

AN ASSESSMENT OF THE SOCIAL IMPACTS OF WATER POLLUTION ON CHILDREN IN INFORMAL SETTLEMENTS: THE CASE OF KLIPTOWN INFORMAL SETTLEMENT, SOWETO, JOHANNESBURG.

By

JENNIFER TADZEI KAMUSONO

Submitted in accordance with the requirements for the degree of

MASTER OF SCIENCE

In the subject

ENVIRONMENTAL MANAGEMENT

At the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: DR D J P DE WAAL

SEPTEMBER 2018

DECLARATION

I, JENNIFER TADZEI KAMUSONO, the undersigned, declare that the work contained in this thesis is my own original work. I have also not previously in its entirety or in part submitted it at any university for a degree. Accordingly, it is my own work in design and execution and further, all materials herein, have been duly acknowledged.

A handwritten signature in black ink, appearing to read 'Kamusono', with a stylized, circular flourish at the beginning.

Signed at Johannesburg on this 10th day of November 2018

DEDICATION

I dedicate this dissertation to my late mother, Marrien Sithole, who instilled in me a culture of studying from a tender age. She always encouraged me to persevere through my studies. I also dedicate this work to my two sons, Tatenda Bruce and Takudzwa Ausubel and my only daughter Rudo Maureen. I hope it will act as a source of inspiration to them as they pursue their academic journeys to succeed in their lives.

ACKNOWLEDGEMENTS

I would like to acknowledge the support I received from numerous individuals during the course of this study. First and foremost, I am truly and sincerely thankful to my supervisor Dr David de Waal for his support, advice and encouragement which inspired me to complete this study. His knowledge and mastery of the study area were seen by his great guidance. While guiding me, he fed me with academic wisdom and opened my eyes. Truly, I am indebted to him.

I would also like to thank the ward counsellor for Kliptown informal settlement Ms Valentine and the City of Johannesburg for allowing me to carry out this study in their area. Ms Valentine supported me by giving hints on how to conduct the study in the crime infested area of Kliptown informal settlement, as well as provided other valuable information about Kliptown. The matron at the City of Johannesburg's Kliptown Clinic willingly and cheerfully supplied all the information needed on social impacts and factors that contributed to water pollution on children in the Kliptown informal settlement. Many thanks also to Mr Justin Mbambo, a resident and church leader in Kliptown's Mandelaview. Mr Justin took his time to move around with me in the informal settlement as I handed out and collected questionnaires from parents in Kliptown's Mandela View, Valentine Village and Tamatievlei informal settlements.

Special thanks go to my husband Cobden Tiriari, for providing financial and moral support. He also drove me to Pretoria each time I needed to see the supervisor, Dr David de Waal. My sincere gratitude also goes to my son Takudzwa Ausubel for his invaluable assistance in constructing graphs and pie charts for data presentation. I would also like to note the assistance I got from Mrs Buhle Makamanzi, Mrs Fungai Tsekeya and Mr Stephen Tsekeya. They provided valuable assistance with the academic writing. Many thanks also go to Mrs Dadirai Mangondo who helped me with editing and proofreading. Special thanks are due to my colleagues, Ms Regina Taurai and Mr Johannes Phiri for giving their time to discuss and clarify much of the information in the study. Lastly, many thanks go to my family for the constant support and encouragement shown throughout my studies.

ABSTRACT

The study investigated the causes of water pollution in Kliptown, an informal settlement 17km south of Johannesburg. The study further examined the impact of water pollution, sanitation and inadequate and low quality water provision on children's social life, health and well-being in informal settlements.

The subject of water pollution due to inadequate water supply and sanitation is one that brings a lot of debate, due to the overwhelming impacts it has on children's social life as well as their health. In informal settlements, social impacts arising from inadequate water supply and sanitation such as the prevalence of water-related diseases like diarrhoea, skin rashes and eye infections have become a permanent feature.

This study aimed at assessing the social impacts of water pollution in Kliptown's Tamatievlei, Mandela View and Valentine Village informal settlements. It also looked at the factors that contribute to the social impacts of water pollution and propose recommendations on how to minimise the social impacts of water pollution on children in Kliptown's informal settlements.

