COMMUNITIES' PERCEPTIONS OF THE HEALTH IMPLICATIONS OF WATER QUALITY IN THE STEVE TSHWETE LOCAL MUNICIPALITY, MPUMALANGA PROVINCE, SOUTH AFRICA

Mini Dissertation submitted in fulfillment of the requirements for the degree **Master of Philosophy in Integrated Water Management** at The Independent Institute of Education, Emeris**.**

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ABSTRACT

One of the most significant factors influencing human health is the quality of drinking water. Many countries, particularly developing countries, have poor drinking water quality. This has led to a number of waterborne illness outbreaks in these countries. The availability of clean drinking water is a universal human right, but the quality of water varies from community to community. Community members are the main beneficiaries when the water quality is good, but they are also the first to suffer from the effects of declining and poor water quality. It has been suggested that a community's attitudes and levels of knowledge regarding water quality influences their judgments of the health implications of using it for drinking.

This study explored community perceptions of health implications of water quality in the Steve Tshwete Local Municipality, Mpumalanga Province (South Africa).

A qualitative research design was employed with a purposive sampling method. Fifteen (15) participants (seven males and eight females) were identified to take part in the study from the Steve Tshwete Local Municipality, between March and April 2025. Semi-structured interviews were used to collect data and interviews were audio recorded and later transcribed using Word dictate. The data was then analyzed using coding and thematic data analysis.

The findings of the present study present six themes which are: Knowledge, attitudes and practices of the community on health and quality of the water, perceptions of the community regarding water quality and its impact on health, community members experiences of water-related health issues, factors affecting the community's perception of water quality risks, recommendations to enhance health education and water quality and infrastructure for water quality development in response to population growth and urbanization.

The findings of the study indicate that the poor quality of drinking water for community members in Steve Tshwete Local Municipality is due to poor waste disposal, poor maintenance of water systems, continuous pipe bursts, increased population growth, illegal connections to the reticulation pipeline and the vandalism of infrastructure.

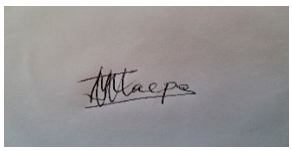
The research recommends that the local municipality of Steve Tshwete could improve service delivery to the community by investing in water infrastructure and maintenance of water plant process to ensure sustainable water management practices. Policymakers and stakeholders should collaborate to increase educational knowledge and awareness about the drinking water quality. The researcher recommendations focus on the policy, practice and further research of the study findings.

Keywords: Community Perception, Water quality, Human health, Environmental Health, Mine activities

DECLARATION

I, Magomarele Jackson Maepa, declare that this Research Report entitled ":
"Communities' perceptions of the health implications of water quality in the Steve Tshwete Local Municipality, Mpumalanga Province, South Africa", submitted for the Master of Philosophy in Integrated Water Management degree at The Independent Institute of Education, Faculty of Science and Technology, is my own, unaided work and has not been previously submitted to another University or Higher Education Institution for degree purposes. Any assistance that I have received has been duly acknowledged in the report.

Except where reference is made in the text, this report contains no material published elsewhere or extracted in whole or part from a thesis or report presented by me for another qualification. No other person's work has been used without due acknowledgement in the main text of the report.

Student signature: 

Date: 24/ 08/ 2026

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ABBREVIATIONS AND ACRONYMS

ADM: Acid Mine Drainage

CLRN: California Learning Resource Network

CDCs: Centers for Disease Control and Prevention

CHWS: Community Health Workers

CLTS: Community-Led Total Sanitation

HWTS: Household Water Treatment and Safe Storage

IERE: Institute for Environmental Research and Education

EORG: European Opinion Research Group

EPA: Environmental Protection Agency

LCIF: Lions Clubs International Foundation

MDGs: Millennium Development Goals

NEEF: National Economic Empowerment Fund

NPS: Non-Point Source

NWA: National Water Act

NWRS: National Water Resource Strategy

PMT: Protection Motivation Theory

ORS: Oral Rehydration Solution

RSA: Republic of South Africa

SDGs: Sustainable Development Goals

STLM: Steve Tshwete Local Municipality

UNEP: United Nations Environment Programme

UNICEF: United Nations International Children's Emergency Fund

USAID: United States Agency for International Development

UN: United Nations

WHO: World Health Organization

WASH: Water, Sanitation and Hygiene

WSA: Water Service Act

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CHAPTER 1: INTRODUCTION

This chapter provides an introduction to the study, which explores communities' perceptions of the health implications of water quality in the Steve Tshwete Local Municipality, Mpumalanga Province, South Africa. The chapter then introduces the research problem and the purpose and aim of the study, research questions and research objectives. Finally, a breakdown of the chapters is provided to guide the reader through the mini dissertation.

Background of the study

Water is an essential natural resource for human health and well-being, without safe accesses to it, waterborne diseases and public health crises could occur (Awowomom et al. (2025). But domestic water supplies can differ greatly in quality, especially in areas with poor infrastructure and insufficient water treatment systems (Bolatova et al., 2025). In South Africa, for example, many of these challenges persist which means ensuring the provision of safe drinking water remains a significant challenge for the government and communities themselves (Mbana & Sinthumule, 2024).

In many regions around the world, including the Steve Tshwete Local Municipality (STLM), Mpumalanga Province in South Africa, the source and quality of household water can have significant implications on the health of the population. The availability of good quality water for drinking and domestic use is crucial in preventing waterborne diseases and reducing the possibilities of other illness within communities (Awowomom et al. (2025). Access to safe and reliable water is a fundamental global human right and enshrined in South Africa's Constitution. However, the quality of water services often faces significant challenges, particularly in municipalities faced with rapid urbanisation, industrial activities, and aging infrastructure. This is particularly relevant in the Steve Tshwete Local Municipality. This area of South Africa is a major area for coal mining and power generation. These activities place considerable stress on water resources, with studies indicating potential water quality issues such as elevated levels of sulphates, manganese, and, at times, microbial pollution due to upstream industrial and anthropogenic contamination as well as challenges in wastewater management (Omalanga & Ongari.,2025).

While the municipality regularly monitors and reports on water quality against the South African National Standard (SANS 241), technical compliance does not always align with the lived experiences and concerns of the community on the ground. Perception of risk is a powerful determinant of public behaviour and trust of local government (Siegrist, Gutscher & Earle, 2005). When communities perceive their water to be unsafe, or not fit for drinking

purposes or domestic use, it can lead to anxiety, the adoption of potentially unsafe coping strategies (e.g., using unverified alternative sources), and a reluctance to use municipal services, even when they are technically potable. Moreover, a persistent narrative of environmental challenges, including reported sewage spillages into water sources, may fuel these concerns (STLM SANS 241 Report, 2024).

The quality of drinking water globally is deteriorating significantly, owing to industrialization, rapid increase in population and misuse of chemicals in agriculture as well as leakages from reservoirs and pipelines all leading to pollution (Haseena et al., 2017). Whilst many institutions, including mines, are often blamed for water pollution, it seems that local authorities are increasingly being named as the culprits (Wright, 2023)

Drinking water pollution is a crucial issue for public health (Dantas et al., 2020; Ravindra & Mor, 2019). The use of unsafe contaminated drinking water can result in various public health problems such as diarrhoea, cholera and hepatitis etc (Fotue, 2013). More than 1 billion individuals worldwide do not have access to clean or safe water and inadequate sanitation facilities. The World Health Organization reported that a 25% reduction in diarrheal illnesses could be achieved by improving the households' access to drinkable wate (WHO, 2018). Due to a shortage of drinking water and the existence of microbiological contamination in the water, many people in developing countries experience various health issues (Zulfiqar et al., 2016). Waterborne diseases account for 20 to 30 percent of hospital cases and about 60 percent of infant deaths. According to research done by Rehman and Baig, (2017); waterborne diseases claimed the lives of 230,000 children in Pakistan alone each year.

In 2023, South Africa's water quality was put in the spotlight when several cholera outbreaks and deaths were recorded. The outbreaks were initially recorded in Hammanskraal, but later spread across four other provinces, including Mpumalanga. Cholera is a waterborne disease that can be contracted when drinking water becomes contaminated with human faecal matter (Raseboku, 2023).

Water's significance stems from both its quality and its availability (Sousa et al., 2015). As a matter of development and health, access to clean drinking water has grown to be a significant concern at the national and regional levels (Wang et al., 2018). A healthy lifestyle can be facilitated by the use of safe drinking water (Bowyer et al., 2020).

In 2015 the United Nations (UN) adopted a set of 17 global goals that are known as the Sustainable Development Goals (SDGs). By 2030, the aim of these goals is that everyone should live in and have a better, more sustainable future.

The SDGs are a global call to action to eradicate poverty, safeguard the environment, and guarantee everyone's peace and prosperity (UN, 2015). They are intended to be accomplished by the combined efforts of individuals, governments, the commercial sector, and civil society. The SDGs highlight the connections between the environmental, social and economic aspects of sustainable development (Islam, 2025)

This research explores the community's perceptions of the health implications of water quality in the Steve Tshwete Local municipality and aligns with the SDG6: Clean water and sanitation: Ensuring universal access to and sustainable management of water and sanitation is the main objective of this goal. The study aims to advance knowledge of the issues surrounding water quality and guide actions to enhance the municipality's provision of water sanitation and water services.

1.2 Problem Statement

Water quality in the Steve Tshwete Local Municipality may pose health risks to the community, leading to various health issues. Understanding the community's perceptions of these risks is therefore crucial for developing effective interventions. The land use in the Upper Olifants catchment (Witbank and Middelburg catchment) is characterised by extensive coal mining, coal fired power stations, the urban centres of Middelburg and Witbank, steel manufacturing industries and agriculture (Malatjie, 2022). More specifically within the Upper Olifants catchment there are 45 mines, 8 power stations and 6 major industries including agriculture and steel production (Water safety plan of STLM, 2018). These industries and activities are of strategic importance to South Africa, but their effects on local communities and the environment come with potential risks (Water safety plan of STLM, 2018).

Although municipal data may show adequate chemical safety margins at treatment facilities, localized infrastructure deterioration sometimes shows up at the consumer level as foul tasting water or discolored (Malatjie, 2022). The community's opinions about the water quality and how it affects their health, however, is not well understood. The community's views of the water quality and possible health concerns must be investigated to close this knowledge gap and guide suitable treatments and policy decisions that will guarantee everyone has access to safe and clean water.

1.3 Purpose of the study

The purpose of the study is to explore communities' perceptions of the health implications of water quality in the Steve Tshwete Local Municipality, Mpumalanga Province, South Africa

This research is guided by an overarching research question and some sub questions

1.4 Research Questions

General Research Questions

What are the community's perceptions of the health implications of water quality in Steve Tshwete Local Municipality?

Specific Research Questions

1) What are the community's perceptions of the current state of water quality in the Steve Tshwete Local Municipality?
2) What are the perceived health risks associated with water quality in the community?
3) What are the factors influencing community perceptions of water quality in the municipality?

1.5 Research Objectives

General Research Objectives

To investigate community perceptions of health implications of water quality in Steve Tshwete Local Municipality

Specific Research Objectives

1) To assess the community's perception, knowledge, attitudes, and practices related to current water quality in the Steve Tshwete Local Municipality.
2) To assess the perceived health risks associated with water quality in the municipality.
3) To explore the factors that influence community perceptions of water quality risks.
4) To develop recommendations for improving water quality and health education.

1.6 Structure of the mini dissertation

This mini dissertation consists of six chapters which are summarised as follows:

• **Chapter one** presents the background of the study, highlights how the communities in the Steve Tshwete Local Municipality perceive the health implications of their water quality. The chapter also introduces the purpose of the research and the research questions and objectives. The problem statement and the significance are also provided.

• **Chapter two** provides an overview of the literature around the research topic to gain a better understanding of what other authors around the world have explored in terms of this research topic. It further describes the main concepts used in this research as well as the theoretical foundation supporting the study.

• **Chapter three** presents the research design and methodology for the study as well as the data collection techniques and approach to data analysis. The chapter also discusses the limitations of the study as well as ethical considerations.

• **Chapter four** presents the findings of the research within the context of the Steve Tshwete Local Municipality based on the semi structured interviews conducted with community members.

• **Chapter five** presents a discussion of the findings considering how to improve access to water quality and health within the community of Steve Tshwete Local Municipality.

• **Chapter six** presents the overall summary of the findings and conclusion of the research alongside the recommendations to improve access to water quality and health within the community of Steve Tshwete Local Municipality

1.7 Conclusion

The purpose of this chapter was to introduce the broader context of communities' perception of health implications of water quality particularly in the Steve Tshwete Local Municipality. The chapter also identified the critical role that water plays in the community for drinking and domestic purposes as well as prevention against water borne disease. In order to guide the reader further, this chapter also introduced the purpose of the research, describing the research questions and objectives and also provided a summary of the structure of the mini dissertation. The next chapter presents the literature review.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

This chapter focuses on the main concepts used in this research. The first section unpacks concepts such as community perception, water quality, human health, mine activities and provides an understanding of the key concepts used in the study. Understanding these concepts is important to lay the foundation for gaining a better understanding of the findings of the study. The study was also guided by protection motivation theory which is also presented in the chapter.

2.2 Key Concepts

It is crucial in research to often define and describe the key concepts that have been used to help situate the research within a body of literature.

2.2.1 Community perception

Community perception refers to the collective attitudes, beliefs, and interpretations held by members of a community regarding specific issues, events, or entities. It encompasses how individuals within the community understand and respond to social, cultural, and environmental factors, influencing their interactions and decision-making processes (Catherine et al., 2023).

2.2.2 Water quality

Water quality refers to the chemical, physical, biological, and radiological characteristics of water. It's a measure of the condition of water relative to the requirements of one or more biotic species and/or to any human need or purpose. (IERE, 2025).

Water can be used for recreation, drinking, fisheries, agriculture or industry. Each of these designated uses has different defined chemical, physical and biological standards necessary to fulfil the respective purpose. For example, there are stringent standards for water to be used for drinking or swimming compared to those used in agriculture or industry (IRJET, 2019).

2.2.3 Human health

According to the World Health Organization (2023), health is more than just the absence of illness or disability; it is a state of total physical, mental, and social well-being. While some suggest this definition as novel (WHO, 1948:100), others criticized it for being imprecise, overly inclusive, and not construed as quantifiable (WHO, 1948:100). It was long dismissed as an unrealistic ideal, and the majority of health discussions reverted to the biomedical field's practicality.

Physical health involves optimal body functioning through exercise, nutrition, and preventive care, reducing the risk of numerous diseases and improving stress control, sleep, and mood (Granero, 2022). A balanced diet is also linked to better mental and physical health outcomes (Granero, 2022).

Mental health can be affected by factors like anxiety, stress, and depression, which negatively impact physical health and increase disease risk. Contributing elements include biological factors, family history, and traumatic experiences, while positive mental health is associated with beneficial behaviors like smoking cessation and increased physical activity (Schneiderman et al., 2008).

Social health involves forming satisfying relationships, adapting to social situations, providing emotional support, reducing stress, and fostering a sense of belonging. Similarly, environmental health focuses on the interactions between people and their surroundings, with clean water, air, adequate housing, and safe communities significantly contributing to good health (Hlengwa et al., 2025).

2.2.4 Mine activities

The processes used to remove valuable minerals and other geological materials from the earth are referred to as mining activities, and they can have a big influence on the environment (Refer Figure 1). These operations involve a number of methods, including placer mining, underground mining, and surface mining, all of which have the potential to release a range of inorganic pollutants into the ecosystem. Recognizing mining as a significant source of inorganic contaminants in soil, water, and air requires an understanding of mining operations (Witchalls, 2022)

Mining activities, from exploration to closure, significantly impact water quality through the release of pollutants, altering its chemistry, increasing sediment load, and disrupting

aquatic ecosystems. This pollution stems from a variety of sources and processes inherent in the extraction and processing of valuable minerals and resources (IERE Team, 2025).

Mining's impact on water is multifaceted and extends far beyond the immediate mining site. The extraction process exposes previously undisturbed geological formations, creating pathways for pollutants to leach into surface and groundwater. This contamination can persist for decades, even after mining operations cease (IERE Team, 2025).



Figure 1: Mining in Mpumalanga: Unlocking the Riches of South Africa's Resource Hub (National Coal Suppliers, 2023)

2.3 Background of Literature Review

Having defined the main concepts in this research, this section reviews the literature in order to understand the dynamics of the research topic and also to gain a better understanding of what other authors around the world have explored in terms of this topic. For instance, Sustainable Development Goal 6 (SDG6) (Clean Water and Sanitation) incorporates empirical studies on global perceptions of water safety into broader frameworks pertaining to public health and the environment (Muthwa & Matsilia, 2026). According to past historical and worldwide health effect assessments, the quantity and proximity of available water often

have an even higher impact on total community diarrhea rates, even while water quality is vital for preventing some outbreaks (Bailey, 2026).

2.3.1 Community perception of water quality

There are several factors which influence how communities perceive the quality of their drinking water which include; prior experiences, trust in the water service provider, the impact of external and interpersonal information such as peers and the media, contextual factors, water color, water taste, appearance, and demographic variables (Catherine et al., 2023). These views are shaped by sociocultural, sociodemographic, and individual experiences; they are also influenced by service satisfaction, trust in local and national authorities, water source choice, and beliefs in human control of environmental issues, as well as the formal and informal flow of information (Catherine et al., 2023). Empirical research conducted globally demonstrates that, irrespective of technical water quality data, community perception of water quality is a significant factor of health behavior.

Communities across the world face issues with water, such as water quality, water scarcity, inadequate sanitation services, unsanitary practices, and a lack of awareness and knowledge about "safe" water collection, handling, and storage. Community members' perceptions of the safety and quality of drinking water are also influenced by water quality characteristics such as taste, color, smell, litter, and the presence of feces near and in the water source, as well as by factors like education, age, length of time lived in the community, the presence of obvious signs of water pollution, and encroachment into the water source catchment area (Okuma et al, 2020). In Bolivia, Wutich & Ragsdale (2008) discovered that rather than using laboratory tests, families evaluated water safety primarily using sensory signals like taste, smell, and colour. Even when risk was understood, the study shows that mistrust of the municipal utility decreased the possibility of implementing boiling or treatment procedures. Long-term unresolved water quality issues can cause the community to perceive health risks and encourage potentially harmful behaviors, such as the use of chemicals or alternative water sources like open wells without protection or buckets left on the ground (Peres et al., 2022). Community practices to maintain water quality are informed by discussions with the government, drinking water service providers, and community members regarding drinking water quality and related health risks and benefits (Lucier et al., 2020).

Establishing drinking water quality standards, monitoring, and managing water resources all depend on an understanding of community attitudes and practices (Lucier et al., 2020). Therefore, the purpose of this study was to explore how the people in the Steve Tshwete Local Municipality perceive the health effects of the water quality. The study's findings give insight into the attitudes, behaviors, and perceived solutions of the community in Steve Tshwete Local Municipality, to maintain and enhance safe and high-quality drinking water.

2.3.2 Public health and water quality

Public health is "the science and art of preventing disease, prolonging life, and promoting human health through organized efforts and informed choices of society, organizations (both public and private), communities, and individuals." (Achenson,1988:431-437). The control of community infections, the education of the individual in principles of personal hygiene, the organization of medical and nursing services for the early diagnosis and preventive treatment of disease, and the development of the social machinery which will ensure to every individual in the community a standard of living adequate for the maintenance of health (Coggon, 2023).

Drinking water quality is paramount to public health. Despite improvements in recent decades, access to good quality drinking water remains a critical issue. The World Health Organization (WHO) estimates that almost 10% of the global population do not have access to improved drinking water sources (WHO/UNICEF, 2019)., and one of the United Nations Sustainable Development Goals is to ensure universal access to water and sanitation by 2030 (United Nations, 2019). Waterborne infections cause diarrhea, which kills nearly one million people every year. Most are children under the age of five (WHO/UNICEF Drinking-Water, 2019).

