample is and their characteristics.*

1) What is your gender?
2) How old are you? (age bracket)
3) What ethnicity are you?
4) Income (ranges)
5) Do you reside in an urban or a rural area?
6) Do you have access to running water daily?
7) What is your tertiary education background?
8) What is your job description here at *(Insert name of organisation)?*
9) What would you say you specialise in?
10) What would you say makes you an expert in the field of water conservation?

### *Water Reclamation in South Africa*

**To build rapport**

How would you describe the water situation/water scarcity in South Africa?

Do you think that sustaining water is a necessary concern for the future?

What are the possible alterative water sources that can be utilised in order to sustain water?

1) **What are your thoughts regarding the use of reclaimed water as an alternative source?**

2) **What are the advantages and disadvantages that come with using reclaimed water to sustain water?** ***(reclaimed water is cheaper and quicker than desalination etc.)***
3) **What possible barriers and enablers exist with regards to reclaimed water?** ***(acceptance, cost, infrastructure etc.).***
4) **How do you overcome the barriers towards reclaimed water?**

*EXTRA INFO*

How does water reclamation as an alternative water solution compare to other alternative options? Would you personally, recommend reclaimed water as the most viable option in sustaining water and why?

Both the focus group and interview schedules consist of open-ended questions so therefore various other questions may be brought to light and answered which will then be used for the purpose of this study and to increase the value of the data collected.

**Prof. Andrew Thatcher (Supervisor)**

**Sign: _____**

**Miss. Genavieve Levin (Researcher)**

**Sign: _____**

**I – Focus Group schedule**

## FOCUS GROUP SCHEDULE FOR DEVELOPING A WATER RECLAMATION DECISION PATHWAY SRVEY

The aim is to design a survey that would be able to inform environment decision makers about the publics attitudes and opinions concerning using reclaimed water for potable and non-potable purposes. The use of reclaimed water is an efficient alternative in sustaining water and therefore alternative water sources for South Africa are important to prevent water crises in the future. public opinion leads to understanding the acceptance or lack thereof regarding using reclaimed water and in order to understand the publics opinion, the researcher would like to understand the various decision pathway surveys that people work through that brings them to accept or reject reclaimed water as an alternative water source and the reasoning behind these decisions.

### *FOCUS GROUP SCHEDULE*

***Demographic questions –*** *A very brief demographic survey will be sent around just to gain an understanding of who the sample is and their characteristics.*

1) What is your gender?
2) How old are you?
3) What ethnicity are you?
4) Are you currently employed? If so, what is your job title?
5) Do you reside in an urban or a rural area?
6) Do you have access to running water daily?

### *Water reclamation in South Africa*

*Focus groups are open, ended and therefore very few questions are required in order to gain sufficient amount of information.*

1) Do you think that sustaining water is a necessary concern for the future?
2) What do you think can be done in order to sustain water?

3) **How do you feel about 'Reclaimed water' as an alternative source of water?** ***(under this question the researcher would elicit conversation regarding if they would use reclaimed***

***water for potable and non-potable purposes, what influences those choices such as treatment process, colour, smell, health risks, their values and attitudes etc.).***

4) If the implementation of reclaimed water usage decreases the costs of water and sustained water for the future, would you change our perceptions regarding reclaimed water?

Both the focus group and interview schedules consist of open-ended questions so therefore various other questions may be brought to light and answered which will then be used for the purpose of this study and to increase the value of the data collected.

**Prof. Andrew Thatcher (Supervisor)**

**Sign: _____**

**Miss. Genavieve Levin (Researcher)**

**Sign: _____**

## J - Interview demographic questionnaire

### DEMOGRAPHIC QUESTIONAIRE FOR INTERVIEW PARTICIPANTS

1. What is your gender?

- ☐ Male
- ☐ Female
- ☐ Other/prefer not to say

2. What is your age in years?

- ☐ 21 - 30
- ☐ 31-40
- ☐ 41-50
- ☐ 51 – 60
- ☐ 60 and above

3. What is your race? *(Please note that race is only used to determine the number of people from different race groups within the sample)*

- ☐ African
- ☐ Indian
- ☐ Coloured
- ☐ White
- ☐ Other/ I would prefer not to answer

4. What is your tertiary education background (If applicable)?

5. What is your job title?

6. What would you say you specialise in?

7. What would you say makes you an expert in the field of water conservation?

8. What is your monthly income?

- ◯ R10 000 or less
- ◯ R11 000 – R20 000
- ◯ R21 000 – R30 000
- ◯ R31 000 – R40 000
- ◯ R 40 000 or more

7. Do you reside in an urban or rural area ?

- ◯ Urban
- ◯ Rural

10. Do you have access to running water daily?

- ☐ Yes
- No

## K – Focus group demographic questionnaire

### DEMOGRAPHIC QUESTIONAIRE FOR FOCUS GROUPS

| DEMOGRAPHIC INFORMATION |
|---|

1. What is your gender?

- ☐ Male
- ☐ Female
- ☐ Other

2. What is your age in years?

- ☐ 20-31
- ☐ 31-40
- ☐ 41-50
- ☐ 51 & Older

4. What is your race? *(Please note that race is only used to determine the number of people from different race groups within the sample)*

- ☐ African
- ☐ Indian
- ☐ Coloured
- ☐ White
- ☐ Other/ I would prefer not to answer

9. What is your tertiary education background (If applicable)?

| |
|---|
| |

10. Are you currently employed?

| |
|---|
| |

11. What is your monthly income?

- ◯ R5000 or less
- ◯ R10 000 – R15 000
- ◯ R15 000 – R20 00
- ◯ R20 000 – R25 000
- ◯ R25 000 or more

7. Do you reside in an urban or rural area ?

- ◯ Urban
- ◯ Rural

10. Do you have aces to running water daily?

- ☐ Yes
- ☐ No

## L – Ethical Clearance Certificate

**UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG**

**HUMAN RESEARCH ETHICS COMMITTEE (SCHOOL OF HUMAN & COMMUNITY DEVELOPMENT**

| | |
|---|---|
| **CLEARANCE CERTIFICATE** | **PROTOCOL NUMBER: MORG/19/007 IH** |
| **PROJECT TITLE:** | Alternative water futures: developing a water reclamation decision pathway survey |
| **INVESTIGATORS** | Levin Genavieve |
| **DEPARTMENT** | Psychology |
| **DATE CONSIDERED** | 01/07/19 |
| **DECISION OF COMMITTEE*** | Approved |

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

**DATE: 01 July 2019**

**CHAIRPERSON**
**(Dr Colleen Bernstein)**

cc Supervisor:

Prof. Andrew Thatcher
Psychology

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**DECLARATION OF INVESTIGATOR (S)**

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

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

**This ethical clearance will expire on 31 December 2021**

PLEASE QUOTE THE PROTOCOL NUMBER IN ALL ENQUIRIES

**M – Turn It In Report**

1112730:RESEARCH_TURN_IT_IN.docx

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