The study applied a mixed method approach, utilising exploratory and descriptive questions to extrapolate both qualitative and quantitative data, which was also presented in quality and quantity form. Outcomes of the investigation indicated that diarrhoea is a major waterborne disease that affects children, mostly under-five years of age, in the informal settlements and that children sometimes missed school due to their being treated for diarrhoea and other water-related illnesses. It was also found that children lived in unhygienic conditions with smelling bucket system toilets and rotting garbage. The study established that children congregated for water at water points for long periods and in the process, they were deprived of time to take part in other social activities.

The study recommends mitigating inadequate, low quality water supply, water pollution and sanitation in an integrated manner to gradually eliminate the negative social impacts on children's social life, health and well-being in Kliptown informal settlement.

TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	BACKGROUND TO THE STUDY	1
1.2	PROBLEM STATEMENT	3
1.3	RESEARCH QUESTION	3
1.4	AIM OF THE STUDY	3
1.5	OBJECTIVES OF THE STUDY	3
1.6	MOTIVATION OF THE STUDY	4
1.7	LIMITATIONS OF THE STUDY	4
1.8	DELIMITATIONS OF THE STUDY	5
1.9	ASSUMPTIONS	5
1.10	STUDY AREA	6
1.11	CHAPTER BREAKDOWN	7
2	LITERATURE REVIEW.....	7
2.1	DEFINITIONS OF CONCEPTS.....	7
2.1.1	<i>INFORMAL SETTLEMENTS.....</i>	<i>7</i>
2.1.2	<i>POLLUTION.....</i>	<i>9</i>
2.1.3	<i>WATER POLLUTION.....</i>	<i>9</i>
2.1.4	<i>DEFINITION OF SOCIAL IMPACTS</i>	<i>10</i>
2.2	DRIVERS OF WATER POLLUTION	12
2.2.1	<i>WATER AND SANITATION</i>	<i>12</i>
2.2.2	<i>SEWAGE CONTAMINATION OF WATER</i>	<i>14</i>
2.2.3	<i>WATER AS A MEDIUM OF DISEASE TRANSMISSION</i>	<i>15</i>
2.2.4	<i>GENDER IMPLICATIONS</i>	<i>16</i>
2.3	FACTORS CONTRIBUTING TO WATER POLLUTION	17
2.3.1	<i>UNPLANNED NATURE AND INCONSISTENT APPLICATION OF THE POLICY OF SERVICE PROVISION IN INFORMAL SETTLEMENTS.....</i>	<i>17</i>
2.3.2	<i>LACK OF ROADS, SEWER AND ABLUTION FACILITIES.....</i>	<i>18</i>
2.3.3	<i>LACK OF MONEY AND SPACE TO INSTALL SANITATION AND WATER SERVICES</i>	<i>19</i>
2.3.4	<i>AVAILABILITY OF QUALITY AND SUFFICIENT WATER</i>	<i>20</i>
2.3.5	<i>LACK OF STRICT LEGISLATION ON WATER POLLUTION.....</i>	<i>21</i>
2.3.6	<i>FLOODING.....</i>	<i>21</i>
2.3.7	<i>POOR WATER STORAGE FACILITIES</i>	<i>22</i>
2.4	INTERVENTIONS TO MITIGATE SOCIAL IMPACTS OF WATER POLLUTION-IMPROVING SANITATION AND WATER SERVICE	23
2.4.1	<i>SANITATION</i>	<i>23</i>
2.4.2	<i>WATER</i>	<i>24</i>
2.5	EXTENT OF THE SOCIAL IMPACTS OF WATER POLLUTION	26
2.5.1	<i>KAMPALA, UGANDA.....</i>	<i>26</i>
2.5.2	<i>THE MIDDLE EAST AND NORTH AFRICA.....</i>	<i>26</i>
2.5.3	<i>SOUTH AFRICA</i>	<i>27</i>