Water concerns are still a major focus in the field of public health, requiring a great deal of attention and priority (Ali et al., 2023). Eighty percent of infections are known to be spread by water, according to WHO data. This spread is caused by a variety of bacterial, viral, and parasitic illnesses that spread through tainted water sources. Furthermore, the ability of water to dissolve and transmit toxins presents a risk to human health. Petroleum products, arsenic, lead, and other similar compounds are among the many harmful environmental contaminants that are known to be carried by water and to represent serious health concerns to the general public. It is important to highlight that the World Health Organization has projected that water-related illnesses, such as cholera, hepatitis, malaria, and several other

infections, cause a considerable number of fatalities annually (Day, 2023); (Xagoraraki & O'Brien, 2020).

2.3.3 Environmental health and water quality

Environmental health (EH) refers to the prevention of disease and injury related to the interactions between people and their environment. It is the branch of public health that focuses on all aspects of the natural and built environment (the areas that are influenced by humans, as opposed to the natural environment), affecting human health and disease. It may also be regarded to the theory and practice of assessing and controlling factors in the environment that can potentially directly or indirectly affect human health or cause disease (Sadiku et al., 2020)

Environmental health (EH) focuses on the interrelationships between people and their environment and promotes a safe and healthy environment. Healthy environments could prevent almost one quarter of the global burden of disease. Thus, maintaining a healthy environment is central to increasing quality of life and years of a healthy life. EH addresses the societal and environmental factors that increase the likelihood of exposure and disease (Sadiku et al., 2020).

The Steve Tshwete Local Municipality is significantly affected by human activities, particularly extensive coal mining, steel manufacturing, and agricultural runoff (Magagula et al., 2024; Malatjie, 2022). This results in the introduction of pollutants such as elevated sulfate concentrations, heavy metals, and acid mine drainage (AMD) into regional water bodies like the Middelburg dam and Klein-Olifants River (Magagula et al., 2024; Malatjie, 2022). According to Ngwenya & Kgathi (2006) in a study conducted in communities close to mining regions in Botswana, residents believed that mining activity had contaminated the groundwater. Continued use was documented despite this view because there were no other sources. Health issues were disregarded, and there was little faith in the government or the mining business.

Pollution, inadequate sanitation, and contamination of water sources by heavy metals, industrial waste, pathogenic bacteria, and other toxins are all contributing to the world's declining water quality and increasingly possible health hazards (Lin, Yang & Xu, 2022). Because pollution affects the availability of clean drinking water and raises the danger of waterborne illnesses, water quality has an impact on human health worldwide (Pandey et al., 2014). Water quality is deteriorating globally as a result of microbiological contamination,

chemical pollutants, and climate change; Low-income and developing areas are more at danger because of poor infrastructure and sanitation (UNESCO, 2022). Middle- and Low-income countries suffer from severe microbiological and heavy metal pollution, which causes widespread waterborne illnesses, while first-world countries battle with new toxins like medicines and microplastics (WHO, 2023).

The situation is especially dire in South Africa's informal settlements, where high levels of E. coli, Salmonella, and heavy metal contamination are caused by rapid urbanization, inadequate waste management, and deteriorating infrastructure (Mudau, 2021). The frequency of diarrheal illness is 40% greater in informal settlements, according to research, underscoring the critical need for better sanitation and water treatment methods (Johnstone et al., 2021). Rising urbanization and policy gaps will worsen water quality without targeted interventions, disproportionately harming poor areas.

The Constitution of the Republic of South Africa (108 of 1996), which protects citizens' rights to a safe and healthy environment, serves as the foundation for the legal framework in South Africa for the delivery of environmental health services. Environmental Health Services (EHS) fall under the purview of the Department of Health. According to the gazette "Scope of Practice of EHPs," EHPs are given extensive authority to look into and handle public health issues under the National Health Act (61 of 2003). However, some services (such as port health, malaria prevention, and hazardous material control) are classified as provincial level services., In the context of the District Health System (DHS), certain services that must be rendered at the municipal level are listed in Section 5 of the National Health Act and the Municipal Structures Act (117 of 1998). These services are known as "municipal health services" (MHS), which was first mentioned in the Constitution.

2.3.4 Effects of community engagement on water quality

WHO (2017:56) has defined community engagement as “a process of developing relationships that enable stakeholders to work together to address health-related issues and promote well-being to achieve positive health impact and outcomes”

In order to create more effective health interventions, programmes, services, and policies while empowering communities as important players in health initiatives, community engagement entails building relationships based on trust and working together to achieve positive and long-lasting health outcomes (Brunton et al., 2017). The strategy aids in identifying and addressing local problems, putting grassroots ideas into practice, and

utilizing local networks and resources to maintain health initiatives and results (Durrance-Bagale et al., 2022).

In the United States, community monitoring in Flint revealed lead pollution that officials had overlooked (National Academies of Science, 2018). Districts with operational Community Water and Sanitation Teams (CWSTs) in Ghana had 40% less downtime and fewer cholera outbreaks. CWSTs oversee rural boreholes, collect tariffs, and conduct chlorine campaigns (Government of Ghana, 2019).

The lack of trust and the conflict between jobs and the environment are addressed by including community leaders in STLM's water services forums, particularly in areas impacted by mining (LOCAL, 2007).

Communities and individuals are essential for fostering general health and well-being, and their active participation is essential for person-cantered treatment and integrated health services. In order to recognize the various interconnected communities that span time and space (such as families, schools, neighbourhoods, and places of employment; early childhood, adulthood) and influence both individual and collective identity, choices, and behaviours, the WHO has also urged expanding the definition of "community" (WHO-African Region, 2023).Furthermore, governments are realizing more and more how important it is to work with communities from different sectors in order to provide a variety of services (Alderwick et al., 2023).

Globally, the pressure on water resources has been increasing, resulting in diminished water availability and quality. Various strategies, such as water treatment technologies focused on water treatment, conservation efforts, nature-based solutions, and water savings measures, have been implemented to mitigate the adverse impacts. However, the results remain inadequate, highlighting the urgent need to promote policy enhancements (Boretti & Rosa, 2019) to achieve sustainable water management. This advancement requires processes that integrate community participation in decision-making. Citizen science projects possess the potential to facilitate community integration and foster more adaptable and resilient governance approaches at the local level (König et al., 2021) grounded in data generation and collaborative endeavors (Capdevila et al., 2020). When implemented effectively, participatory processes in water and sanitation management, can empower participants, cultivate greater social awareness of water related issues, for tidy the legitimacy of interventions, and ultimately enhance the delivery and sustainable management of water services and their sustainability. However, such processes necessitate a contextually tailored design, underpinned by adequate financial resources and technical capabilities.

Additionally, stakeholders must be well-informed about the political landscape to ensure successful implementation (Jiménez et al., 2019).

2.3.5 Sustainable Development Goals (SDGs)

The United Nations (UN) adopted a set of 17 global goals in 2015 that are known as the Sustainable Development Goals. By 2030, they aim for everyone to live in a better, more sustainable future. The SDGs are a global call to action to eradicate poverty, safeguard the environment, and guarantee everyone's peace and prosperity. They are intended to be accomplished by the combined efforts of individuals, governments, the commercial sector, and civil society (UN, 2015).

Health and well-being are widely acknowledged as being essential to sustainable development. In order to achieve this, SDG 3, focuses on good health and well-being. These objectives, which are outlined in the statement "Transforming our world: the 2030 Agenda for Sustainable Development" (UN, 2015), reflect the global commitment to building a sustainable future for everybody. The objective is to promote well-being and guarantee healthy lifestyles for everyone, regardless of age (UN, 2015).
Although it is defined specifically as a goal, it is clear that it has two-way relationships with the other goals.
The investigation into the community's perceptions of the health implications of water quality in the Steve Tshwete Local municipality aligns with the following sustainable development goals:

- SDG3: Good health and well-being: The health effects of water quality are specifically addressed by this goal. Understanding how community people see these health risks is the goal of this study. Having access to safe and clean water is essential for overall health and wellbeing.

- SDG6: Clean water and sanitation: Ensuring universal access to and sustainable management of water and sanitation is the main objective of this goal. The study advances knowledge of the issues surrounding water quality and can guide actions to enhance the municipality's sanitation and water availability.

- SDG11: Sustainable Cities and Communities: The significance of inclusive, secure, resilient, and sustainable cities and human settlements is emphasized by this aim.

Building sustainable communities requires having access to clean, safe water, and this study can pinpoint obstacles and areas for development.

- SDG17: Partnerships for the goals: In order to accomplish the SDGs, this objective emphasizes how crucial cooperation and partnerships are amongst all parties involved, including governments, the commercial sector, and civil society. The study highlights the value of community involvement and collaboration with water service companies and local government agencies.

In the context of Steve Tshwete Local Municipality, the SDGs are being implemented through initiatives such as (STLM IDP, 2024-2025):

- Just Transition: The municipality is committed to a just transition, which involves transitioning to a low-carbon economy while ensuring social justice and equity.
- Climate Change Mitigation: The municipality is taking bold climate action, demonstrating leadership and commitment to reducing greenhouse gas emissions and promoting sustainable development.

2.4 Factors that can influence the perception of people about water quality

Water quality perception is influenced by a wide range of characteristics, including age, gender, demographics, correlations with past experiences, education level, cultural practices, and sensory information such as taste, smell, sight, and colour (Jones et al. , 2005; de França., 2009; Kunwar & Bohara., 2020; Wright et al. 2012; Larson et al. 2016; Mirlohi et al. 2011; Doria, 2010). These are important because they control people's perceptions of what is clean and safe, which in turn influences how they perceive the water's quality. Perceptions of drinking water quality can affect behavior related to choosing a clean water source, according to Kelly et al. (2018) & Anthonj et al. (2020). According to Kunwar & Bohara (2020), individuals who have positive evaluations of their drinking water may be less inclined to modify their habits.

2.4.1 Gender

In relation to gender, some studies have highlighted that, women are more concerned than men about the risk factors and the quality of water resources (Okumah, 2020). The fact that women perform a significant portion of household and other domestic tasks and are primarily dependent on natural resources like water bodies and forest resources may be the reason

why women express greater concern about environmental conditions. Their perceptions of water quality are therefore shaped by their sensitivity to environmental resources (Maruapula et al., 2023).

2.4.2 Age

Age may also have an impact on how people perceive the quality of the water, according to some research. For instance, older people may be better able to identify changes in water quality over a comparatively longer period of time because they have been exposed to the conditions of water resources for a longer period of time (Okumah, 2020). Their perceptions of water quality may be influenced by this wide range of experiences. Younger people, who are frequently less experienced, might not have seen how water resources have changed. Their opinions about the quality of the water may be influenced by their lack of experience. The relationship between age and opinions of water quality, however, seems to be complicated because it may depend on other factors, much like gender (Lwamba, 2022). In the rural regions of Kenya, gender and age determine the degree of exposure to water sources (boreholes, shallow wells, pans). Women and girls have detailed seasonal knowledge of water quality since they oversee the daily gathering of domestic water. (Nadal et al., 2025).

2.4.3 Education level

Perceptions of water quality have been found to be associated with education (Maruapula et al., 2023). According to EORG (2002), education may have an impact on the "meanings people read" into water quality, implying that individuals with higher levels of education are more likely to have a broader understanding and appreciation of what constitutes water contamination.

This suggests that, regardless of their surroundings, highly educated people typically classify the water quality in the dam-river system as poor. This could be because educated individuals are more conscious of environmental problems such water scarcity and pollution (Noga & Wolbring, 2013). It is anticipated that educated individuals will typically rate the water quality in the dam-river system as poor. The anticipation was based on the idea that educated individuals are more conscious of water pollution and are more knowledgeable about the chemical characteristics that cause it.

According to Symy et al. (2000), Frick et al. (2004), & Phiri (2014), educated individuals are more likely to be involved in the community, have a greater understanding of environmentally responsible behaviour, and are aware of environmental protection. Many South Africans still require environmental education, as noted by Lotz-Sisitka & Burt (2006). In order to comprehend the consequences for various users, it is crucial to be aware of environmental issues including water pollution, water quality, and water quantity. To encourage community-level water resource monitoring, management, and conservation, more awareness and education are needed (Nare et al., 2011; Noga & Wolbring, 2013). By doing this, local communities receive training and encouragement to learn how to take care of their own health and well-being.

Similarly, a study on household water use throughout Nigeria's varied urban and rural geopolitical zones revealed that risk perception is significantly influenced by income and education level. However, urban dwellers with higher levels of education are more inclined to invest in alternative purification techniques and doubt the safety of public or borehole water (Nadal et al., 2025). Also, the younger, and more educated cohorts are more responsive to institutional public health messaging about point-of-use water treatment (such as boiling or chlorination), while older community members mainly rely on traditional historical memory of water sources (Nadal et al., 2025).

2.4.4 Cultural and Religious factors

The socially constructed myths and beliefs that affect how the environment is perceived are largely shaped by cultural factors (Doria, 2010). Different ethnic groups' perceptions of risk and water quality may be influenced by these socially constructed norms. In many religious practices, water may also be a significant object. In a study by (Coetzee et al., 2016) black South Africans recognized water uses associated with spiritual and cultural beliefs (Coetzee et al., 2016). The functions of water in religion, such as ablution and baptism, can be described in terms of purity and the purifying element (Doria, 1998; Gritti, 2001). Perceptions of water quality may be significantly influenced by these religious viewpoints on the purifying functions of water.

People in the areas around the Nile traditionally performed rituals and prayed to the river, acknowledging that it was the hallowed foundation of Ancient Egyptian civilization and that its life-giving power was divine (Anafi-Wadieh, 2025).

2.4.5 Sensorial information (organoleptic)

Previous studies have already assessed the factors that contribute to consumers' perceptions of the risk of drinking tap water, as well as the factors that influence their perceptions of water quality and the adoption of avoidance practices to improve the quality of tap water (Delpla et al., 2020). As Doria (Doria, 2010) (p. 1) states, "perceptions of water quality result from a complex interaction of diverse factors." While many of these factors seem to be common across study cases, each one's relative importance varies by site (Alameddine et al., 2017). The organoleptic properties of tap water—taste, smell, and transparency—have the biggest impact on how well people perceive their water (Doria et al.,2005; Robak & Bjornlund, 2018). This is because taste and smell are frequently related. However, in western nations, water taste is typically valued more than smell and appearance because it may reveal the presence of water chemicals (Doria,2010).

According to some research, there are certain connections between the chemical makeup of water and its organoleptic properties. In particular, though a poor taste is not always linked to risk perception, the taste of water with a high mineral content is typically better assessed, whereas the opposite is true for tap water with a high chlorine, limestone, or hardness content (Doria, 2010). However, there is evidence that the public associates the organoleptic properties of water with the belief that drinking tap water may or may not be harmful to one's health (Doria, 2010). In other instances, lower water quality ratings are solely caused by chemical concerns, independent of tap water composition (Doria, 2010). In this regard, one of the primary determinants of whether tap water is accepted for drinking is the perception of safety or risk (Doria, Pidgeon, Hunter, 2010; Johnson,2003; Brouwer, Hofman-Caris, Van Aalderen, 2020). It should be noted that the risk perception gap, which has been described as the public's perception of tap water quality and the potential and related health risks, is independent of technical or analytical assessments (Brouwer, Hofman-Caris, Van Aalderen, 2020).

2.4.6 Contextual factors

Johnson (2003) points out that contextual factors may mediate the effects of sociodemographic characteristics on perceptions of water quality.

It is necessary to investigate perceptions in various contexts since contextual elements (such as sociocultural circumstances) may interact with all the other factors to determine

water quality perceptions. This implies that attitudes in various geoclimatic, sociopolitical, and economic regions—including developing nations—need to be investigated. The majority of previous research has concentrated on certain societal groups, such as farmers (Lowder, Skoet, & Raney, 2016). It could be deceptive to generalize the opinions of particular social groups to the entire population because different social groups have distinct experiences, ideas, and knowledge bases. Furthermore, it is crucial to investigate the opinions of the general public because they both contribute to and are impacted by river pollution and water management regulations (Okumah et al., 2019a).

2.5 Water Pollution and water quality

Water pollution is defined by Alrumman et al., (2016) as the introduction of unwanted elements into water that deteriorate its quality

According to Juneja et al., (2013), marine dumping, atmospheric deposition, and the release of effluent wastes from homes and businesses are some of the main causes of water contamination. According to Islam et al., (2017), major contaminants often found in water include lead, arsenic, microbial diseases, organic chemicals, and heavy metals. Pharmaceuticals and personal hygiene products have become much more common in water in recent years, according to Fraser (2019), all cause possible risks these to both humans and animals.

For humans to survive, water is a necessary resource. According to UNESCO's 2021 World Water Development Report, freshwater consumption has grown by roughly 1% annually since the 1980s and has climbed sixfold over the previous century. Water quality is facing serious difficulties as a result of rising water demand. The degradation and contamination of the environment brought about by industrialization, agricultural production, and urban living have a negative impact on the water bodies (rivers and oceans) that are essential for life, which in turn affects human health and sustainable social development (Xu et al., 2022a). An estimated 80% of urban and industrial wastewater worldwide is released into the environment untreated, endangering ecosystems and human health. This percentage is higher in the least developed countries, where sanitation and wastewater treatment infrastructure are appallingly lacking.

South Africa is no exception when it comes to water contamination. Physical and economic causes are contributing to the nation's growing water scarcity dilemma. A rise in pollutant

fluxes into river systems brought on by urbanization, forestry, wetland degradation, industry, mining, agriculture, energy consumption, and unintentional water pollution worsens South Africa's water shortage. As a result, there are now fewer clean water resources available, and many communities lack access to clean drinking water. In South Africa, coal mining and coal-fired power plants in particular have been found to be major causes of water pollution, with hazardous byproducts and excessive water use further taxing water supplies (Jimenez, 2025).

“Mpumalanga, Gauteng, Kwa-Zulu Natal, and Limpopo in particular are plagued by mine-impacted water pollution” says Raquel Nosie Mazwi, (director of mine and industrial water quality regulation, Department of Water and Sanitation, 2025).

Mpumalanga has problems with mine water because of abandoned mines and deteriorating infrastructure systems meant to control water affected by mines. Elevated pyrite levels linked to gold mining are present in Gauteng's topography and are known to contaminate water. Numerous coal mines in Kwa-Zulu Natal have been abandoned and inundated with water. In addition to producing water with high salt levels, Limpopo, particularly the Lephalale region, is home to active coal mines. Limpopo mines have an effect on the Olifants watershed (Infrastructure News, 2025).

2.5.1 Sources of Water Pollution in South Africa

A wide range of things can contaminate water bodies, including pathogenic bacteria, decomposable organic waste, fertilizers, plant nutrients, hazardous chemicals, sediments, heat, petroleum (oil), and radioactive elements (Bhadarka, 2024). There are two different sources of water pollution: point and non-point.

2.5.2 Point Source

Point sources of pollution are easily recognized and have a direct source. These sources, can include storm sewer discharges and municipal and industrial wastewater effluents. These; mostly affect the immediate area where they are released. A pipe that releases wastewater or other materials from a factory into a body of water is one example of a specific source of pollution (Viman et al., 2010).

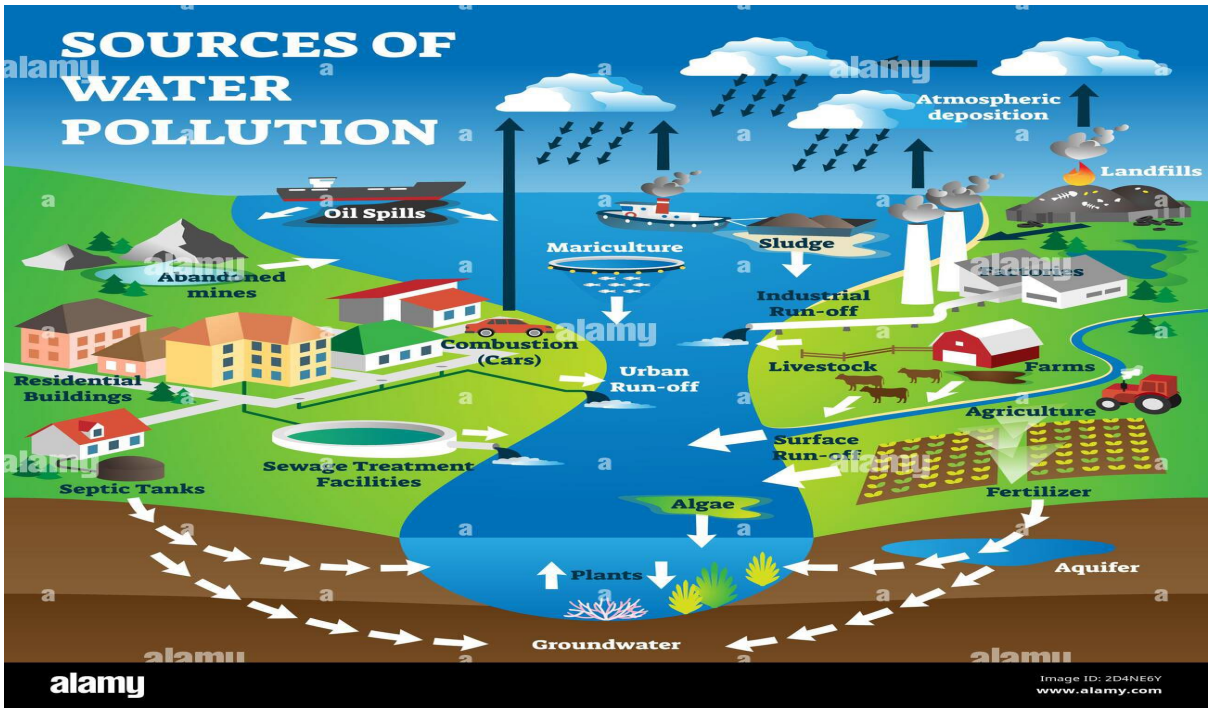


Figure 2: Sources of Water Pollution (Consciouswater.ca, 2023)

2.5.2.(a) Industrial Waste

Worldwide, industrial water contamination is a major problem. Water bodies become unfit for drinking and other uses when dangerous chemicals and substances are released into them. One significant cause of water pollution that has negative effects on the environment and human health is the release of industrial waste. Hazardous chemicals and other organic and inorganic materials are released into water bodies by industrial activities. Aquatic ecosystems become threatened by this contamination. Freshwater sources are contaminated by the common practice of releasing wastewater from various industrial processes into bodies of water (Islam et al., 2023). Even though there is a lot of water on Earth's surface, freshwater can only be obtained from certain sources, such as ponds, lakes, rivers, streams, and reservoirs.

2.5.2.(b) Sewage

Inadequate handling of sewage and industrial effluents is a major cause of river water pollution, which has negative effects on aquatic ecosystems and human health (Sultana & Khan, 2022). Water contamination from sewage is a serious issue that affects both freshwater and marine environments. Sewage's organic matter and mineral ions foster the growth of microbes, especially bacteria connected to corrosion processes.

Heavy metals and other contaminants like phosphorus and nitrogen can be removed from contaminated water by using marine algae for wastewater treatment. Marine algae are effective wastewater treatment agents due to their intrinsic absorption properties, providing a useful basis for ongoing study and improvement in this area. There is a wide range of equipment and technologies available for treating water pollution, including infiltration, sewage treatment, image acquisition, power generation, and control boxes. These instruments are purposefully designed to treat water contamination in a simple, practical, and effective manner (Sultana & Khan, 2022).

2.5.3 Non-point Source

Non-point-source (NPS) pollution is a kind of pollution in which it is difficult to see or accurately identify true source of pollution (Xepapadeas, 2011). Runoff from farms and urban solid waste are two examples. This type of pollution can occasionally have impact hundreds or even thousands of miles away from its source.

2.5.3 (a) Agriculture Runoff

The term "agricultural runoff" refers to the discharge of agrochemicals, including pesticides and fertilizers, into surface waters. This is a major non-point source of pollution that has negative effects on aquatic ecosystems, wildlife, and human health. Water and soil are contaminated by the use of pesticides, mineral fertilizers, and animal dung in agriculture (Xia et al., 2020). Constructed wetlands (CWs) have become a popular, economical, and energy-efficient way to reduce agricultural runoff pollution (Kassa, 2020), (Elhaj Baddar et al., 2023). CWs provide a number of economic and environmental advantages by effectively removing contaminants from agricultural runoff, including as pesticides, nitrogen, and phosphorus (Sohoulande Djebou et al., 2023). Microbial biodegradation and nitrogen removal are facilitated by these wetlands. To increase the removal efficiency of certain contaminants from agricultural runoff, a variety of methods and approaches have been investigated, including adsorption beds, artificial wetlands using alum-sludge substrates, and Fe-citrate-based photo-Fenton chemistry (Kassa, 2020). These technologies' main objective is to control eutrophication caused by agricultural runoff and lessen the harmful effects of pesticides and fertilizers in ecosystems (Boogaard et al., 2015).

2.5.3 (b) Urban Runoff

One significant source of pollutants that are introduced into surface waters, including microplastics and nanoparticles, is urban runoff (Pahl, Richter & Wyles, 2020). Microplastics, metals, chemical compounds, and other contaminants may be introduced into aquatic habitats by this runoff (Pahl, Richter & Wyles, 2020). Variations in watershed characteristics, land use patterns, and rainfall events might affect the concentration and mix of these contaminants in urban runoff (Mazari, Mubarak & Sazoi, 2022).

Stormwater runoff is a significant danger to water quality since it is often released untreated into receiving waterways (Marlow, Moglia, Cook & Beale, 2013). For runoff pollution to be effectively controlled and regulated, a thorough understanding of the temporal and spatial distribution of contaminants in urban runoff is essential. Targeted initiatives in more urbanized catchments are required to specifically address microplastic contamination (Marazzi, Loiselle, Anderson, Rocliffe & Winston, 2020). Pollutant levels in urban runoff can change during a storm, making management and treatment difficult (Mazazzi, Loiselle, Anderson, Rocliffe & Winston, 2020). The variety of urban land regions, temperature fluctuations, and the range of activities occurring within the watershed all affect the characteristics of stormwater runoff (Kluboy & Tretyakov, 2022).

2.5.3.(c) Contamination of groundwater

Pollutants from the Earth's surface enter subterranean water reservoirs and cause groundwater contamination (Ferrer, Folch, Masó, Sanchez, & Sanchez-Vila, X.,2020). According to Nayebare, Owor, Kulabako, & Taylor, (2022), faecal matter that seeps underground and harbours infections makes water dangerous to drink. Groundwater contaminated by pathogens may contain bacteria, viruses, protozoa, and occasionally helminth eggs (Chahal, Van Den Akker, Young, Franco, Blackbeard, & Monis, (2016)) Cholera and diarrhoea can result from drinking such tainted water (Lu, 2021). Buitenkamp & Stintzing (2008), indicate that nitrates are significant source of groundwater pollution that can lead to blue baby syndrome a disorder that primarily affects children in rural Romania and Bulgaria (Li, Song, Yang, Li, Wang, & An,2021). When nitrate levels in groundwater are above 10 mg/L (10 ppm), the probability of this illness significantly increases. Because most nitrates, which are mostly wasted by plants, eventually seep into groundwater reserves, overuse of nitrate-based fertilizers greatly contributes to groundwater pollution (Khan, &

Mohammad, 2014). Dental and skeletal health issues are often caused by excessive fluoride poisoning in groundwater (Li, Karunanidhi, Subramani, & Srinivasamoorthy, 2021).

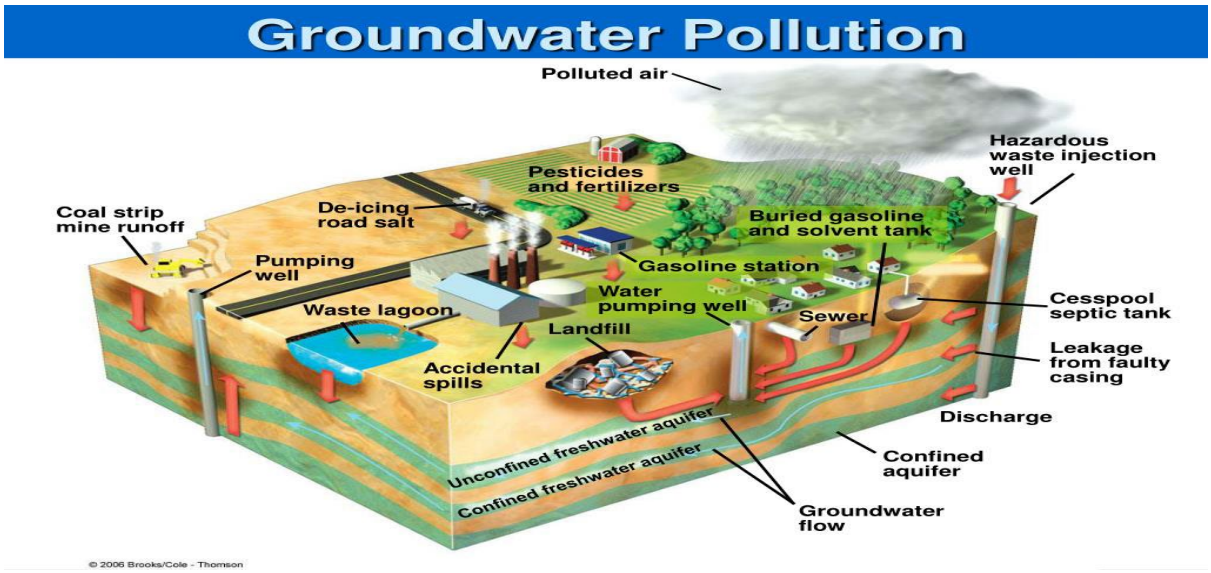


Figure 3: Groundwater Pollution (Brooks/Cole-Thomson, 2006)

2.5.3 (d) Acid mine drainage

Acid mine drainage (AMD) is a mining byproduct produced by both operating and abandoned mines. It is created when pyrite (FeS2) and other sulphide minerals oxidize in the presence of water, air, and oxidizing bacteria, producing effluent that is acidic and rich in metals. Elevated concentrations of aluminium (Al), iron (Fe), and manganese (Mn), moderate or low concentrations of zinc (Zn), copper (Cu), nickel (Ni), and arsenic (As), radioactive elements like uranium (U), and extremely high concentrations of sulphate ions ($SO4\ 2^{1}$) are all found in acid mine drainage (Baene-Moreno et al.,2020, Nguegang & Abushe, 2024). Furthermore, the types of mining ores and geohydrological parameters affect the chemical composition of AMD (Simate & Ndlovu, 2014).

If released untreated, this disagreeable effluent, which is rich in different chemical species, is extremely poisonous and detrimental to both the environment and human health. The pH of the receiving water course is lowered by acid mine water, which increases the concentration of most chemical species and the toxicity of the entire aquatic environment, impacting the water's appropriateness for a wide range of specific purposes (Bwapowa, 2017, Dong et al., 2018). AMD not only has detrimental effects on the aquatic ecology but also contaminates and erodes soil, making it unfit for agricultural use (Willis, 2021; Moeng, 2019).

The presence of radioactive materials, metalloids, and toxic metals in AMD-polluted areas increases the risks of carcinogenic, mutagenic, and teratogenic effects on humans and animals, extending the detrimental and toxic effects of AMD beyond its eco-toxicological effects to human health (Moeng, 2019). All things considered, AMD is an unpleasant issue that is prevalent in nations with sophisticated mining sectors, like the USA, Canada, Chile, Australia, Brazil, South Africa, and China, among others (Skouden et al., 2018, Akci & Koldas, 2006).



Figure 4: Acid mine drainage (Mark Lewis, 2022)

According to Akpan and Ajayi (2016) deposits of raw sewage into the natural sources of water had been a major contributing factor to water contamination. However, contaminated water weakens the health as well as an individual's living. Labrador et al., (2020) also argued that pathogens and faecal contamination through the environment cause a serious health risk. According to Pasha et al., (2020) water can be polluted due to various factors, such as leaking tanks, untreated sewage and blocked drain storms. Thus, to reduce the health risk, economic and environmental losses, precise detection of contaminants is needed.

Water from "improved water sources," such as household connections, public standpipes, boreholes, protected dug wells, protected springs, and rainwater collections, is considered "safe drinking water" if it poses no substantial health risks over the course of a lifetime (Kumpel et al., 2016).

However, water quality evaluation is subjective and depends on a variety of factors, including user experience, socioeconomic characteristics, beliefs, cognition, the location of the water source, and information from the local media (Mooney et al., 2021).

Water quality is critical to public health, and community perceptions significantly shape water policies. This literature review examines existing research on community perceptions of water quality, health implications, and water management strategies in South Africa, focusing on the Steve Tshwete Local Municipality in Mpumalanga Province. WHO (2018), everyone has the fundamental human right to obtain clean drinking water, regardless of wealth, religion, nationality, colour, or faith. Diseases like diarrhea, polio, cholera, and dysentery are spread by contaminated drinking water and inadequate sanitation. Poor drinking water quality is significantly affecting consumers' health. It was reported that at least 2 billion people globally use a drinking water source contaminated with faeces (WHO, 2018).

Understanding the status of drinking water quality and associated health risks is the basis for making wise decisions on drinking water quality protection and management.

2.5.3 (e) Pesticides and Fertilizers

Herbicides and Pesticides Weed and pest control involve the utilization of herbicides and pesticides (Mustafa & Hassan, 2024). Their infiltration into groundwater occurs through leaching. influenced by rainfall, irrigation practices, pesticide properties, and soil composition (Mustafa & Hassan, 2024). Leaching is more pronounced in sandy soils when the herbicide demonstrates higher solubility in water. Furthermore, runoff facilitates the transport of insecticides and herbicides into natural water reservoirs (Prata, Silva, Da Costa, Mouneyrac, Walker, Duarte, & Rocha Santos, 2019). The introduction of pesticide residues into these water bodies disrupts indigenous flora and wildlife (Riyaz, Shah, & Sivasankaran,2021). Particularly hazardous are pesticides exhibiting slow or negligible degradation rates, perpetuating their impact on ecosystems ((Victoria, 2015), 81 Pope III, Bhatnagar, McCracken, Abplanalp, Conklin, & O'Toole, 2016)).

2.6 Infrastructure conditions

Water supply infrastructure connected to sanitation is already set up and maintained in industrialized nations (Mustafa & Hassan, 2024). Unfortunately, untreated sewage enters aquatic bodies in large quantities in developing countries. Therefore, improving basic sanitation infrastructure and treatment techniques is essential. It is essential to guarantee that everyone has access to safe drinking water. Sixty seven percent (67%) of people in

developing nations are predicted to lack access to adequate sewage systems by 2030 (Schwanebeck et al., 2012).

2.7 Impact of water pollution on human health

The impact of water pollution on human health is substantial. The contamination of water sources due to both natural and human-induced activities pose a global threat to public health (Gopinathan, 2022). Water pollution can result in a range of health implications, encompassing both communicable and non-communicable diseases, chemical intoxication, as well as the dissemination of pathogens and disease vectors (Boelee et al., 2019). Research has indicated that exposure to polluted water can give rise to health risks, encompassing both carcinogenic and non-carcinogenic effects, with children being particularly susceptible (Agbasi & Egbueri, 2022). The contamination of water by cytotoxic substances, such as heavy metal ions, pharmaceuticals, pesticides, and dyes represents a significant public health concern (Srivastava et al., 2020). Implementing remedial measures and adopting mitigation strategies is crucial to address water pollution and safeguard human health (Hicks, 1998). Integrated water management interventions hold the potential to diminish adverse health impacts and amplify health benefits. Future research endeavors should concentrate on formulating approaches and technologies aimed at eliminating hazardous contaminants from water and wastewater. Because pollution affects the availability of clean drinking water and raises the danger of waterborne illnesses, water quality has an impact on human health worldwide (Pandey et al., 2014).

Middle- and low-income countries suffer from severe microbiological and heavy metal pollution, which causes widespread waterborne illnesses, whereas first-world countries battle with new toxins such as medicines and microplastics (WHO, 2023).

2.8 Theoretical Foundation

A theoretical foundation, also known as a theoretical framework, is the set of well-established theories, concepts, and principles that serve as a research study's or academic work's fundamental framework (Watson, 2022). Babbie (1980:391) defines a theory as a “persistent and methodical organizing framework consisting of concepts that help create an overall outlook, a model, scheme, or technique that organizes and frames our thinking about the causes of particular phenomena”. Figure 5 below summarizes the fundamental concepts and predicted outcomes of the Protection Motivation Theory.

A theoretical framework that categorizes the general knowledge of how to investigate communities' perceptions of the health implications of water quality in Steve Tshwete Local Municipality is required. The study was informed by Protective Motivation Theory**.**

2.8.1 Protection Motivation Theory

The goal of protection motivation theory (PMT) is to encourage protective action by explaining how individuals perceive and react to dangers and threats. A concise explanation is given by Ezati Rad & associates (2021:2): *"*PMT assumes that adopting a protective behavior against health threats is dependent on personal motivation for self-protection"

As a health promotion paradigm, Protection Motivation Theory (PMT) asserts that a certain level of risk-related knowledge can provide the required motivation to assess risk severity, vulnerability, and capacity to mitigate risk in individuals (Tang & Feng, 2018). The PMT theory has gained popularity as an explanation for locals' risk-reduction practices against natural calamities. This theory comprises the concept of fear as well as two phases of threat appraisal (perceived vulnerability, perceived severity, and reward) and coping appraisal (reaction efficacy, self-efficacy, and response costs) (Bubeck, Wouter Botzen, Lauden, Aerts & Thieken, 2018).

According to this theory, a person is more likely to engage in preventive behaviours if they perceive a risk as likely to occur (perceived vulnerability), the risk's consequences as serious (perceived severity), and the perceived internal and external rewards are smaller than those of current behaviours that raise the likelihood of harm. Additionally, perceived reaction efficacy and self-efficacy should outweigh adaptive response costs. The behavioural intention that initiates or sustains protective activity is equivalent to protection motivation (Faryabi, Sharifabad, Sardooei, Daneshi, Hushmandi & Raei, 2021)).

According to PMT, individuals evaluate threats and risks through two appraisals: threat appraisal and coping appraisal.

2.8.1(a) Threat Appraisal

The first appraisal involves assessing the severity, vulnerability, and perceived susceptibility to a particular threat or risk (Lahiri et al., 2021:1). Shillair (2020) states that: *"the* threat

appraisal process includes assessing the severity of the threat and the likelihood (i.e., vulnerability) of the threat happening*".*

Example includes:

- **Perceived susceptibility**: This is a person's perception that a certain threat may have negative effects on them. When it comes to drinking contaminated water, people who think they have a high chance of doing so view their susceptibility as high.
- **Perceived severity**: This relates to a person's assessment of the potential severity of the effects of being exposed to a certain threat. For example, when drinking contaminated water frequently results in life-threatening illnesses, the severity of the problem is likely medium to high.
- **Vulnerability**: Expression expresses opinions regarding one's ability to stave off harm from the threat. Boiling water before consuming, for instance, can prevent illness.

People are more inclined to act if they think there is a serious threat, that there will probably be unfavourable outcomes, and that they could be seriously harmed.

2.8.1 (b) Coping Appraisal

The second assessment focuses on determining how well a person can handle the perceived threat by using different coping strategies, like taking preventative measures or getting expert assistance (Lahiri et al., 2021). According to Shillair (2020), *"…*the coping appraisal process includes consideration of the efficacy of the response, how difficult the response is to carry out (e.g., response cost), and the perceived self-efficacy of enacting the coping response" *(p. 1).*

If such a negative incident happened, a person's choice would be based on their "self-efficacy," or confidence in their ability to handle the situation.

At this point, the scenario involves determining whether or not to take situational control measures by evaluating one's own abilities to use appropriate strategies to prevent damages from the prospective threat (Lahiri, 2021).