2.5.4	<i>UNITED STATES OF AMERICA (USA)</i>	27
2.5.5	<i>ZANZIBAR AND TANZANIA</i>	27
2.5.6	<i>ZIMBABWE</i>	28
2.6	SUMMARY	29
3	Research Methodology	29
3.1	TYPE OF RESEARCH: ETHNOGRAPHIC RESEARCH.....	29
3.2	RESEARCH PARADIGM: DESCRIPTIVE	30
3.3	RESEARCH APPROACH: MIXED	30
3.4	THE RESEARCH DESIGN: FLOW DIAGRAM.....	30
3.4.1	<i>QUESTIONNAIRE</i>	31
3.4.2	<i>QUESTIONNAIRE PRETESTING</i>	31
3.4.3	<i>STRUCTURED INTERVIEWS</i>	32
3.4.4	<i>OBSERVATION METHOD</i>	32
3.5	VALIDITY AND RELIABILITY	32
3.6	RESEARCH POPULATION.....	33
3.7	SAMPLING	33
3.8	DATA PRESENTATION AND ANALYSIS PROCEDURES.....	33
3.9	ETHICAL CONSIDERATIONS	34
3.10	CONSENT	34
3.10.1	<i>ENSURING CONFIDENTIALITY</i>	34
3.10.2	<i>LANGUAGE</i>	34
3.10.3	<i>SAFEGUARD MEASURES</i>	34
3.11	SUMMARY	34
4	BACKGROUND OF KLIPTOWN INFORMAL SETTLEMENT	35
4.1	INTRODUCTION	35
4.2	CASE STUDY BACKGROUND.....	35
4.3	STUDY AREA	36
4.4	DEMOGRAPHICS OF PARTICIPANTS	36
4.5	SOCIAL CHALLENGES AND OPPORTUNITIES	37
4.6	SUMMARY	38
5	DATA PRESENTATION AND DISCUSSION	39
5.1	INTRODUCTION	39
5.2	DATA COLLECTION AND ANALYSIS PROCEDURES	39
5.3	QUESTIONNAIRE SURVEY	39
5.4	STRUCTURED INTERVIEW	40
5.5	FIELD OBSERVATION AND SECONDARY LITERATURE ANALYSIS.....	40
5.6	SECTION A: QUESTIONNAIRE RESPONDENT ANALYSIS	40
5.6.1	<i>RESPONSE RATE</i>	40
5.6.2	<i>ANALYSIS OF DEMOGRAPHIC DATA</i>	40
5.6.3	<i>SOCIAL IMPACTS OF WATER POLLUTION</i>	42

5.6.4	<i>FACTORS CONTRIBUTING TO WATER POLLUTION</i>	49
5.7	RESPONSE FROM THE INTERVIEW	54
5.7.1	<i>DIARRHOEA, SKIN RASHES, EYE INFECTIONS, MALARIA AND BILHARZIA</i>	54
5.7.2	<i>FACTORS THAT CONTRIBUTE TO SOCIAL IMPACTS OF WATER POLLUTION</i>	56
5.7.3	<i>MEASURES TO IMPROVE WATER SUPPLY AND SANITATION</i>	56
5.8	THE OBSERVATION METHOD	56
5.8.1	<i>EXPOSURE TO A POLLUTED AND UNHYGIENIC ENVIRONMENT</i>	57
5.8.2	<i>CHILDREN QUEUED TO FETCH WATER</i>	57
5.8.3	<i>OVER FLOWING AND BAD SMELLING TOILETS</i>	57
5.8.4	<i>FACTORS THAT CONTRIBUTED TO WATER POLLUTION IN THE KLIPSPRUIT RIVER</i>	58
5.8.5	<i>FACTORS THAT CONTRIBUTED TO THE SOCIAL IMPACTS OF WATER POLLUTION IN KLIPTOWN INFORMAL SETTLEMENT</i>	58
5.8.6	<i>SOCIAL IMPACTS OF WATER POLLUTION ON CHILDREN IN KLIPTOWN INFORMAL SETTLEMENT</i>	59
5.9	OBSERVATION ANALYSIS	59
5.10	SUMMARY	60
6	SUMMARY, CONCLUSION AND RECOMMENDATIONS	61
6.1	SUMMARY OF FINDINGS	61
6.2	CONCLUSION	62
6.3	RECOMMENDATIONS	62
7	REFERENCE LIST:	64
8	APPENDICES	72
8.1	APPENDIX 1: QUESTIONNAIRE FOR PARENTS IN KLIPTOWN INFORMAL SETTLEMENT	72
8.2	APPENDIX 2: INFORMED CONSENT FORM FOR PARENTS	75
8.3	APPENDIX 3: INTERVIEW SCHEDULE FOR THE MATRON AT KLIPTOWN CLINIC.....	75
8.4	APPENDIX 4: INFORMED CONSENT FORM FOR THE MATRON	77
8.5	APPENDIX 5: ETHICAL APPROVAL FROM UNIVERSITY OF SOUTH AFRICA.....	78
8.6	APPENDIX 6: AUTHORISATION LETTER FROM THE CITY OF JOHANNESBURG.....	80
8.7	APPENDIX 7: LETTER OF INTRODUCTION FROM THE UNIVERSITY OF SOUTH AFRICA.....	82