Example include:

- **Response efficacy**: One's perception of the efficacy of preventive measures, such as boiling water to avoid illness.
- **Self-efficacy**: Believing that one has what it takes requires a willingness to sustain consistent behavioural change (i.e., your ability to leave a pleasant life and pay close attention at all times).
- **Response costs**: This relates to the possible financial and non-financial costs of adopting protective behaviours, such as the potential expense of hospital treatment for your illness.

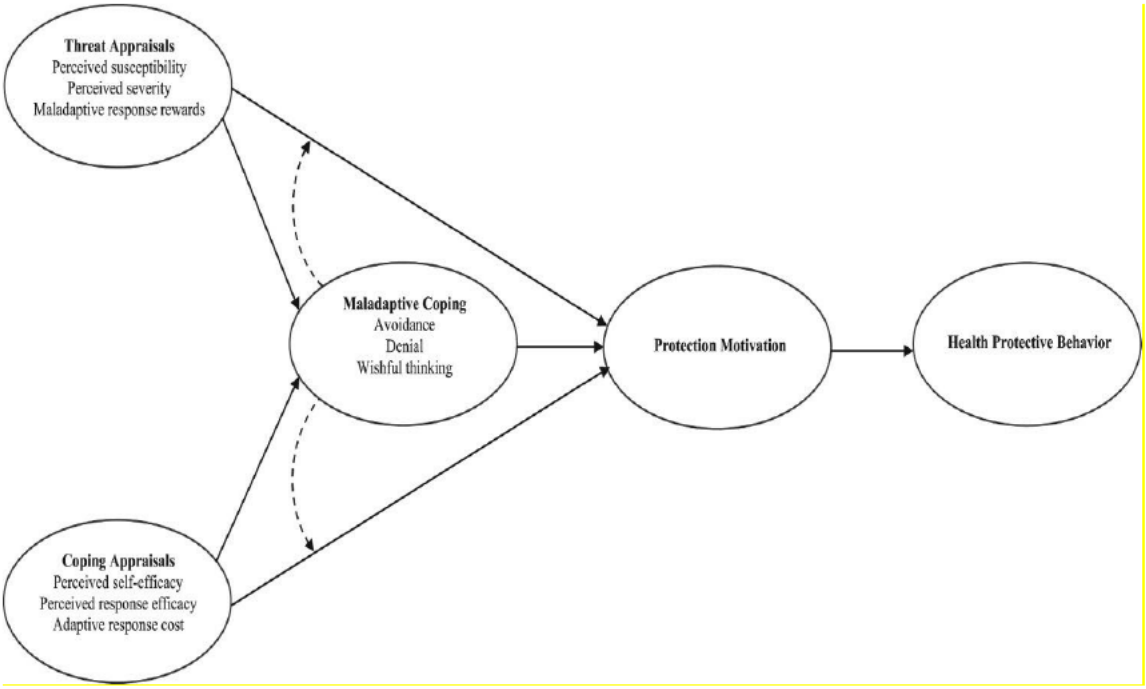


Figure 5: Protection motivation theory (Rogers, 1975)

2.8.2 Application of Protection Motivation Theory on water quality and health globally

A psychological paradigm known as Protection Motivation Theory (PMT) aims to explain and forecast people's adaptive and maladaptive coping reactions to perceived dangers, such as environmental hazards or health concerns. PMT, which was developed by R.W. Rogers in the 1970s, asserts that people's motivation to defend themselves against threats is based on their cognitive assessment of the threat and their perception of their capacity to handle it. The idea has been widely used to comprehend and forecast health-related behaviours and to guide the creation of successful interventions for health promotion.

The link between environmental deterioration and issues related to human health is becoming more widely acknowledged. For instance, the buildup of contaminants in lakes, streams, and groundwater seriously endangers human health in addition to compromising the condition of our environment (EPA, 2022). Growing contamination problems are caused by a variety of sources, including fertilizers, wastewater, air deposition, urban runoff, and many more. It is no longer safe to drink or engage in recreational activities like swimming or fishing in many water resources (Denchak, 2022). According to Odetola et al., (2021), 21 million Americans relied on community water systems that did not meet the EPA's (U.S. Environmental Protection Agency) water quality standards in 2015. The World Health Organization (2015) estimates that 1.8 million people died as a result of water pollution worldwide. Institutions cannot completely eradicate the risks that water pollution poses to human health and the environment, and they have little regulatory power. For instance, only point source water pollution is covered by the US Clean Water Act (EPA, 2021). Therefore, in order to bridge the gap when institutional solutions and legislation fail to adequately safeguard the environment and public health, human behaviour change is required. In this survey-based study, we investigate the predictive power of people's subjective perceptions of water pollution, as well as their assessments of the threat and coping mechanisms, for two categories of behaviours: environmental and personal health-protective measures.

According to Harris & Guten (1979), health protective behaviours are any actions taken by an individual to preserve, advance, or protect their health. Flushing pipes in the morning to remove any impurities that may have accumulated over night is an example of a water-related health protective habit (Katner et al., 2018). According to Paco et al., (2019), environmental protective behaviours include actions that lessen the negative effects of human activity on the environment, like using less plastic and fertilizer. Although these two categories of behaviour have mostly been studied separately up to this point, there are growing requests to integrate environmental and health perspectives (Bentley, 2014; Graham & White, 2016). In this study, we explore how communities' perceptions of the health implications of water quality in the Steve Tshwete Local Municipality, Mpumalanga Province (South Africa). We are going to use protection motivation theory (PMT), a theoretical framework commonly used to comprehend protective behaviours, to compare and contrast the factors that predict environmental protection and personal health protection. Four essential variables are used in PMT (Maddux and Rogers ,1983) to predict protective behaviours: vulnerability and perceived severity (together, threat appraisal), as well as self-efficacy and response efficacy (together, coping appraisal) (Floyd et al., 2000; Maddux & Rogers ,1983).

In both experimental and survey studies, protective behaviour and behavioural intentions have been associated with threat appraisal factors (perceived severity and vulnerability). Perceived vulnerability is the chance that a person believes they will be injured by a risk (Floyd et al., 2000), whereas perceived severity is the negative con sequences that a person associated with a danger (Miles, 2020). Regarding the relationship between behaviour and perceived severity, a meta-analysis of research on risk messaging discovered that in some circumstances, such as when communicating the dangers of tobacco smoke, higher perceived severity led to greater acceptance of suggested adaptive behaviour or intention (Floyd et al., 2000).

Similarly, when interviewing participants were asked about lead contamination, researchers discovered that greater intentions to engage in health-protective behaviour were linked to higher assessments of the degree of contamination exposure (Cooper et al., 2020). Perceived vulnerability was found to be correlated with parents' willingness to engage in preventative actions in order to prevent water pollution to their children (Lwin & Saw, 2007). According to Lwin et al., parents who believed their child was more likely to become sick because of water contamination also expressed a stronger desire to take steps to keep their kids from getting water pollution. Actual conduct has also been found to be influenced by perceived vulnerability to hazards provided by environmental issues. For instance, Janmaimool (2017) discovered in a study on pro-environmental behaviours in the workplace that people were more inclined to recycle when they believed that environmental pollution could have a detrimental effect on their own health and well-being.

Behaviour and risk perceptions have a complicated relationship. You may not adopt protective behaviours even if you feel vulnerable and think there is a serious risk if you believe that you are not capable of carrying them out (perceived self-efficacy) or that they are unlikely to work (perceived response efficacy) (Bandura, 2000; Floyd et al., 2000). Therefore, in order to better account for people's choices about protective activities, PMT additionally incorporates these two coping appraisal variables. According to numerous other studies, perceived self-efficacy (Westcott et al., 2017; Verkoeyen & Nepal, 2019) and response efficacy (Flynn et al., 1995; Scholz & Freund 2021) can predict protective behaviours and behavioural intents. For instance, response efficacy was a strong predictor of parents' intention to adhere to prescribed medical treatment in a study of preventative actions against muscular dystrophy (Flynn et al., 1995). When it comes to anticipating preventative activities, self-efficacy can be especially significant. The most potent predictor of behavioural intentions that come before actual activity, according to Maddux and Rogers (1983), is self-efficacy.

More recently, PMT has been applied to predict non-health behaviours in environmental situations (Bubeck et al., 2012; Floyd et al., 2000; Martin et al., 2007). Originally, PMT was created to study protective health behaviours (Maddux & Rogers, 1983). However, even when discussing environmental issues, these studies typically concentrate on risk-avoidance behaviours. For instance, Martin et al., (2017) discovered that homeowners' risk-reducing actions, such clearing yard waste, were predicted by their perception of their vulnerability to wildfire-related damage to their personal property. According to Kahlor et al., (2006), many risk issues that endanger our personal well-being (personal risk) also present impersonal hazards, which are dangers that do not directly affect us. This covers a wide range of current environmental concerns. For instance, drinking water, fish eating, and recreational activities like swimming can all be directly threatened by water contamination. However, aquatic ecosystems and the species that depends on them are also harmed by water pollution. The current study examines how PMT characteristics predict protective behavioural intentions in the context of water pollution, both in reaction to impersonal risks (such as environmental threats) and personal risks (such as threats to one's health).

2.8.3 Application of Protection Motivation Theory in South Africa

The application of Protection Motivation Theory (PMT) to water quality and health in South Africa entails evaluating how protective behaviours are motivated by threat appraisal (perceived severity/vulnerability to polluted water) and coping appraisal (response/self-efficacy in treating water) (Roger, 1975). Recognizing water scarcity and contamination, having faith in the effectiveness of treatment techniques (such as boiling and filtering), and being able to put these strategies into practice are important motivators that collectively boost the adoption of safe water practices.

Key Aspects of PMT in the South African Water Context:

- **Threat Appraisal (Risk Perception):** Particularly in places with deteriorating infrastructure, participants must feel personally vulnerable and view poor water quality as a serious threat to their health (such as cholera and diarrheal illnesses).
- **Coping Appraisal (Action Capability):**
  - **Response Efficacy:** The beliefs that certain methods, such boiling water, applying filters, or taking chlorine tablets, can successfully eliminate pollutants.

- **Self-Efficacy:** Self-assurance in one's capacity to regularly carry out these tasks in spite of possible obstacles (e.g., lack of electricity for boiling, high cost of filters).

- **Protective Behaviors:** High threat and coping assessments culminate in actions that safeguard health, such as purifying water, buying bottled water, or reporting problems with water quality.

- **Social & Environmental Context:** Droughts, socioeconomic inequality, and municipal infrastructure failure all have an impact on the perceived costs of adaptation in South Africa.

Application Strategy:

In addition to alerting people to the dangers of poor water quality (raising threat appraisal), effective interventions should offer readily available, reasonably priced, and user-friendly treatment options (enhancing coping appraisal).

3. Key Contextual Applications in STLM

- **Water Conservation Campaigns:** When water levels drop, the municipality should issue campaigns that combine threat (drought severity) and coping (saving 20kl per month) to motivate behavior.

- **Law Enforcement & Civic Duty:** Use the "Batho Pele" principles to encourage citizens to report illegal land use or stolen infrastructure.

- **Disaster Risk Reduction (DRR):** Implement proactive cleanup campaigns and strengthen stormwater infrastructure, which provides tangible evidence that the municipality is acting, increasing trust in the system (UNEP, 2018).

4. Overcoming Maladaptive Responses

Residents may engage in "maladaptive" behavior (e.g., ignoring restrictions) due to "optimism bias" or perceived high cost of change.

- **Penalty Tariffs:** Implement penalties (e.g., R100 per kl for exceeding 20kl) to make the cost of *not* acting higher than the cost of acting.

- **Clear Communication:** Ensure that the benefits of acting (e.g., uninterrupted water supply) are clearly linked to the recommended behaviors (adhering to restrictions).

By focusing on these two pillars—fear appeals regarding the threat and enhancing the community's capacity to act (self-efficacy)—the Steve Tshwete Local Municipality can foster a culture of safety and responsibility to its community members.

2.9 Policy and Legislative Framework on access to water in South Africa

In order to achieve the commitments on water, rights set out in the Constitution of South Africa, several policies, legislation and strategies have been developed by the South African government. Some of the important legislation about the water rights in South Africa are discussed below. The National Water Act (Act 36, 1998) and the Water Service Act (Act 108,1997) are the most important documents that guide the country on how water must be protected and conserved.

2.9.1 Constitution of the Republic of South Africa (Act No. 108 of 1996)

According to the Constitution of South Africa (1996), everyone has the right to clean water. As access to water is a fundamental human right in South Africa, the government has taken steps to guarantee that everyone, including those who cannot afford to pay, primarily the rural poor, has access to at least a minimal level of service. National Water Act (Act 36, 1998) and the Water Service Act (Act 108,1997) are complementary and they provide a framework for the sustainable use of water resource management while allowing improved and broadened service delivery.

Section 1(a) of the Constitution enshrines South Africa's founding principles of equality, human dignity, and the advancement of human rights and freedoms. Everybody's right to adequate water is guaranteed by Section 27, which also requires the state to enact laws and take other actions to gradually realize this right. Additionally, it guarantees the rights to life, human dignity, and equal protection under the law, preventing unjust discrimination in the provision of water services. The rights to a healthy and safe environment and fair administrative action in matters pertaining to water are further protected. Additionally, Section 195 of the Constitution lays out the ideals and standards that ought to guide public administration.

2.9.2 National Water Act (Act 36 of 1998)

Promulgated, 27 years ago, sustainability and equity serve as the primary tenets of the National Water Act 36 of 1998 (NWA), which establishes the legal framework for managing

South Africa's water resources. Based on these principles, the national government, acting through the Minister of Water and Sanitation, is responsible for managing South Africa's water resources for the benefit of all. This includes making sure that water resources are protected, used, developed, conserved, managed, and controlled in a way that considers, among other things, need, equity, redress, efficiency, safety, and growth (Section 2 of the NWA).

A National Water Resource Strategy (NWRS) must be gradually developed by the Minister in accordance with this. The NWRS is a legally binding framework that must be reviewed every five years for the strategic management of water resources at the national level. The goal of the strategy is to offer a framework that lays out the goals and plans of action for the efficient management of water resources at the regional and national levels. Although it does not amount to legislation, it must be implemented by all institutions and authorities that have NWA-related authority (Section 7 of the NWA). 2004 saw the publication of the third NWRS, which was revised in 2013. In response to the National Development Plan, NWRS II is designed to accomplish three main goals: water that promotes economic growth and the eradication of poverty; water that is protected, used, developed, conserved, managed, and controlled in a sustainable and equitable manner; and water that helps the economy and creates jobs.

2.9.3 Water Services Act (Act 108 0f 1997)

The Water Services Act 108 of 1997 (WSA) governs the delivery and access of water as a service, whereas the NWA deals with water as a resource. The WSA's primary goal is to guarantee the right to basic sanitation and water supply, which is essential for securing the constitutionally guaranteed rights to adequate water and a healthy environment. According to Section 1 of the WSA, basic water services are defined as "the prescribed minimum standard of water supply services necessary for the reliable supply of a sufficient quantity and quality of water to households, including informal households, to support life and hygiene."

The WSA recognizes the power of local government to provide water and sanitation services in accordance with the constitutional requirement, as well as the national government's role in assisting and bolstering municipalities in carrying out this mandate. In order to achieve this, municipalities as water services authorities as defined by the Act are required to guarantee long-term, effective, economical, and sustainable access to water services.

The WSA lays out the legal framework for creating water services organizations such as water services providers, intermediaries, committees, and water boards in order to efficiently manage access and delivery of water services. By encouraging efficient management and conservation of water resources, the Act also supports the NWA.

2.10 Conclusion

This chapter unpacked the key concepts related to this research and laid out the important literature on the topic, highlighting the complexity of sources of water pollution and the potential implications to both health and education. The availability of safe and reliable water for all consumers is key to achieving the SDGs and other global goals. But many countries including South Africa still face water challenges.

Community practices to maintain water quality are achieved by a conversation with the government, drinking water service providers, and community members regarding their perceptions of the quality of drinking water and the dangers and advantages to their health that come with it. Establishing drinking water quality standards, monitoring, and managing water resources all depend on an understanding of community attitudes and practices.

Achieving both national and international human rights components for sustainable development in water supply may depend on the acknowledgment of water as a human right. All communities may benefit from a more sustainable water supply as a result. Although water has not been expressly recognized as a stand-alone human right in 33 international treaties, WHO (2023) stated that access to safe drinking water is subject to special requirements under international human rights law. As a result, nations must ensure that all people have access to sufficient clean drinking water.

The following chapter sets out the research design and methodology that was used by this study in answering the research questions. It is followed by the findings and then discussion which is framed in terms of the protection motivation theory.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the research design and methods used to explore community perceptions of the health implications of water quality in Steve Thswete Local Municipality [STLM]. It covers the research paradigm, design, study area, population, sampling, data collection process, data analysis process, trustworthiness, and ethical considerations.

3.2 Research Paradigm

The research paradigm, serves as the driving framework for research and is influenced by underlying worldviews and beliefs (Killam, 2013). These paradigms are made up of fundamental viewpoints that affect how researchers approach the process of knowledge construction. They stand for a group of opinions and beliefs that influence how study findings are interpreted and understood (Khatri, 2020). American philosopher Thomas Kuhn first used the term "paradigm" in a research context in 1962. He described it as a philosophical framework that underpins scientific investigation.

The study used the interpretivism paradigm which makes the assumption that reality is socially produced and that investigating lived experiences, meaning, and context is necessary to comprehend community perceptions. According to Du Plooy-Cilliers et al., (2014), interpretivism emerged as a response to positivism's flaws and restrictions, particularly with regards to its application to the social sciences. A qualitative technique within this paradigm is acceptable because the study investigated the "how" and "why" communities perceive water quality and health risks.

This perspective emphasizes people's ideas and thinking in relation to the sociocultural context. Because the interpretivism philosophy requires a comprehensive understanding of the participant's behaviours, thoughts, and meaning, the researcher actively participates in the study.

Interpretivism was used to investigate how residents within the STLM interpret water quality and its effects on their health, Interpretivism allowed for the recognition of the human perceptions, influenced by socioeconomic status, historical trust in municipal services, and local industrial background, are numerous, subjective, and socially situated, in contrast to

positivism, which views a single, objective trust through quantitative measurement. By taking this approach, the study prioritizes community members' insider perspectives, acknowledging their lived experiences as the main source of information about the health effects of the water they regularly drink.

The philosophical study of how to explore the communities' perceptions of the health implications of water quality in Steve Tshwete Local Municipality and obtained knowledge, verified, and comprehended is known as epistemology in research philosophy. It looks into the basic issues of what constitutes genuine knowledge and how scholars come to know what they claim to know. The techniques, strategies, and procedures that researchers use to study and interpret phenomena are greatly influenced by epistemological factors (Rehman & Alharthi, 2016).

3.3 Research Design

Qualitative research seeks to investigate meanings, experiences, and situations in contrast to quantitative methodologies, which concentrate on measuring and quantifying. (Tilman et al., 2025), a qualitative research design was discussed in the study, highlighting its capacity to capture the complexity of social interactions and the depth of human experience. According to (Tilman et al., 2025), qualitative research is especially useful in fields where questions of context, subjectivity, and interpretation are crucial since it enables researchers to gain a thorough grasp of the phenomena under investigation.

The research approach used in this study was qualitative. Numerical data alone cannot adequately convey the complexity of public perceptions of water safety, which is frequently influenced by institutional narratives and physical indications like taste, colour, and smell. Qualitative research aims to investigate how people perceive a social phenomenon. According to Mahajan (2018), qualitative research is a type of social activity that focuses on how individuals interpret and make sense of their experiences in order to comprehend their social reality. By contrasting, comparing, reproducing, categorizing, and classifying the subject of study, researchers gradually create a sense of a social phenomenon in qualitative studies, which are primarily investigative processes (Creswell & Creswell, 2018). Mkandawire (2019) notes that qualitative design is a subjective method of assessing beliefs, behaviours, attitudes, and social interactions while discussing qualitative data-gathering strategies in research. Community members in the Steve Tshwete Local Municipality were interviewed regarding their opinions of the health implications of water quality. Their

perceptions of the water quality were investigated and how they interpreted what was happening around them and their experience regarding water quality and its health effects.

3.4 Case study

A case study is a thorough, in-depth analysis of a single subject, such as an individual, a group, an organization, an event, a phenomenon, or a problem (Pair & Warren, 2025). This kind of study examines the topic in order to fully comprehend problems in a real-world context by gaining a thorough knowledge within the study's context is the goal; the findings should not be generalized. According to Heale & Twycross (2018), a case study can also be characterized as a thorough, methodical analysis of a person, group, community, or other unit in which the researchers look closely at data related to many variables. To offer a comprehensive, multidimensional analysis of the particular setting of the STLM, a case study design is utilized. In its real-time, local government context, this design is quite useful for investigating a modern phenomenon (perception of water quality). In order to create a thorough understanding of the relationship between infrastructure, environmental elements, and community well-being, it enables the integration of various data, such as community interviews, observed water features, and public conversation.

This type of study looks into the subject to get a thorough understanding of issues in a real-world setting. Here, the objective is to gain a comprehensive knowledge within the context of the study rather than extrapolating the results. Because case study research takes into account the social context and culture, it is qualitative in nature and usually inductive. Case study research, which incorporates the researcher's assumptions and comprehension, is typically informed by interpretivist theory. A case study can be descriptive, exploratory, or explanatory and necessitates in-depth understanding using a variety of data sources. A case study design was used to explore the challenges the Steve Tshwete Local Municipality community have with water quality especially that the municipality is surrounded by mining activities and agricultural practices.

3.5 Study Area

3.5.1 Study Location

Steve Tshwete Local Municipality (STLM) (Figure 6) is in the center of the Nkangala District Municipality region. The municipality is approximately 3,976 square kilometers in extent and forms 23.7% of the Nkangala District region (Steve Tshwete Local Municipality, 2017). The

intersection between the two national transport corridors, the N4 (Maputo Development Corridor) and the N11 (Middelburg/ Bethal/ Ermelo and Richards Bay Corridor) is located in the center of the Municipality, the intersection is viewed as one of the most important features of the Steve Tshwete Local Municipality (Steve Tshwete LM, 2016). Middelburg is the largest town within the municipal area which has a population of 278 749 in 2016 (STLM IDP, 2021), followed by Hendrina towards the south-eastern area. The municipality is home to several large industries such as Columbus Steel, Eskom, the Nkangala District Municipality's head office and various government departments which are located in the town Middelburg.

The Steve Tshwete Municipality area is broken up into four functional areas:

1) Middelburg Town which includes Middelburg and Mhluzi.
2) Steve Tshwete Mining Belt Towns which include Rietkuil, Arnot, Pullenshope, Komati, Blinkpan, Goedehoop, Douglas, Lesedi, Schoongezicht and Bank.
3) Steve Tshwete Power Station towns which include Kwazamokuhle and Hendrina,
4) 4) Steve Tshwete Rural which includes Kwamakalane, Mafube, Doornkop (STLM, 2013).

The Steve Tshwete Local Municipality in South Africa's Mpumalanga Province provides an interesting case study for exploring the effects of water quality on health, for a number of reasons

- Industrial activity: There is a lot of industry in the area, especially mining, which can contaminate and pollute water supplies. Heavy metals are a particular health concern.

- Rural communities: The municipality has communities who live in rural areas with inadequate access to sanitary facilities and clean water. This makes people more susceptible to waterborne illnesses and other conditions linked to low water quality, such as heavy metal contaminations.

3.5.2 Demographic Characteristics

The municipality has a population of 242 031, up 5.0% from 229 831 in 2011, according to Stats SA (Census, 2022). Between 2011 and 2022, the average annual population growth rate was 0.5%, which was marginally less than the average annual economic rate of 0,6 %. Due to population growth, the municipality is now the seventh-largest Local Municipal Area in the province of Mpumalanga, a minor improvement from its eight-place ranking in 2011. The number of industries that emerged between 2001 and 2011 and drew workers to STLM (previously Middelburg) may be the reason for the population's slow growth (STLM IDP, 2024/2025).

3.5.3 Ecological and Environmental Characteristics

The study area is located in the Mpumalanga Province's summer rainfall regions, which have a typical highveld climate with warm summer between 12 and 29 degrees Celsius and cold winter between -3 and 20 degrees Celsius. There are distinct wet and dry seasons in the Mpumalanga Highveld; approximately 91% of the region's mean annual rainfall (600-800 mm) occurs between October and April (Magagula et al., 2024). The topography of the study area is mostly characterized by flat grasslands with rolling rocky zones on top of the escarpment, 1,500-1,750 above sea levels. The area falls within the Olifants Water Management Area. The water management area is characterized by extensive agricultural and mining activities, mostly associated with coal deposits dominating the northern part of the area (DWAF, 2004). The catchment in which the study area falls consist of perennial stream situated on both the eastern and western side, draining towards the major rivers, namely the Olifants and Klein—Olifants Rivers.

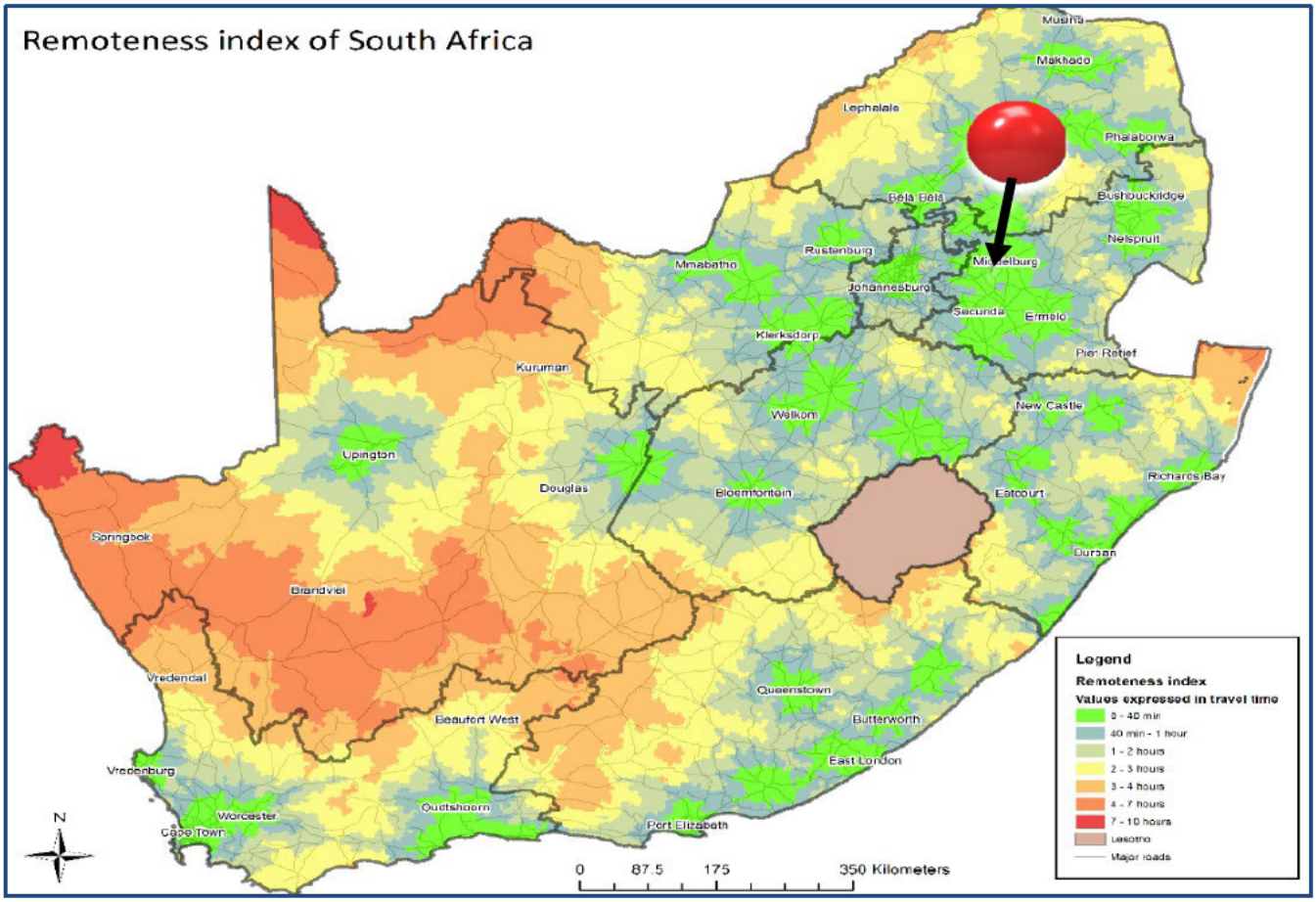


Figure 6: STLM is well located in South Africa in terms of economic access (CSIR, 2019)

3.6 Sample Method

3.6.1 Target Population

A population, which comprises a group of people who share traits within a specific geographic or institutional area, is a fundamental component of research methodology (Martínez-Mesa et al., 2016). The population gives researchers a thorough grasp of the group they are studying, making it easier to investigate different phenomena (Martínez-Mesa et al., 2016). On the other hand, the target population is a subset of the larger population under investigation and is distinguished by particular characteristics or standards that are directly related to the research question (Alvi, 2016). Researchers are able to concentrate their investigations on population segments that are of particular interest or significance because this subset is defined according to criteria that correspond with the goals and scope of the research study (Asiamah et al., 2017; Casteel & Bridier, 2021; Willie, 2022).

The target population for the current study were the resident of STLM, the age group is above 18, environmental health personnel, water professional, local priest and business personnel.

3.6.2 Population and Sampling

The process of selecting a small number of examples from the study population is known as sampling (Babbie, 2007). Correct sampling ensures that the components selected from the target population are representative of the entire population from which the components are drawn. There are two primary types of sampling: probability sampling and non-probability sampling. The probability sampling technique gives each component of the study population an equal chance of being included in the sample, and it is possible to calculate the likelihood that any one of them will be chosen.

Basic random, stratified, systematic, and cluster sampling techniques are all included in probability sampling (Makwana et al., 2023). In non-probability sampling, participants are chosen depending on the researcher's perception and the participants are not randomly chosen. The non-probability sampling methods include convenience sampling, snowball sampling and quota sampling (Makwana et al., 2023). Purposeful sampling was used in this study to select study participants. Purposive sampling, according to Babbie (2014), is the process of choosing a sample based on the researcher's assessment of which participants will be most helpful or representative and have the most pertinent knowledge regarding the topic under study. The aim of purposive sampling is to deliberately choose subjects or locations that will best aid the researcher in comprehending the issue and the study question (Creswell & Creswell, 2018). According to Gill and Johnson (2010), exploratory research enables researchers to carefully choose a sample with a specific goal in mind based on their assessment of the community of interest.

The researcher selected the participants by virtue of characteristics that are thought by the researcher to be likely to have some relevance to the research objectives (Ahmed, 2024). Participants were residents of the Steve Tshwete Local Municipality who depended on municipal water sources. Information-rich cases are individuals or events or settings from which researchers can learn extensively about the issues under examination. Hence the term 'purposeful sampling' is used. In this study the following broad groups of people were identified.

1. Community members: Individual community members from the Steve Thswete Local Municipalities who uses municipal water services.
2. Community leaders: Local leaders, such as ward councilors, traditional leaders, or community organization representatives
3. Water committee members: Members of local water committees or water user associations.

3.6.3 Selection of study participants and sample size

Participants were selected from the community based on inclusion and exclusion criteria mentioned below. The participants with the experiences and knowledge about the health-related issues and water quality around Steve Tshwete Local Municipality were selected. Participants were interviewed until data saturation was reached upon interviewing the fifteen (15) participants, because no new themes, insight, or perspectives emerge from additional interviews. Data saturation in qualitative research is the moment at which more data gathering stops producing new themes, codes, or insights (Tight, 2024). Different aspects of data adequacy are addressed by the various types of saturation. When no new patterns or categories appear during analysis, data saturation highlights the dataset's breadth and guarantees thorough coverage of the topic being studied (Rahimi & Khatooni, 2024; Saunders et al., 2018; Yang et al, 2022).

(Glaser & Strauss, 2017) presented saturation as a crucial stage in theory formation, drawing on grounded theory to guarantee that theoretical constructs are adequately developed and comprehensive. Data saturation, typically works best with small groups of people.

Inclusion criteria involved:

1. Residency: community members residing in the Steve Tshwete Local Municipality for the past 6 months or more.
2. Age: 18 years or older
3. Willingness to participate: Participants should voluntarily agree to participate in the study and provide informed consent
4. Exposure to water resources: Participants who use specific water resources (e.g. municipal water supply, boreholes, rivers) or have experienced water-related health issues.

Exclusion criteria involved

1. Temporary workers visiting Steve Tshwete Local Municipality
2. Tourists within the Steve Tshwete Local Municipality

3.7 Data collection methods

Any method of gathering data can be used by a researcher employing a case study design, including individual in-depth interviews, focus group interviews, non-participant observation, participant observation, field notes, journals, logs, and more (Astalin, 2013). This study used semi-structured in-person interviews to gather data in order to get detailed perspectives and opinions from the participants (Creswell & Creswell, 2018). This approach produced rich and comprehensive data from participants by allowing for flexibility in investigating their responses (Howitt, 2016). In the semi-structured interview schedule questions about the municipality's water supply quality and identifying specifics (gender, age group, and educational attainment) were asked (Appendix 3). The period of data collection was March 2025 through April of 2025. The ward committee introduced the researcher to the participants. The interviews were conducted at the participants' preferred places and were prearranged in order to minimize disruptions. Until the researchers concluded that enough rich data had been collected to adequately answer the research topics, data gathering proceeded in an iterative and reflective manner (Braun & Clarke, 2020) with each interview taking between 30 and 60 minutes. It became clear that no new information was emerging from the data after 15 interviews, leading to the conclusion that data saturation had been reached. To improve data accuracy, all interviews were audio recorded with participants' permission and promptly transcribed using Microsoft Word dictate. Participants' identifying information was concealed during the transcription process using codes, protecting their privacy.

3.8 Data analysis

As recommended by Braun & Clarke (2006, 2014, 2020), data were analyzed using the thematic content analysis following phases. The analysis was carried out using a flexible iterative technique rather than a linear one, which allowed for a thorough examination of the data's patterns. To gain a comprehensive understanding and familiarize oneself with the facts, the first step was to listen to the audiotapes and read the transcripts several times. At this point, preliminary concepts regarding the data were developed with the help of the notes

made during data collecting. In order to find important characteristics and patterns in the data, the author manually coded the data line by line while methodically taking notes and underlining passages. Emerging topics were then developed by sorting and combining different starting codes. After that, pertinent passages from the transcripts that matched the themes were compiled. After then, topics were examined and adjusted to make sure the data produced a cohesive narrative. In addition, the author kept track of codes, reorganize, remove, or combine themes. In order to express the tale each topic tells and how it relates to the larger narrative of the research study, each theme was also carefully examined, defined, and given succinct names and descriptions. Creating a report that provided a succinct and well-organized account of the study was the last stage. This involved contextualizing the results within the framework of the body of current literature and supplying adequate evidence for the identified themes through data extracts. The author remained reflective throughout, admitting that their viewpoints had an impact on the analysis. In order to guarantee a more thorough and nuanced interpretation of the data, the authors also placed a high priority on frequent team talks.

Data analysis was conducted using thematic data analysis method. This entails findings, assessing, categorizing, and summarizing themes in a set of data (Braun et al.,2014). According to Braun et al., (2014) and Nowell et al., (2004), it is a helpful technique for analyzing the viewpoints of various research participants, revealing similarities and differences, and producing unexpected findings. It is particularly helpful for summarizing important aspects of a huge data set since it compels the researcher to treat the data in a methodical manner, which results in a final report that is clear and well-organized (King, 2004). The analysis started with listening to the audio recordings alongside the field notes at the end of each day's interview/discussion session. They were transcribed sequentially on a daily basis. The researcher read through the transcripts, identified recurrent patterns classified as codes and subsequently, similar codes were grouped together as themes.

The following were the steps taken during thematic data analysis of the data of the study:

1. **Familiarization with the Data:**
    - Immersion with the data collected from interviews.
    - Transcribed the audio reading and read the transcripts several times.
    - The objective was to fully comprehend the material and start identifying any early trends.

2. Generating Initial Codes:

- I was responsible for methodically locating and labelling data segments pertinent to the study question.
- Similar to labels were attached to significant data segments, codes help in the organization and classification of information.

3.Generating Initial Themes:

- This stage signifies the transition from individual codes to more comprehensive meaning patterns.
- I begin classifying codes that appear to cluster together, suggesting possible themes.
- Because it's important to understand that themes do not emerge from the data, I intentionally constructed themes based on their interpretation of the coded data.

4.1. Reviewing Themes:

- I had to critically assess the original themes in relation to the coded data and the complete data set.
- Based on this assessment process, I was able to determine whether I needed to improve, eliminate, or even come up with new themes.

a. Refining, Defining, and Naming Themes:

- I was tasked with creating precise and succinct definitions for every subject, capturing their boundaries and scope.
- My objective was to determine the "essence" of each theme and make sure that each one made a unique and significant contribution to the study as a whole
- In order to communicate the themes' main ideas to the reader, I was involved in coming up with clear and evocative titles for them.

b. Writing Up:

- I had to connect the themes in order to provide a compelling and engaging narrative about the data at the end.
- The write-up should do more than just summarize the facts; it should also provide perceptive interpretations, connect the results to previous research, and relate the findings to the study topic.

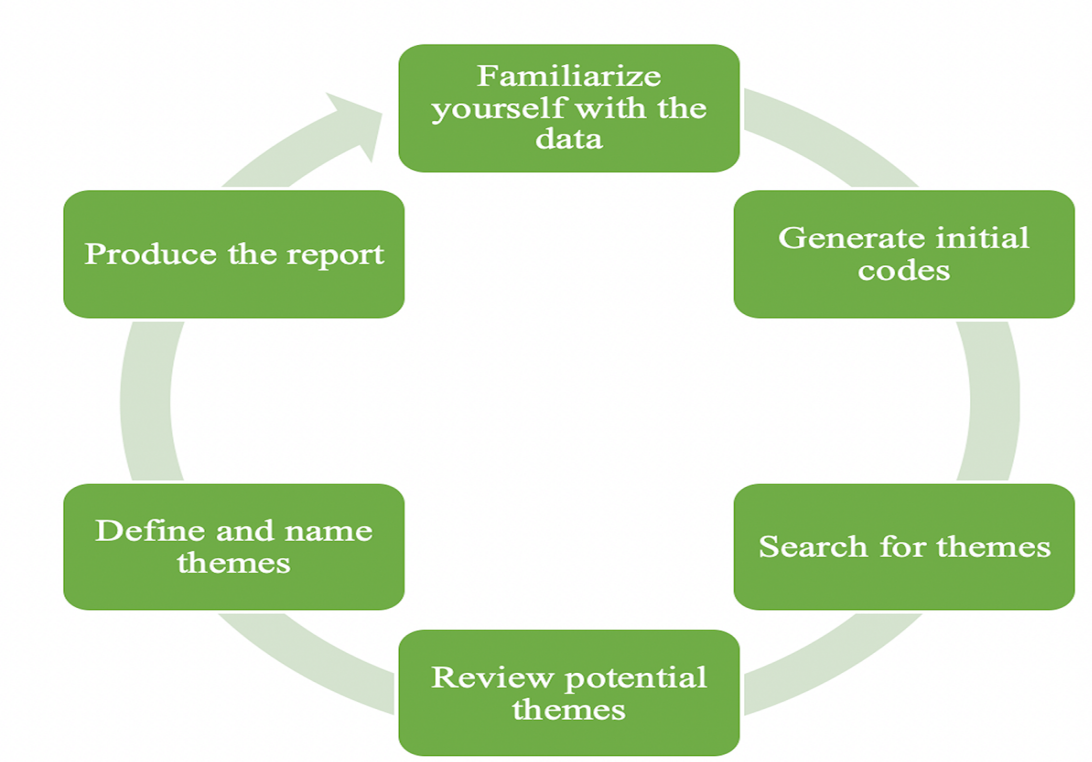


Figure 7: The continuous cycle of Thematic Analysis (adapted from Braun & Clarke, 2006)

3. 9 Trustworthiness

Trustworthiness is the most significant factor affecting the rigour of qualitative research investigations (Amankwaa, 2016; Eryilmaz, 2022). It is widely acknowledged that credibility is necessary for both quantitative and qualitative research designs in order to generalize the results. There are methods for improving credibility in every research design. Researchers' abilities and efforts in the qualitative study are signs of reliability. In qualitative research, transferability terms are substituted for validity and reliability, which are crucial for ensuring the study's credibility and dependability.