LIST OF FIGURES

FIGURE 1 SOWETO AND KLIPTOWN INFORMAL SETTLEMENT IN GAUTENG CONTEXT. (SOURCE- ARCHIDEEVZW.BLOGSPOT.COM 16/09/2005; SOUTH AFRICAN HISTORY ONLINE; ADAPTED GOOGLE EARTH PRO).....	6
FIGURE 2: TYPES OF POLLUTION (SOURCE- ADAPTED FROM (REEVE, 2002))	9
FIGURE 3: SOCIAL IMPACTS OF POLLUTION (SOURCE- ADAPTED FROM (CENTRE FOR GOOD GOVERNANCE, 2006)	29
FIGURE 4: RESEARCH METHODOLOGY FLOW DIAGRAM.....	31
FIGURE 5: KLIPTOWN INFORMAL SETTLEMENT (SOURCE: GOOGLE EARTH PRO AND RESEARCH RESULTS.....	36
FIGURE 6: HOUSING UNITS IN THE KLIPTOWN INFORMAL SETTLEMENT	36
FIGURE 7: KLIPSPRUIT RIVER FLOODPLAIN.....	36
FIGURE 8 INCOME OF RESPONDENTS (SOURCE- RESEARCH DATA	41
FIGURE 9: AGES OF CHILDREN AFFECTED BY THE PHYSIOLOGICAL IMPACTS OF WATER POLLUTION (SOURCE- RESEARCH DATA)	42
FIGURE 10: GIRLS VERSUS BOYS FETCHING WATER AT DIFFERENT TIMES OF THE DAY (SOURCE-RESEARCH DATA)	44
FIGURE 11: ABSENTEEISM DUE TO WATER-RELATED DISEASES (SOURCE-RESEARCH DATA)	44
FIGURE 12: SCHOOL ABSENTEEISM DUE TO WATER-RELATED ILLNESSES AND GENDER IMPLICATIONS. (SOURCE- RESEARCH DATA)	45
FIGURE 13: GENDER IMPLICATIONS OF QUEUING FOR WATER (SOURCE-RESEARCH DATA)	45
FIGURE 14: CASES OF CHILDREN DRINKING CONTAMINATED WATER AND EATING CONTAMINATED FOOD (SOURCE-RESEARCH DATA).....	47
FIGURE 15: TREATMENT AREAS FOR WATER-RELATED ILLNESSES (SOURCE-RESEARCH DATA)	48
FIGURE 16: PERCENTAGE OF CHILDREN TAKEN TO KLIPTOWN CLINIC, SPIRITUAL HEALERS OR HERBALISTS (SOURCE- RESEARCH DATA	49
FIGURE 17: LOCATION OF RESPONDENTS IN KLIPTOWN INFORMAL SETTLEMENT.	49
FIGURE 18: SPATIAL DISTRIBUTION OF RESPONDENTS ACCORDING TO ZONES IN KLIPTOWN INFORMAL SETTLEMENT (SOURCE-RESEARCH DATA).....	50
FIGURE 19: USE OF THE KLIPSPRUIT RIVER (SOURCE- RESEARCH DATA	52
FIGURE 20: DISPOSAL OF GREY WATER (SOURCE-RESEARCH DATA)	53
FIGURE 21: RECOMMENDATIONS BY PARENTS (SOURCE-RESEARCH DATA)	53
FIGURE 22: GRAPHICAL PRESENTATION OF THE PREVALENCE RATES OF WATERBORNE RELATED ILLNESSES (ADAPTED FROM KLIPTOWN CLINIC RECORDS 2015	55
FIGURE 23: CHILDREN PLAYING IN GREY WATER AT THE BACK OF THE SHACK (SOURCE-RESEARCH DATA).....	57
FIGURE 24: CHILDREN PLAYING ALONG A DIRTY ROAD (SOURCE-RESEARCH DATA).....	57
FIGURE 25: CHILDREN QUEUING FOR WATER AT A HOUSEHOLD TAP IN MANDELA VIEW (SOURCE- RESEARCH DATA)	57
FIGURE 26: OVER FLOWING MOBILE TOILET (SOURCE-RESEARCH DATA)	58
FIGURE 27: BUCKET SYSTEM TOILET (SOURCE-RESEARCH DATA)	58
FIGURE 28: SUMMARY OF RESEARCH FINDINGS (SOURCE-RESEARCH DATA)	60