Every researcher acknowledges the value of consistency, objectivity, and rigour in their research and works to establish standards that guarantee reliability. One of the most widely used and widely acknowledged standards for the reliability of qualitative research was provided by Lincoln & Guba, (1985). For the current study, trustworthiness was enhanced using a reliable qualitative research approach technique and being conscious of my own biases and points of view while immersing myself in the data. To boost trustworthiness, they highlighted four key ideas: credibility, transferability, dependability, and confirmability (Ghafouri & Ofoghi, 2016; Earnest, 2020; Eryilmaz, 2022; Enworo, 2023; Riazi & Ghanbar, 2023).

3. 9 .1 Credibility

According to Lincoln & Guba, (1985), credibility is the degree to which the study exhibits internal validity and the degree to which the results align with the opinions, experiences, and perceptions of the participants. Semi-structured interviews were employed to increase credibility, and more time was spent to understand the participants' intended meaning. In order to do this, researchers need to invest enough time in understanding the participant's intended meaning. It is essential to engage in close and active communication with the participant in order to regularly confirm their intended message while carefully reviewing every facet of their narrative, activities, and subject matter (Birt et al., 2016). By spotting and fixing any potential misconceptions or errors, it seeks to

eliminate personal prejudice and determine the exact meaning of the participant's narrative (Candela, 2019). According to Brown et al. (2002), credibility is satisfactorily attained when the theory developed is directly based on the data collected from the participants and represents the conditions, dimensions, and levels of their experience with the phenomenon under study. The researcher made sure that participants could freely participate and thus freely share their experiences in order to establish credibility for the current study. As a result, the original facts gathered from participants and their experiences serve as the foundation for the theory that was produced. The researcher employed a semi-structured interview guide that allowed for probing and the identification of recurrent categories, which aided in the collection of rich and accurate data.

3.9 .2 Transferability

A study's external validity is referred to as transferability. It can be established by giving a detailed explanation of the participant's answers and the researcher's interpretation (Stahl & King, 2020) as well as the extent to which the study's findings and conclusions can be applied to various settings or contexts. For a study to be transferable, a thorough research overview that includes participant selection, setting, techniques, and contextual information must be provided (Findley et al., 2021). For the current study transferability will be achieved beyond the study findings if the contexts, setting, or populations are applied or adapted.

However, the study's transferability is determined by the readers' awareness of the details and their ability to apply or alter the knowledge to a similar circumstance (Maxwell, 2021). To decide whether the results should be applied to the sampled population or environment or to other populations or settings, it is vital to differentiate between the two concepts of generalizability and transferability (Maxwell, 2021). Transferability was used in the current study since the qualitative research approach as employed in the study's findings. According to Du 42 Plooy-Cilliers et al., (2014), transferability is the ability of the findings and analysis to be used to a similar situation and produce similar findings. According to Brown et al. (2002), a thorough explanation of these ideas helps future

researchers decide how the study might be applied practically in different contexts. To help readers decide whether the findings may be applied in different contexts, the researcher in this study provided a thorough description of the research population, context, participants, research methods, and emerging theory.

3.9 .3 Dependability

The sustainability of the results over time is referred to as dependability (Korstjens & Moser, 2018). In the present study dependability was achieved by incorporating data collection method, data analysis and data from the literature review from different authors. In order to guarantee the reliability of a given study, the researcher must meticulously record every stage of the procedure to make sure that nothing is overlooked, as any missing information could compromise the reliability of the study's conclusions. The methodologies employed, the procedure for gathering data, and the analysis should all be included in the documentation. When the study can be repeated using the comprehensive log, it can be considered reliable (Roberts et al., 2019). Furthermore, if the results of the duplicated studies closely match the study, it suggests that the study has a high degree of reliability and credibility (Nyirenda et al., 2020). To ensure reliability, the researcher in this study gave comprehensive information regarding the data collection and analysis process as well as the research design. Additionally, the researcher was supervised by two senior research supervisors during the whole research procedure.

3.9 .4 Confirmability

Confirmability is the standard by which a study's conclusions are solely based on participant replies and unaffected by the biases, motives, interests, or opinions of the researcher (Connelly, 2016). It has a high correlation with the qualitative works' believability. The degree of confirmability is increased when the participant is involved in the validation process of the collected data, also known as member checking, which helps to guarantee that it correctly reflects their actual opinion. The researcher must also

engage in reflexivity, which entails continuously being aware of their own prejudices (Olmos-Vega et al., 2023).

It is important keep neutrality when analysing the study's findings and to stop these biases from affecting the data gathered. In the present study of communities' perception of the health implication of water quality in the Steve Tshwete Local Municipality, confirmability was achieved by describing the research method in detailed which includes data collection, findings and analysis, to help other researchers reach findings that are comparable to the researchers. To confirm the interpretation of the results, it is also advised to look for a third viewpoint or participate in peer debriefing. It is to guarantee that the participant's intended meaning is precisely recorded and that the researcher's personal prejudice is removed (Simoni et al., 2019). Throughout the study, the researcher regularly used notes and maintained a secure record of the raw data and coding. Additionally, by developing the theory just using the participants' raw data, the researcher preserves objectivity.

3.10 Ethical Considerations

While ethics are the rules and laws that support people in upholding their values, research ethics are a set of guiding principles that assist researchers in conducting ethical investigations, (Christensen & Johnson, 2011). Anonymity, participant harm, confidentiality, and informed consent are ethical considerations that the researcher should constantly keep in mind when conducting any research and this study is no exception.

The IIEMSA research committee provided ethical approval for the study (see Appendix No.5). There were no rewards for the study participants; participation was entirely voluntary. The informed consent as given by each participant and forms were signed by each participant.

3.11 Written informed consent

The research project was explained to the participants before they agreed to participate in the study. The steps involved in conducting the research, gathering data, and using that data were all thoroughly discussed.

According to Vanclay et al., (2013), participation must be voluntary and based on a complete understanding of the research and the ramifications of their involvement in order for participants to give their informed consent. This implies that the researcher must disclose all relevant information and potential risks of involvement, especially those related to the future of the data obtained.

Respecting participants was essential. Vanclay et al., (2013) state that researchers should always treat participants with respect by not criticizing or judging them and by ensuring that their ideas are appropriately recorded and taken into consideration throughout the evaluation process.

3.12 Voluntary participation and participant anonymity

Participants were informed that participation in this study was completely optional, completely impartial, and not mandatory. Participants were informed that they could discontinue participation at any time. This was also included in the consent form (see Appendix No.1). It was also made clear that there were no rewards or compensation for participating in the study. The consent and participation form were clear that participants' anonymity would be preserved, meaning that their responses won't be connected to their names going forward.

Furthermore, Vanclay et al., (2013) note that voluntary engagement needs to be free from coercion or the possibility of negative consequences for not participating. Payment for involvement is not prohibited by the lack of coercion, but it must be reasonable given the participants' time and usual income expectations and cannot be so large as to be considered an improper enticement or bribe.

3.13 Confidentiality

Certain participants may occasionally be connected to particular pieces of information throughout the data collection process. Even though it is known to the researcher who said what, the researcher attempted to ensure that the information was kept as confidential as possible for the objectives of this study. Private or personal information or viewpoints were not revealed.

Additionally, participating in this study carried no risk. Interviews took place place at each participant's place of employment at a time that suited them.

3.14 Limitation of the research

Any restriction or constraint that may have an impact on a study's internal validity, external validity (generalizability), concept validity, or statistical conclusion validity is technically referred to as a research limitation. The range of conclusions that can be made from the obtained results is intrinsically limited. These limitations are intrinsic to the research process because of practical limits, the nature of the phenomenon being examined, or the limitations of existing methodology; they are not necessarily defects in the research design (CLRN team, 2024).

Therefore, these might have affected the depth of the responses because of the time or logistical constraint. Also, the varying levels of some of the participants' familiarity with the management of water department may have influenced the responses as some of them were water professionals at the time of the interviews. All the participants are educated and this left out responses from members of the community who are not educated.

3.15 Conclusion

The research design and methodology utilized to collect data for this study has been described in this chapter. The study's goal was to explore the people of the Steve Tshwete

Local Municipality perceive the health effects of water quality. Semi-structured interviews were used to achieve this. Interviews were conducted with fifteen (15) Steve Tshwete Local Municipality participants. All participants gave their voluntary consent, and the research was conducted in accordance with all applicable ethical guidelines. The next chapter details the findings of the study.

CHAPTER 4: FINDINGS

4.1 Introduction

The finding from the study explores community perceptions of health implications of water quality in Steve Tshwete Local Municipality. A total of fifteen participants took part in the interviews, seven males and eight females. A semi-structured interview was chosen to gain insights from the participants. After the data was collected, thematic analysis was used to analysed the data. Data analysis started with listening to the audio recordings alongside the field notes at the end of each day's interview/ discussion session. These were then transcribed with the assistance of dictate on Microsoft word.

Participant quotes have been presented to support the main findings. Six themes were identified from the process, knowledge, attitudes and practices of the community on health and quality of the water, perceptions of the community regarding water quality and its impact on health, community members experiences on water-related health issues, factors affecting the community's perception of water quality risks, the plan for the developing recommendations to enhance the health education and water quality and infrastructure for water quality development in response to population growth and urbanization. The chapter has been organized under these themes.
Demographic information from the study participants is presented in the table below.

Table 1: Characteristics of study participants

Participant No.	Age	Gender	Education	Employment Status
1	36	F	B.SC	Employed
2	32	F	N. Diploma	Employed
3	30	F	E. Health	Employed
4	38	M	B. Tech E.H	Employed
5	53	F	N. Diploma	Employed
6	45	M	Diploma	Employed
7	37	F	Grade 11	Contractor
8	48	F	Masters	Employed
9	51	M	Masters	Employed
10	34	F	B.Eng. Degree	Employed
11	40	M	Matric	Employed
12	60	M	Honours Degree HRM	Employed
13	34	M	B.SC Degree	Employed
14	63	M	Matric	Self Employed
15	47	F	Master of E. Health	Employed

4.2 Demographic characteristics of the participants

Fifty three percent of the participants (eight) that participated in the study were female and forty seven percent of the participant were male (seven). A slightly higher number of female participants aligns to the overall community demographic profile as there are more women than men. It is also often females that use water more than males.

All the participants were employed and were residents of Steve Tshwete Local Municipality at the time of the interviews. The lowest qualification was grade 11 and highest qualification were master's qualifications. The results of this study show how

people in the Steve Tshwete Local Municipality, Mpumalanga, South Africa, perceive the health effects of the water quality.

Six themes were identified during the data analysis process and presented one by one below:

1) Knowledge, attitudes and practices of the community on health and quality of the water.
2) Perceptions of the community regarding water quality and its impact on health.
3) Community members experiences on water-related health issues.
4) Factors affecting the community's perception of water quality risks.
5) Recommendations to enhance health education and water quality.
6) Infrastructure for water quality development in response to population growth and urbanization.

4.3 Theme: 1) Knowledge, attitudes and practices of the community on health and quality of the water.

According to Badran, (1995) knowledge is the acquisition, retention, and use of information or skills. Cognition is the process through which knowledge is acquired and used by people in everyday life. It allows people to make sense of information which leads to understanding and knowledge (Badran, 1995). Knowledge accrues from both education and experience. The community's knowledge, attitudes and practices (KAP) of water quality and health refer to the collective awareness, beliefs, and behaviors of people within a geographic area concerning the safety of their water and how those factors relate to their well-being. Each of the KAP is a sub-theme under the theme 1.

4.3.1 Sub-theme 1: Knowledge of the source of water pollution

Knowledge in relation to water refers to an individuals' range of understanding and practices related that inform their interactions with water (Ge & Liu, 2022). Sumaya,

(2022) suggests that knowledge controls environmentally friendly behavior and attitudes as a conditional and situational aspect.

The community members were asked about their knowledge, attitudes and practices of water quality and health impacts in the Steve Tshwete Local Municipality. Knowledge is about what the community knows and understands about water quality and health. Knowing the sources of water pollution in the community and understanding the causes and symptoms of waterborne diseases demonstrates knowledge (e.g. diarrhoea, cholera). From the data collected, levels of knowledge, regarding sources of water pollution varied in the community. Participants responded differently indicating that they have different knowledge and understanding of the main sources of water pollution. How a community perceives the threat depends on their understanding of mining pollution or the deterioration of municipal infrastructure. Their threat appraisal will be more active if they are aware of acid mine drainage or bacterial outbreaks.

The participants mentioned sewage spillage, waste water spillage industrial influence as well as mining activities as some of the sources of water pollution in the community;

Sewage spillage from the manhole and sewage discharged to the river and discharge from the mines, the waste from the mines. (Participant 1)

I think it's sewer, waste water spillage, industrial and mining activities and illegal dumping and littering within our municipality. (Participant 5)

The main water pollution, I will answer this in two folds, within the community it's the blockage, sewer blockages that spill over into our streams, nearby streams and these are caused by all the foreign objects that communities are dumping into our sewer systems and as a result they cause blockages, blockages cause spillages. The spillages you know leads into our streams and the second like I said, I'm going to answer in two folds. The second problem that we encounter, this is a mining town, there's a lot of sulphates from

disused mine. So, as a result, they pollute our source, and finally getting into our source, which is a dam. (Participant 9)

So firstly, I would say the industrial and mining spillages as well as the sewage spillage into our water streams and lastly, I will say the agricultural sectors in terms of fertilizers when there are the runoffs. (Participant 12)

These responses by participants show a good level of knowledge of various causes of water pollution in general as well as good knowledge of what is happening in the community/ town with regards to water pollution.

4.3.2 Sub-theme 2: Attitudes of participants towards water quality

An attitude is a way of thinking or feeling about something. (Erhabor, 2023) In this study attitude is regarded as the community's feeling, beliefs, and perceptions towards water safety and health practices. Sumaya, (2022) found that attitudes either impact pro-environmental behavioral intentions positively or negatively. Perceived severity, or how serious they believe the health concerns are, and perceived vulnerability, or how likely they believe their family is to become ill, both influence attitudes. This is significantly mediated by institutional trust.

Some of the participants attitudes towards safe drinking water and health impacts are highlighted below:

Clean safe water is important for human health, environmental sustainability, which protect ecosystem. (Participant 1)

Drinking the safe water, I think it help us actually not to have those diseases that are caused by contaminated water. It is very important to consume for our health. (Participant 4)

It is extremely important to have access to clean water as you know, dirty water affects our health. So, it is extremely important that we have healthy potable water. (Participant 9)

Participants have positive attitudes toward water quality because they are knows of the benefits of safe drinking water for their health and wellbeing as well as for the environment protection.

4.3.3 Sub-theme 3: Practice of participants to address water quality

Practice demonstrates the acquisition of knowledge (increased understanding of a problem/disease) and any change in attitude caused by the removal of misconceptions about problems or disease that translates into preventive behaviors (Benner, 1982:402-407). In this study, questions were asked to participants around the frequency of checking water for visible signs of contamination and the use of water treatment and purification techniques in the home. When a community weighs response costs (such as the expense of purchasing bottled water or the energy cost of boiling water during load-shedding) against their self-efficacy (feeling capable of treating the water), the actual protective measures they take are fully reliant on their self-efficaciousness. These acts of checking represent examples of practice or action taken by individuals. Specifically, they noted that;

Mostly I check every day when I'm opening my water, I just try to flush out. Maybe 4-3 minutes before you using and if it's for consumption (Participant 2)

I always make sure that whenever I consume water, I use a glassware. I check the turbidity and also the foreign object inside the water to makes sure that whatever that is going through my stomach is of a good quality. (Participant 4)

By using filters in our tap water. (Participant 11)

Because the participants looked for any visible signs of water contamination and actively took measures to identify risks, these actions were a practice. These practices also resulted from participant knowing that good water quality practices will reduce their risk of contracting a waterborne illness for example.

4.4 Theme 2: Perceptions of the community regarding water quality and its impact on health.

The community's perceptions of water quality refer to the shared belief and understanding that people have about the safety, purity, and aesthetic properties of their drinking water (Maruapala, 2012).

Regarding health impact, this perception is crucial because it directly influences the community's behavior and decisions about water usage, which can significantly affect their outcomes.

Community perception of water quality acts as a mediator between the actual water quality and the community's subsequent health practices and status. Understanding this perception is vital for public health officials to design effective water management, risk communication, and behavioral change campaigns.

The participants perceived the water quality to be poor because of high content of minerals in the water pipes as well as industrial waste and mine waste;

Reaction of different chemicals in our water or reaction of the high content of mineral in our pipeline. (Participant 1)

the agricultural runoff; mostly the industrial waste; mines there are too many in Middleburg, they release heavy metals, chemicals and toxins into water sources (Participant 2)

Pollution, air pollution, soil pollution. water pollution and the pollution because of the industries and also the human behavior (Participant 4)

A small number of participants mentioned that they thought some health problems were caused by poor water quality and these include diarrhea, headaches and skin rash.

The health problem was just with diarrhea and the headaches. (Participant 3)

The salts in the water, the level is high after drinking the water, I feel like I want to vomit, but it doesn't happen that I've vomited, skin rash (Participant 6)

The participants shared their own personal experiences of health-related impacts which they associated with the community water quality.

4.5 Theme 3: Factors affecting the community's perception of water quality risks

The "factors affecting the community's perception of water quality risks" refers to the diverse elements that shape a community's subjective evaluation of the dangers associated with their water supply.

This perception is not solely based on objective, scientific water quality data, but instead a complex interplay of sensory, social, cultural, psychological, and demographic factors that influence how safe or unsafe people feel their water is (Doria, 2010).

One of the factors mentioned by participants was access to information about water quality. The community does not appear have enough information about water quality.

Access to information about water quality affects my perception, because, if I understand water quality then that can impact me positively where I know that, I can raise awareness to the next person (Participant 2)

It's a law that the information of the municipality should be available to the community. The municipality should be transparent about the information because whatever we give to them is what they are pay. (Participant 6)

Other factors mentioned were cultural and traditional practices by the community. The participants believed that these practices introduce unwanted substances or unclean objects into the rivers, thereby, affecting the quality of water. It is believed that the community members do not know that some of their practices can reduce the water quality.

Cultural and traditional practicing can impact the quality of the water by the substances which they add into our water (Participant 1)

By making our water dirty some of them they are using things that are not healthy for our water to be used. (Participant 10)

The biggest problem is information the people does not know what influence their actions have on a river system (Participant 14)

Awareness and education together with cultural practices seem to be the main drivers that influence the communities' perceptions of water risks. A lack of knowledge and awareness can lead to communities being vulnerable to poor water quality and its associated health impacts.

4.6 Theme 4: Community members experiences of water-related health issues

Community members experiences of water-related health issues are far more than just getting sick, it encompasses a complex array of physical, psychological, social, and economic burdens placed upon individual and the entire community (Seretlo-Rangata, Sodi & Govender, 2025).

These experiences are often magnified in vulnerable populations (such as children or elderly), creating significant health equity issues.

The health problems experienced by participants or family members related to drinking water quality are mentioned below.

One time as well we cooked food and we also got sick and I think it's because of the water that was used in the food (Participant 3)

Those Hammaskraal communities, those health problems, were as a result of the quality of their drinking water. (Participant 8)

Some participants mention specific types of health problems experienced.

The salts in the water, the level is high after drinking the water, I feel like I want to vomit, but it doesn't happen that I've vomited, skin rash (Participant 6)

Basically, diarrhea from feedback from my people working for me and then maybe myself sometimes when I take a shower, my skin gets itchy (Participant 14)

Some participants have had direct health related experiences which they associate with the quality of the water in the STLM. When participants know how water quality can affect them health wise, they can make better decisions about their water practices.