LIST OF TABLES

TABLE 1: NUMBER AND PERCENTAGE OF CHILDREN BY AGE GROUP	11
TABLE 2: PERCENTAGE SANITATION NEEDS: INFORMAL SETTLEMENTS IN 2011	18
TABLE 3: INFORMAL SETTLEMENTS IN KLIPTOWN	37
TABLE 4: DETAILED ACCOUNT OF HOUSING AREAS IN KLIPTOWN INFORMAL SETTLEMENT AND SAMPLE SIZE	39
TABLE 5: PERCENTAGE OF CHILDREN QUEUING FOR WATER (SOURCE-RESEARCH DATA).....	43
TABLE 6: FREQUENCY OF VISITS TO WATER POINTS AND TIMES OF THE DAY (SOURCE-RESEARCH DATA)	43
TABLE 7: GENDER OF THE CHILDREN SENT TO FETCH WATER (SOURCE-RESEARCH DATA).....	43
TABLE 8: PERCENTAGE OF CHILDREN WITH LOW ACADEMIC PERFORMANCE DUE TO ABSENTEEISM (SOURCE-RESEARCH DATA)	45
TABLE 9: PERCENTAGE OF CASES OF DIARRHOEA (SOURCE-RESEARCH DATA)	48
TABLE 10: SANITATION (SOURCE-RESEARCH DATA).....	50
TABLE 11: WATER FACILITIES USED IN KLIPTOWN INFORMAL SETTLEMENT (SOURCE-RESEARCH DATA)	51
TABLE 12: PREVALENCE OF WATER POLLUTION RELATED ILLNESSES (ADAPTED FROM KLIPTOWN CLINIC RECORDS 2015).....	55
TABLE 13: CHECKLIST TO OBSERVE FACTORS THAT CONTRIBUTED TO WATER POLLUTION IN KLIPSPRUIT RIVER (SOURCE-RESEARCH DATA).....	58
TABLE 14: RUBRIC TO ASSESS CHECKLIST OF FACTORS THAT CONTRIBUTED TO WATER POLLUTION IN KLIPTOWN INFORMAL SETTLEMENT (SOURCE-RESEARCH DATA)	58
TABLE 15: RUBRIC SHOWING SOCIAL IMPACTS OF WATER POLLUTION ON CHILDREN IN KLIPTOWN INFORMAL SETTLEMENT (SOURCE-RESEARCH DATA).....	59

TABLE OF ABBREVIATIONS

ABBREVIATION	MEANING
ACP-EU	Africa Caribbean and Pacific- European Union
AEASA	Agricultural Economic Association of South Africa
AMD	Acid Mine Drainage
APHRC	African Population and Health Resource Centre.
ASSAf	Academy of Science of South Africa
AWSB	Athi Water Services Board
BNG	Breaking New Ground
CCT	City of Cape Town
CORC	Community Resource Centre
COURC	Community Organisation Urban Resource Centre
CUBES	Centre for Urban and Built Environment Studies
CPAU	Cooperation for Peace and Unity
Cwb	<p>“C” - Stands for temperate climate.</p> <p>“w” - Indicates dry winters (driest winter month average precipitation is less than 30 mm).</p> <p>“b” - Indicates the warmest month.</p>
EECCA	Eastern Europe, Caucasian and Central Asia
EIA	Environmental Impact Assessment
IIED	International Institute for Environment and Development
JMP	Joint Monitoring Programme
JOSHCO	Johannesburg Social Housing Company
MDGs	Millennium Development Goals
MENA	The Middle East and North Africa
MWLE	Ministry of Water, Lands and Environment
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Cooperation and Development
PLoS	Public Library of Science
PMG	Parliamentary Monitoring Group
RSDF	Regional Spatial Development Framework
RWH	Rain Water Harvesting