4.7 Theme 5: Recommendations to enhance health education and water quality.

The ultimate goal of such a plan is to enhance public health by reducing waterborne diseases and promoting healthier behaviors related to water use.

Participants were asked during the interviews for suggestions on ways to improve water quality in their community. Participants mentioned education and awareness, new technology and the maintenance of the plant process equipment as being. important.

To raise awareness to the community to engage them. Focus more on the maintenance of the plant or improve our technology (Participant 2)

We need to educate our people that you know small things like sanitary pads don't go into the sewer system (Participant 9)

Adding education is still key. It's stricter bylaws and fines to, especially to the transgressors. (Participant 15)

The role played by community-based organizations and advocacy groups in promoting water quality and health education was also mentioned as important**.**

They are engaging directly with communities, raising awareness, policy changes, debates to implement solutions, teach the kids in the community how to reduce pollution, dispose of waste and preserve your water. (Participant 5)

Educate the community leaders and they can also do their part in the sense that they can have meetings with the community and stress the fact that they must not pollute the rivers, because at the end of the day it's also their drinking water. (Participant 14)

During interviews, participants mentioned that in order for the water system to function effectively, proper maintenance according to schedule should be the first priority. This

would minimise sewerage and waste water leaks into the water. They mentioned that the community has to get involved with the issues that affect them and that awareness and education were important. Specific messages could be disseminated to the community using various media platforms for example.

4.8 Theme 6: Infrastructure for water quality development in response to population growth and urbanization.

During the interviews participant were asked what they thought were some of the ways of improving the quality of the drinking water through infrastructure were. They indicated the following:

Advocate for improvement of policy and improvement of infrastructure, such as upgrading water treatment, reticulation and fixing pipeline (Participant 1)

To raise awareness to the community and to focus more on the maintenance of the plant or improve our technology. (Participant 2)

To reduce pollution from the source to promote sustainable land management and invest in water Infrastructure upward. Proper processing of this water in the plant before the municipality distributes to communities. (Participant 9)

Participants mentioned that infrastructure needs to be upgraded and maintained to prevent leaks and spills but also to prevent vandalism from taking place. Regular maintenance is important especially to accommodate population growth.

4.9 Conclusion

The findings from the study indicate that participants in the STLM have varied understandings of the causes of water pollution in the community/town but overall have a good understanding. Participants know the importance of clean drinking water and some undertake practices to check the quality of their drinking water. Concerns about

waterborne diseases (such cholera, diarrhea, or digestive problems) and the long-term toxicological impacts from mining heavy metals arise when communities perceive their water is of poor quality (Ngema et al., 2024). Many participants perceived the water quality of STLM to be poor because of the high content of minerals in the water pipes as well as industrial waste and mine waste. Some participants shared their own personal experiences of health-related impacts which they associated with the community water quality. The community does not appear have enough information about water quality and wanted more, from education, awareness and from the municipality. Participants mentioned that infrastructure needs to be upgraded and maintained to prevent leaks and spills but also to prevent vandalism from taking place.

The next chapter discusses some of these findings.

CHAPTER 5: DISCUSSING THE FINDINGS

5.1 Introduction

The discussion of the findings is the main topic of this chapter. The purpose of the study is to explore the communities' perception of the health implications of water quality in the Steve Tshwete Local Municipality. The findings of the study include six themes and these are knowledge, attitudes and practices of the community on health and quality of the water, perceptions of the community regarding water quality and its impact on health, factors affecting the community's perception on water quality risks, community members experiences on water-related health issues, the plan for the developing recommendation to enhance the health education and water quality and infrastructure for water quality development in response to population growth and urbanization.

5.2 Knowledge, attitudes and practices of the community on health and quality of the water.

A community's knowledge pertains to their comprehension of a particular subject, in this case the water quality and health. Their feelings and any preconceived notions they may have about this topic are referred to as their attitude. Practice is the term used to describe how they act to show their attitude and level of knowledge (LCIF, 2020). The local municipality of Steve Tshwete is surrounded by a number coal mines and agricultural communities. These according to the participants are the main sources of water pollution in the community. Studies have shown that the impact of unrehabilitated abandoned mines on acid mine drainage can leave water sources with high levels of manganese and sulphate (Akinwekomi et al., 2022; Baloyi et al., 2023).

Knowledge of the source of water pollution.

One of the most important components of resolving water-related issues in the community is knowledge and comprehension of those issues. Models of environmental citizenship (Dobson, 2007; Aslin & Lockie, 2013), water-related engagement (Dean et al., 2016), and environmental literacy (NEEF, 2015) all place a strong emphasis on knowledge. It has been suggested that increased knowledge of water quality and health enable members of the community to participate in problem-solving and innovation (Davies & Simon, 2012). The knowledge of water quality and health and the ability to use this knowledge to make decisions are integrated into the idea of "water literacy" and other types of literacy, such as health literacy (Daugh,1984; Nutbeam, 2008). Assessing a person's level of water quality knowledge is crucial for several reasons. Initiatives that interact with communities are thought to be more successful when they are focused and in line with what the communities already know (Commonwealth of Australia, 2012; McDuff et al., 2003; Buhr & Wibeck, 2014). Furthermore, determining the advantages and disadvantages of community's water quality and health knowledge provides a crucial starting point for programs that seek to raise awareness.

Attitudes of participants towards water quality

Regarding the attitudes of communities towards water quality, this study shows that participants have positive attitudes towards primary source of their drinking water quality. Participants mention positive attitudes like using filters at tap water and boiling the water before use if you suspect anything on the drinking water quality from the tap. Numerous characteristics, such as participants' educational level, gender, employment status, and ethnicity, affect the attitudes toward water quality. Participants mentioned that small things like sanitary pads shouldn’t go into the sewer system because they will cause blockage and spillage on the sewer networks. The participants listed education to community members especially ward councils and ward committees about water quality testing and monitoring of water distribution networks. This is similar to the findings in the

Roodeplaat Dam study which shows that highly educated people have a tendency to think that the water quality is poor, and their opinions are related to gender (Maruapula, Yessoufou & Modley, 2023). It has been shown that attitudes might have a favourable or negative effect on non-environmental behavioural intentions (Sumaya, 2022).

During the water crisis, Amnesty International (2020) reported a "complete loss of trust" in Giyani. Similar rejection of municipal messages was discovered in Harare by Nhapi (2009). Hanna-Attisha et al. (2016) shown how government denial increased community mistrust in Flint, Michigan.

Periurban Accra inhabitants were "forgotten" by the government, according to Amoah and Agyei-Mensah (2016). In Lusaka, Simatele and Binns (2008) referred to this as a "culture of coping." Rollins et al. (2002) also discovered gendered self-reliance in rural KwaZulu-Natal.

According to Ferrer & Klein, (2015), health-related information, awareness, and health risk perceptions or how a person views a health threat are significant factors that influence health behaviours and are part of behaviour change theories. The general idea is that a person's thoughts and feelings (such as perceived risk, worry, concerns, confidence, and trust) and the social processes that shape these feelings will either encourage or discourage them from implementing a particular behaviour (Brewer et al., 2017).

By identifying new practices and strengthening the positive ones that already exist, behaviour change interventions are essential to achieving sustainability in communities. It addresses multifaceted community issues that necessitate significant changes in human behavior with regard to long-standing habits, social interactions, physical activity, and health, and is regarded as essential to the pursuit of a sustainable future (Yusliza et al., 2020). According to Schroé et al., (2020), behavior change in individuals and communities is a consultative process that is classified into two genres: initiating behavior change and maintaining the changed behaviour. This process is regarded as a locus of change. According to Desai et al., (2020), it offers motivation and information to achieve extraordinary knowledge of current realities, covers behaviour modeling, increases individual self-efficiency, and guarantees people's empowerment both locally and

nationally. Integrated behavior changes interventions focus on many facets of life, including health, nutrition, water, sanitation, and hygiene (WASH) practices, and community sustainability. Behaviour change interventions are thought to be crucial for enhancing living conditions and achieving sustainability in communities, given the growing concern over human life quality and community development (Dickin & Gautam, 2019).

Practice of participants to address water

This study shows that participants check for visible signs of contamination in their drinking water on a daily basis. Practices are the observable actions of an individual in response to a stimulus (Gumucio, 2011). The acts and behaviours people display in response to their knowledge and attitudes are referred to as practices (Gumucio, 2011). These can include following prescription guidelines and making lifestyle decisions that have an effect on one's health. Through the analysis of practices, KAP research uncovers actual behaviours, allowing for customized treatments to promote desired health outcomes (KAP research, 2025).

Due to supply disruptions, the Department of Water and Sanitation (2021) reported that JoJo tanks were widely used in Mbombela, Mpumalanga. The Department of Health (2016) discovered little chlorine uptake in Bushbuckridge because of taste and expense.

The degree of awareness of the issue, the persistence of these health issues, and community beliefs and practices regarding drinking water-related health hazards are all related.

5.3 Perceptions of the community regarding water quality and its impact on health.

The perception of the community members was that the water quality was poor because of the probable high contents of minerals from farming and mining activities that release

heavy metals into the water sources. Other elements mentioned where the deposits dis inside the distribution water networks system and reservoir. The community has mentioned that coal mines, stainless-steel factory (Columbus Stainless) and farms (maize, beans and peanuts) because of fertilizers and pesticides were the main sources of water pollution. Participants mentioned that health impacts of water pollutions were diarrhoea, headaches and skin rush. Accordingly, perception is a sophisticated psychological process that identifies, arranges, and interprets sensory data from humans to create a meaningful image of the cosmos (Amodu et al., 2022). Thus, the notion of homes is a primordial way for humans to interact cognitively with their surroundings. Communities are more likely to feel a sense of ownership and trust in their water supply if they are aware of the quality of their water and know how to manage their water sources (Malcolm et al., 225). According to Nkuna & Okem, Acid Mine Drainage AMD plays a significant role in influencing perception in Emalahleni and Steve Tshwete. Color and smell are linked by communities to mining and health hazards (Nkuna & Okem, 2018).

Nhapi discovered that the best indicator of people's perceptions of water as dangerous in Zambia's Copperbelt was being close to mines [Nhapi, 2009]. In Ghana, the sense of risk was twice as high in "galamsey" areas as in non-mining areas (Aubynn, 2009).

Even before test results, Flint, Michigan's transition to Flint River + old lead pipes led to a perception of "poison water" (Hanna-Attisha 2016). According to Hrudey and Hrudey (2007), infrastructure age is a global perception element.

The findings showed that the community's view of the health effects of water is divided into two categories under the STLM: visibility and immediacy. Because they lack an aesthetic trigger, chronic chemical risks from regional mining operations are psychologically decreased, whereas acute microbiological threats induce high threat appraisals due to immediate sensory signals (colour and odour). In the end, structural socioeconomic hurdles raise response costs even in areas with high health worries, pushing lower-income residents into a fatalistic risk-minimization condition where they now drink contaminated water since the cost of prevention is too high.

The participants' perceptions about the water quality also come from the fact that they see many people from the community making the water dirty by the rubbish that they

dump there. However, this might not have any influence on the quality of water that goes into the various houses as the water would have been purified before it is reticulated. In the absence of real water quality problems, trust may erode and negative perceptions may arise if communities are excluded from the decision-making process and information about water quality (Mishra et al., 2024). Therefore, when tackling the intricacies of water resource management, it is important to grapple with the unique traits of various communities and stakeholders (Okumah, Yeboah, Bonyah, 2020). The participants said that health education about WASH to primary and secondary schools will help the community to eliminate or reduce water contamination.

Unsafe water and sanitation are responsible for 829,000 deaths each year, according to the World Health Organization (2023). The Department of Health discovered that 62% of Bushbuckridge households associated illness among children with contaminated water. According to Hanna-Attisha et al. (2016), children's obvious illnesses in Flint influenced people's perceptions of health risk. According to Perreault (2006), risk perception is political as well, which is consistent with STLM code EQ_spatial_inequality.

Poor water, sanitation, and hygiene (WASH) have a significant impact on poverty reduction, impairs economic and social development, and impacts all facets of health and development (Boschi-Pinto, Velebit, & Shibuya, 2008). By enhancing WASH habits, many communicable diseases can be effectively managed. The prevalence of waterborne diseases can be decreased by putting the three main WASH practices into practice. Hand washing with soap at crucial times and properly disposing of waste can lower the occurrence of waterborne illnesses by 30% and 40%, respectively. Similarly, waterborne disease prevalence can be decreased by 30 to 50% by safe drinking water treatment and storage (UNICEF, 2016).

Pollution, inadequate sanitation, and contamination of water sources by heavy metals, industrial waste, pathogenic bacteria, and other toxins are all contributing to the world's declining water quality and possible health hazards (Lin, Yang & Xu, 2022). Because it affects the availability of clean drinking water and raises the danger of waterborne illnesses, water quality has an impact on human health worldwide (Pandey et al., 2018). Chemical pollutants, microbial contamination, and climate change are all contributing

factors to the global decline in water quality, with low-income and developing nations being particularly vulnerable because of their poor infrastructure and sanitation (UNESCO, 2022).

Nkuna and Okem (2018) reported skin irritation and recurring diarrhea in Emalahleni associated with AMD. According to the Department of Health (2016), Mpumalanga has an 18% prevalence of U5 diarrhea. According to Kumpel and Nelson (2016), diarrhea following disruptions was reported by 42% of Nairobi households. Aubynn (2009) and Nhapi (2009) reported illnesses associated with mining. According to Howard et al. (2010), diarrhea is two to three times more common with intermittent supplies worldwide. According to WHO (2023), contaminated water causes 485,000 diarrheal deaths in LMICs each year.

In South Africa's informal settlements, high levels of E. coli, Salmonella, and heavy metal contamination are caused by fast urbanization, inadequate waste management, and deteriorating infrastructure (Mudau, 2021). The frequency of diarrheal illness is 40% greater in informal settlements, underscoring the critical need for better sanitation and water treatment methods (Johnstone et al., 2021).

The public's perception and comprehension of water quality frequently deviate from scientists' and policymakers' objective assessments (Eden, 1996; Pacione, 2003; Doria, 2010). This discrepancy may lead to reduced policy support, less water-related practices, and public opposition to important water projects (Nelson et al., 2023; Grey et al., 2013). The process by which people select, organize, and interpret sensory data to create a cohesive picture of their water quality is known as water quality perception (Auslander & Langlois, 1993; Heekeren et al., 2008; Hu et al., 2011; Alhassan and Kwakwa, 2013). According to Toby et al., (2024), it combines a person's experiences, deeply held cultural beliefs, educational background, and dominant media narratives.

5.4 Factors affecting the community’s perception of water quality risks

The community's perception of the water's quality is influenced by taste, smell, and colour. When participants see that the water is brown, they think it is unsafe to drink. The aforementioned organoleptic factors are further influenced by deposits in reservoirs and the network, as well as salts in our raw water that come from mines. Different studies have shown that communities' perceptions of drinking water quality are influenced by a variety of factors, including perceived control, past experiences, trust in the water service provider, contextual factors, peer and media influence, colour, water taste, appearance, and demographic variables (Benameur et al., 2022; Delpla et al., 2020). However, these views are shaped by a variety of sociocultural, sociodemographic, and personal factors, including service satisfaction, trust in local and national authorities, the choice of water source, beliefs in human control over environmental issues, and the formal and informal flow of information (Bitew et al., 2020). Apart from its organoleptic characteristics (taste, odor, and appearance), other elements that affect how the general public views the quality of drinking water include education, past experiences, community information flow, trust in the water supplier, and demographics (Watson et al., 2025). Consumer dissatisfaction can be immediately triggered by aesthetic concerns like taste, colour, and odor, but they can also conceal more serious but less obvious risks like long-term exposure to arsenic (Watson et al., 2025).

5.5 Community members experiences on water-related health issues.

In the present study some participants have experienced water-related health issues such as skin rash, some want to vomit after consuming the water and some family members have experience diarrhoea. Diseases like cholera, diarrhoea and dysentery are spread by contaminated drinking water and inadequate sanitation (WHO, 2018). All people, regardless of their nationality, religion, colour, wealth, or creed, have the fundamental human right to obtain clean drinking water. Citizen's health is being adversely affected by poor drinking water quality. The World Health Organization (WHO) stated during the

United Nations 2023 Water Conference in New York City on March 22, 2023, that at least two billion people worldwide consume water contaminated with faeces. The situation has somewhat improved since many developing nations made the development of safe water supplies and the decrease of waterborne illnesses their top public health priorities in recent years. The situation is far from ideal, especially in rural regions, and the growing demand for water and the resulting decrease in supply due to economic development and population growth might potentially worsen this marginally better state of affairs (Li and Qian 2018a). Thus, there is still much work to be done before human, resource, and environmental harmony is achieved (Li et al., 2017a).

In Flint, Hanna-Attisha et al. (2016) reported rashes and illnesses associated with water changes. According to Howard et al. (2010), diarrhea is two to three times more common with intermittent supplies worldwide. In Bangladesh, Jalan and Ravibabu (2004) connected debt and stunting to recurrent sickness. According to WHO (2023), contaminated water causes 485,000 diarrheal deaths in LMICs each year. Threat appraisal is motivated by lived disease (Rogers, 1983). PE demonstrates that low-income, peri urban households bear the brunt of this expense (Mehta, 2014).

According to Kumpel and Nelson (2016), diarrhea was reported by 42% of Nairobi homes following water outages. Aubynn (2009) in Ghana and Nhapi (2009) in Zambia reported gastrointestinal and skin diseases in the vicinity of mining. Similarly, Nkuna and Okem (2018) reported skin irritation and recurring diarrhea in Emalahleni, South Africa. According to the South African Department of Health (2016), the prevalence of under-5-diarrhea in Mpumalanga was 18%, higher than the national average of 13%. Also, the Department of Water and Sanitation (2021) recorded public reports of gastroenteritis in Mbombela, Mpumalanga Province.

Lack of access to clean water and proper sanitation is a major cause of preventable illness and death, especially, in rural areas all over the world. A lack of clean water makes people more susceptible to diseases such schistosomiasis, intestinal nematode infections, lymphatic filariasis, trachoma, diarrhoea, malnourishment, and malaria (GBD 2016 Diarrheal Disease Collaborators, 2018). Lack of access to water and sanitation contributed to 742 000 deaths from diarrhoea in 2012 (Prüss-Ustün, Bartram, Clasen et

al., 2014). Children under the age of five are particularly affected by diarrhoea, which is also one of the main causes of death in this age group (UNICEF, 2017).

5.6 Recommendations to enhance health education and water quality.

According to the participants, new technology and maintenance of the plant process equipment are parts of the ways to enhancing water quality by minimising the risks of sewerage leaks and waste water spills. Technology can improve water quality by the use of machine learning algorithms in water treatment plant monitoring and optimization has demonstrated significant promise in anticipating system faults and improving performance (Zhu et al., 2022). There is also an urgent need for decentralized, low-maintenance, and reasonably priced solutions that can instantly adjust to changing water conditions because the prices and technical know-how needed to manage these systems are limiting for many low-income areas (Senna et al., 2023). The problems caused by excessive salinity levels in dry areas are being addressed by advancements in electrochemical water treatment technologies, which are successfully guaranteeing the availability of drinkable water (Porada et al., 2013).

The participants also mentioned that raising awareness and promoting health education about water quality will make the community more knowledgeable. By encouraging community members to learn about water quality and health, the non-profit organization and advocacy groups can collaborate with the local government. This will safeguard community public health by lowering waterborne illnesses and encouraging healthy water-use habits (WHO, 2011).

According to the World Health Organization (2017), "risk communication" should begin with community perceptions rather than merely technical information. Education works best when paired with free supplies, according to the CDC's (2020) Household Water Treatment and Safe Storage (HWTS) framework.

Because CHWs demonstrated in households and used local language, a CLTS + health education program in Kenya boosted consistent boiling and chlorine usage by 38%

(Clasen et al., 2008). Amoah and Agyei-Mensah (2016) discovered that radio dramas in Accra raised awareness of safe storage but not practice because of expense.

Because water quality was not addressed, the Department of Health (2016) in Bushbuckridge discovered that health presentations at clinics increased understanding of ORS but not prevention.

A complex strategy is needed to stop the development of these diseases, which includes enhancing water quality, building more sanitary facilities, encouraging hygiene education, and putting strong public health regulations into place. By lowering healthcare expenses and increasing productivity, effective prevention techniques not only safeguard human health but also advance economic growth. It is critical to acknowledge that investments in water infrastructure and hygiene programs are essential to protecting public health and averting future outbreaks of waterborne diseases as the world community strives for universal access to clean water and sanitation (Gough & Gotter, 2011).

5.7 Infrastructure for water quality development in response to population growth and urbanization.

The responses from the study participants showed that fast development to the community increases the high demand and volume of water uses. The infrastructure became overburdened due to urbanization and population growth, and participants noted that the water quality would not improve without adequate infrastructure maintenance. The distribution network pipe line and the various process units of the water treatment plant are examples of infrastructure. The resilience of water supply and sanitation systems and services is anticipated to be impacted by global driving forces such as urbanization, population expansion, demographic shifts, climate change, and growing water shortages (Howard et al., 2016; Kohlitz et al.,2017 & Hyde-Smith et al., 2022). The planning of new systems and services will need to be updated, and current infrastructure will need to be modified as climate change scenarios become more accurate (Edmondson, 2024).

Participants think that maintaining the reservoirs on time will enhance the quality of the drinking water. Prior to the municipality's distribution, the purification plant must meet the drinking water standard. The South African water crisis is caused by a number of factors, including uneven access to water, deteriorating water quality, frequent, protracted droughts brought on by climatic disparities, and inadequate maintenance and investment in water infrastructure (Viljoen & Van der Walt, 2018; Kohler, 2016; Ziervogel et al., 2014). The results show that the community in the STLM views urbanization and population growth as direct pressures that reduce infrastructure capacity rather than as purely demographic changes. According to PMT, the apparent delay between bulk water development and quick formal expansion serves as a phycological stimulant. It consistently increases the perceived susceptibility of the community to waterborne sickness. The municipality maintains high technical operational benchmarks nationally, but localized infrastructure strain undermines the community's confidence in the effectiveness of the response, forcing vulnerable households into high-risk water storage practices that complicate the local public health landscape. This dynamic creates a clear trust paradox.

Rapid urbanization, past land confiscation, and a lack of infrastructure and housing provided by the government are the main causes of South Africa's population surge into informal settlements. Although the 1955 South African Freedom Charter sought to give everyone access to appropriate housing, informal settlements are still a major problem, particularly in the province of Gauteng. Informal settlements continue to exist despite government attempts, which leaves residents without adequate infrastructure (Moloisane, 2018). Due to people' increased vulnerability and lack of access to sanitary facilities and safe water, inadequate water infrastructure in informal settlements can provide serious health hazards (Danti, 2018).

The high population density and limited infrastructure in South Africa's informal settlements increase the danger of disease transmission, making them prospective locations for pandemics (Pandey et al., 2014). In Accra, Ghana and Lusaka, Zambia, new informal settlements are constructed more quickly than pipes (Amoah & Agyei-Mensah,

2016 and Simatele & Binns, 2008). The residents' reliance on communal standpipes and vendors raises the possibility of cross-contamination.

In Flint, Michigan in the US, population stress combined with neglected maintenance results in bacterial and lead pollution (Hanna-Attisha et al., 2016).

Only 46% of systems in South Africa had a score of >80 in the DWS (2021) Blue Drop Report, indicating a nationwide decline. The main causes include inadequate maintenance, a backlog of infrastructure brought on by urbanization, and a lack of expertise.

According to Nkuna and Okem (2018), Govan Mbeki, Steve Tshwete, and Emalahleni have the greatest population growth in Mpumalanga as a result of coal. The municipal infrastructure was not intended for family dwellings, but rather for mining hostels. As a result, AMD enters stormwater and sewers overflow.

Improving living conditions and lowering public health risks can be achieved by upgrading informal settlements and supplying necessities including roads, water, power, and sanitary facilities (Corburn & Sverdlik,2019). The type of drinking water source used is strongly influenced by employment status, indicating that people who work informally may not have as much access to good water sources (Lin, Yang, & Xu., 2022).

5.8 Conclusion

This chapter focused on discussing the findings presented in Chapter 4 according to the objectives of the study. The discussion was aligned to the literature review to support the findings. The next chapter provides the conclusion based on the findings presented in Chapter 4 as well as the discussion of the findings in Chapter 5. It also provides a number of recommendations as well as opportunities for future research studies.

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

One of the most significant factors influencing human health is the quality of drinking water. Unfortunately, many nations, particularly developing nations, have unsatisfactory drinking water quality, which has led to a number of waterborne illnesses. The availability of and access to clean drinking water is a universal human right but quality of water varies from community to community. This chapter summarizes the main findings from the research process and provides insights into the main research questions of this study which were:

- What are the community's perceptions of the current state of water quality in the Steve Tshwete Local Municipality?
- What are the perceived health risks associated with water quality in the community?
- What are the community's experiences with water-related illness and their attributions to water quality?

The chapter concludes with recommendations on how to address and possibly resolve the water quality and health related issues faced by the STLM.

6.2 Summary of the findings

The purpose of this study was to explore the communities' perceptions of the health implications of water quality in the Steve Tshwete Local Municipality. Four objectives were developed to address the overall purpose.

- To assess the community's knowledge, attitudes, and practices related to water quality and health.
- To assess the community's perceptions of water quality and its impact on health.
- To explore the factors that influence community perceptions of water quality risks.

- To develop recommendations for improving water quality and health education.

A qualitative research design was employed with a purposeful sampling method. Fifteen (15) participants were identified to take part in the study from the Steve Tshwete Local Municipality, between March and April 2025. Semi-structured interviews were used to collect data. The data was then analyzed using coding and thematic data analysis.

The findings from the first objective revealed that participants show a good level of knowledge of various causes of water pollution in general and that they had a good local knowledge of what was happening in the community with regards to water pollution. Participants had positive attitudes toward water quality because they know of the benefits of safe drinking water for their health and wellbeing as well as for the environment protection. Participants knew that good water quality practices will reduce their risk of contracting a waterborne illness, because they look for any visible signs of water contamination.

Findings related to the second objective revealed that the participants perceived the water quality to be poor and related this to some experiences of health-related issues from water.

Participants were knowledgeable about the organoleptic (taste, smell, and colour) aspects of the water quality. Participants' understanding of the cultural activities taking place at the source (such as slaughtering of animals) helped spread the word about the need for the community to abstain from such practices which was related to the third objective of the study.

The findings of the third objective revealed that participants' knowledge of water-related health problems enabled them to make the right choice when examining and checking for signs of contamination of water pollution, preventing them from contracting waterborne illnesses**.**

The findings of the fourth objective revealed that participants mentioned that in order for the water system to function effectively, proper maintenance according to a maintenance schedule should be the first priority. They also mentioned that the community has to get

involved with the issues that affect them and education and awareness messages could be disseminated to the community using various media platforms.

6.3 Conclusions from the research

This research study concludes that it has collected and presented evidence that strongly suggests the high mineral content of nearby mines, steelwork factories, and agricultural communities is the cause of water pollution in the Steve Tshwete Local Municipality, which has an impact on the health and well-being of the community.

These insights highlight the importance of community engagement, effective management strategies, and future research to enhance water quality and equity in the municipality. The community perceptions of the health implications of water quality in the Steve Tshwete Local municipality indicate that many residents view the quality of water as very bad, particularly those with high education levels.

6.4 Recommendations

A number of human rights laws safeguard water as a universal human right. In South Africa, the Constitution establishes the right to adequate water and assigns municipalities the duty of providing water to the people. The research recommends that local municipality of Steve Tshwete could improve service delivery of the community by investing in water infrastructure and maintenance of water plant process to unsure sustainable water management practices. Policymakers and stakeholders should collaborate to increase educational knowledge and awareness about the drinking water quality. By applying the polluter pay principle to community members. Adopting an integrated water management systems such as rainwater harvesting, storage tanks, and collection of storm water to improve water quality, availability and accessibility. The promotion of water quality education and awareness at primary and secondary schools

during water weeks, encouraging schools to play drama and sketches about the important of drinking water quality. By spreading more awareness of water quality issues to residents via all media platforms. Enforce municipal bylaws to prevent illegal connections and vandalism, and ensure effective collaboration between government

A final recommendation is for future research on this topic. Future research in the Steve Tshwete Local Municipality will probably concentrate on comparing community perceptions of water safety to actual water quality measurements, especially with regard to pollution, turbidity, and health hazards associated with mining. Research will probably focus on how sensory elements (taste, odour, and colour) affect public trust and create, assess, and improve municipal Water Safety Plans (WSPs) to increase dependability. Future research will probably close the gap between real chemical parameters (such as high sulphate and manganese levels from coal mining in Mpumalanga) and perceived water quality (community experience).

These recommendations aim to address the pressing issue of water quality and its impact on community health in Steve Tshwete Local Municipality.

Policy Recommendations

1. The current municipal bylaws place a strong emphasis on either static online PDF uploads of water testing or post-event reporting. When aesthetic anomalies (discoloration, turbidity) arise, the policy should require real-time public dashboards via SMS and community radio. Clearly stating the seriousness of the issue reduces social media anxiety and halts the propagation of false information.

2. A municipal policy framework must legally co-bind the Department of Mineral Resources and Energy (DMRE), nearby mining companies, and STLM in light of the long-standing community concern over acid mine drainage and heavy metals in the Olifants River Catchment. Instead of relying entirely on municipal resources,

this taskforce should enforce strong co-funding methods for community-level water protection.

Recommendations on Practice

1. The use of strictly technical, laboratory language in municipal communication has to change (e.g., reporting confusing chemical parameters). It is important to train public relations staff to communicate using the sensory signals (color, odour, taste) that locals actually use to assess dangers. Public danger inflation is directly managed by explaining why water seems turbid (e.g., pipe maintenance vs. raw water pollution).

2. Workshops should be created by community health workers using the coping appraisal variables from PMT. Practical demonstrations should concentrate on reducing response costs, such as teaching safe, energy-efficient solar water disinfection (SODIS) techniques or correctly applying household bleach for disinfection, rather than just informing residents that poor water is dangerous (which increases threat anxiety without offering solutions).

3. Technical teams should record the neighborhood's qualitative "sensory complaints" in addition to analysing the water when using mobile laboratory resources for on-site water testing. Technicians can identify localized cross-contamination sites more quickly by directly comparing objective microbiological and chemical data with community perception logs.

Recommendations for Further Research

1. Future studies should examine the seasonal variations in community risk assessments. Deeper insights into behavioural changes over time could be

obtained, for example, by examining whether threat perceptions increase during periods of excessive rainfall as opposed to dry seasons.

2. A targeted study that compares the financial limits of health protection in affluent suburban regions using private boreholes and filtration systems. This would assist in figuring out how public health vulnerability is shaped by structural wealth inequality within the same local municipality.

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APPENDICES

Appendix No.1



Consent Form

I, [participant name], hereby consent to participate in this research study. I understand the purpose of the study, procedures involved, and the potential risks and benefits. I acknowledge that my participation is voluntary and that I can withdraw from the study at any time.

Signature

Signature: _____ Date: _____

If you have any questions or concerns about this study, please contact:

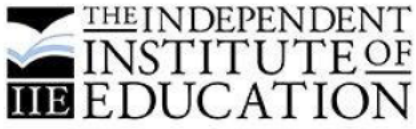
Magomarele Jackson Maepa

IIE MSA

[redacted]

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Appendix No.2



Annexure H – PARTICIPANT OR RESPONDENT INFORMED CONSENT FORM

Explanatory information sheet and consent form for participants
To whom it may concern, My name is **Magomarele Jackson Maepa** and I am a student at The IIE's **MSA campus**. I am currently conducting research under the supervision of Dr Bukola Olutola. T**he study aims to ascertain how the communities in the Steve Tshwete Local Municipality, Mpumalanga Province (South Africa) perceive the health implications of their water quality**. I hope that this research will enhance our understanding of **this information can be used to inform policies and interventions aimed at improving water quality and reducing the risk of water-borne illness.** I would like to invite you to participate in my study. In order to explain to you what your participation in my study will involve, I have formulated questions that I will try to fully answer so that you can make an informed decision about whether or not to participate. If you have any additional questions that you feel are not addressed or explained in this information sheet, please do not hesitate to ask me for more information. Once you have read and understood all the information contained in this sheet and are willing to participate, please complete and sign the consent form below.
What will I be doing if I participate in your study?
I would like to invite you to participate in this research because (**ensure that their voices, concerns, and experiences are heard and taken into account**). If you decide to participate in this research, I would like to **(participants will engage in in-depth interviews to share their personal experiences, concerns, and opinions about water quality and health implications)**. You can decide whether or not to participate in this research. If you decide to participate, you can choose to withdraw at any time or to decide not to answer particular interview questions.
Are there any risks/ or discomforts involved in participating in this study?
Whether or not you decide to participate in this research, there will be no negative impact on you. There are no direct risks or benefits to you if you participate in this study. You might,

however, indirectly find that it is helpful to talk about your (**the community perception of health implications of water quality**). If you find at any stage that you are not comfortable with the line of questioning, you may withdraw or refrain from participating.

Detail the potential risks and how it will be managed by the researcher. Indicate how the ethical considerations will be applied in the context of the study.

Do I have to participate in the study?

- Your inclusion in this study is completely voluntary;
- If you do not wish to participate in this study, you have every right not to do so;
- Even if you agree to participate in this study, you may withdraw at any time without having to provide an explanation for your decision.

Will my identity be protected?

I promise to protect your identity. I will not use your name in any research summaries to come out of this research and I will also make sure that any other details are disguised so that nobody will be able to identify you. I would like to ask your permission to record the interviews, but only my supervisor, I and possibly a professional transcriber (who will sign a confidentiality agreement) will have access to these recordings. Nobody else, including anybody at **IIE MSA**, will have access to your interview information. I would like to use quotes when I discuss the findings of the research, but I will not use any recognisable information in these quotes that can be linked to you.

What will happen to the information that participants provide?

Once I have finished all interviews, I will write summaries to be included in my research report, which is a requirement to complete my M**aster of Philosophy in Integrated Water Management**. You may ask me to send you a summary of the research if you are interested in the final outcome of the study.

What happens if I have more questions about the study?

Please feel free to contact me or my supervisor should you have any questions or concerns about this research, or if there is anything you need to know before you decide whether or not to participate.

You should not agree to participate unless you are completely comfortable with the procedures followed.

My contact details are as follows:

Magomarele Jackson Maepa
[redacted]
[redacted]

The contact details of my supervisor are as follows:

Dr Bukola Olutola

[redacted]

[redacted]

Participant or respondent Informed Consent – Audio and Visual Recordings.	
I agree to participate in the research conducted by **Magomarele Jackson Maepa** about **the study aims to ascertain how the communities in the Steve Tshwete Local Municipality, Mpumalanga Province (South Africa) perceive the health implications of their water quality**. This research has been explained to me and I understand what participation in this research will involve. I understand that: • I agree to participate in this research and be recorded for the purpose of data collection. • My confidentiality will be ensured. My name and personal details will be kept private and confidential. • My participation in this research is voluntary and I have the right to withdraw from the research at any time. There will be no repercussions should I choose to withdraw from the research. • I may choose not to answer any of the questions that are asked during the research interview. • I may be quoted directly when the research is published, but my identity will be protected.	
Signature	**Date**

Appendix No.3



Interview Schedule

AN INVESTIGATION INTO THE COMMUNITIES' PERCEPTIONS OF THE HEALTH IMPLICATIONS OF WATER QUALITY IN THE STEVE TSHWETE LOCAL MUNICIPALITY, MPUMALANGA PROVINCE, SOUTH AFRICA

Introduction	Age Gender Education Employment status Job description
To assess the community's knowledge, attitudes, and practices related to water quality and health.	(1) What do you think are the main sources of water pollution in our community? (2) How important is it for you to have access to clean and safe drinking water? (3) What is your primary source of drinking water? (4) How often do you check your water for visible signs of contamination?
To assess the community's perceptions of water quality and its impact on health	(1) What do you think are the main factors that affect the quality of our community's water? (2) What health problems do you think are most likely to be caused by poor water quality? (3) What do you think is the most important action that can be taken to improve the water quality in our community? (4) Do you think the water quality in our community is better, worse, or the same as it was 5 years ago?
To understand the factors that influence community perceptions of water quality risks.	(1) How does trust in local authorities or water utilities affect your perception of water quality?

	(2) Do you think access to information about water quality affects your perceptions? (3) How do cultural or traditional practices influence your perception of water quality? (4) How does the appearance of the water (e.g., color, clarity) affect your perception of its quality?
To explore the community's experiences with water-related health issues.	(1) How often do you seek medical care for water-related health issues? (2) Can you share any personal experiences or stories related to water-related health issues? (3) What type of health problems have you experiences (e.g., diarrhea, skin rashes, respiratory issues)? (4) Have you or family member ever experienced any health problems that you think were related to the quality of your drinking water?
To develop recommendations for improving water quality and health education	(1) What do you think are the most effective ways to improve water quality in our community? (2) What types of health education programs or materials would be most effective in our community? (3) What types of community-based initiatives or activities would be most effective in promoting water quality and health education? (4) What role can community-based organizations and advocacy groups play in promoting water quality and health education?

Thanks, you for considering participating in this research study.

Appendix No.4
Themes

Codes	Basic themes identified	Organizing themes	Global themes
Sewer blockage, sewer spillage, women activities. Discharge from mine, lack of education, Human activities	Community perceptions towards water quality and health	The community daily practices of visible sign of contamination to drinking water	Knowledge, attitudes and practices of the community on health and quality of the water
Human behaviour, Agricultural runoff, water pollution, fast development, tap water, borehole water, skin irritation, stomach cramps	Human behaviour towards water pollution	Human behaviours towards water pollution of the drinking water main source	Perceptions of the community regarding water quality and its effects on health
Sewage spillage, taste, smell and colour, brownish and orange colour	Sewage spillage and sewer blockage on water distribution networks	The role of cultural and traditional leaders in community water quality	Factors affecting the community's perception of water quality risks
Skin rashes, diarrhoea, vomiting, twice yearly	Pollution of water by mining activities	Community knowledge of water pollution by mining activities	Community members experiences on water-related issues
Lack of education, raising awareness about water quality and health education, using filters at home	Lack of education about water quality and health implication of water pollution	The maintenance of water storage and distribution of water quality infrastructure by officials	The plan for the developing recommendations to enhance the health of education and water quality
Community Perceptions, proper maintenance of infrastructure, transportation of water by PVC pipeline	The rule of traditional leader in water quality	Drinking water quality health implications to community members	infrastructure for water quality development in response to population growth and urbanization Participant

Appendix No.5

THE INDEPENDENT INSTITUTE OF EDUCATION

Vega

Varsity College

Rosebank College

MSA

School of Hospitality & Service Management
A school of The IIE

Our Ref: M. 780325
Enquiries: research@iie.ac.za

04 March 2025

Outcome of Ethics Clearance for Master of Philosophy in Integrated Water Management

Student name: Magomarele Jackson
Student number: [redacted]
Brand and campus: IIEMSA

Dear Magomarele,

Thank you for submitting ethics clearance for the study titled: *An Investigation into The Communities' Perceptions of the Health Implications of Water Quality in the Steve Tshwete Local Municipality, Mpumalanga Province, South Africa:*

We are pleased to inform you that your ethical clearance application has been approved. This means that you may proceed with data collection once you have addressed the comments shared by the HDC. You are reminded to inform the IIE's Higher Degrees Committee of any changes made to the research methodology or title of the research prior to examination. Kindly ensure that all ethical considerations are duly applied whilst collecting, analysing and interpreting the data for the completion of your research.

Dr Reza Hosseini

Chair: Higher Degrees Committee

[redacted]