ABBREVIATION	MEANING
SA	South Africa
SDGs	Sustainable Development Goals
SSA	Sustainable Sanitation Alliance
UN	United Nations
UNDP	United Nations Development Programme
UNICEF	United Nations Children’s Fund
US	The United States of America
WRC	Water Research Commission
WRS	World Research Commission
WHO	World Health Organisation
WISA	Water Institute of South Africa
WASH	Water Sanitation and Hygiene
WSDP	Water Services Development Plan

DEFINITION OF TERMS:

TERM	DEFINITION
Ablution block:	A multi-purpose public facility used by a large number of residents. The facility may include toilets, showers, hand basins and wash troughs.
Children	Young human beings below the age of puberty or below the legal age of majority.
<i>E. coli</i> (Escherichia coli)	A bacterium that lives in the digestive tracts of humans and animals.
Endemic	When a disease has strongly established itself in the population, and there are a constant number of cases.
Epidemic	The rapid spread of infectious disease to a large number of persons in a given population within a short period, usually two weeks or less.
Floodplain	Low level land adjacent to a river, stream or coastal area that is prone to flooding when it rains heavily.
Grey water	Waste water resulting from the use of water for domestic purposes but not including human excreta.
Informal settlement	An unplanned settlement area where housing is not in compliance with current planning and building regulations.
Sanitation	Disposal of human excreta and grey water.

TERM	DEFINITION
Social impacts	Effects of activities on the social fabric of the community and well-being of the individuals and families.
Vulnerability	The inability to withstand the effects of a hostile environment.
Waterborne diseases	Diseases that can spread through contaminated water. The contamination can involve bacterial, viral or protozoan organisms. Examples include cholera (bacteria), dysentery (bacteria), cryptosporidiosis (protozoa), hepatitis A (virus) and giardia (protozoa).
Water pollution	The contamination of water by various pollutants, making it substandard for use and dangerous to human health.

1 INTRODUCTION

The chapter provides background information on South African informal settlements in relation to the provision of water and sanitation. It further highlights the problem area to be investigated in the research, namely water pollution and its negative social impacts on children living in informal settlements. The geographical area covered in the study is outlined. The chapter covers the aims, objectives, problem statement, the motivation for the study and limitations and delimitations of the research. The geographical area covered in the study is outlined.

1.1 BACKGROUND TO THE STUDY

Informal settlements are prevalent in under-developed and developing countries. Rural-urban migration in Africa has exacerbated the sprouting of these settlements. The phenomenon of the ever increasing informal settlements in Africa is also widespread in South Africa. Between 1.2 million to 2.4 million South African households live in informal settlements. In the Ekurhuleni Metro alone, there are 110 informal settlements. In the City of Johannesburg, there are more than 190 informal settlements (Mvukla Trust, 2014). In the vast informal settlements of Johannesburg, sanitation and water supply is inadequate. For sanitation, 52% of the population have dug pit latrines for themselves, 45% rely on chemical toilets, 2% have communal flush toilets, and 1% uses other communal sanitation (Bond, 2010). In addition, water facilities are also inadequate. More than 80% of residents in informal settlements have minimal services, with communal water supply being the norm. These conditions create adverse health and social challenges for the informal settlers and vulnerable groups of people including children. Inadequate sanitation and water supply tend to breed waterborne infections like diarrhoea, dysentery, gastroenteritis and cholera, which may lead to disease epidemics. Under these circumstances, it is undoubtedly expected that children are the most affected by virtue of being minors who need to be cared for (Bond, 2010).

In the past few years, South Africa's informal settlements had experienced water pollution problems, which have social impacts on children in informal settlements. The water pollution problems have attracted media attention, stimulating public debate. These water pollution problems give rise to a wide range of social impacts and are most intense when children are involved.

To date, few studies have been conducted on the social impacts of water pollution on children in informal settlements. Many studies focused on an extensive series of environmental, social, economic and spatial challenges of water pollution in cities, towns and villages. They also concentrated on households. They did not focus on children in informal settlements in South Africa. Water pollution problems have become more frequent and severe in children. This study will identify and evaluate the social impacts of water pollution on children in Kliptown's Tamatievlei, Mandela View and Valentine Village informal settlements in Soweto, Johannesburg.

Access to safe and clean water is widely recognised as a basic human right. Children need to have access to clean water, so that they are free from disease and other health-related risks. Children are a vulnerable group who are also ignorant of the dangers of drinking and playing with contaminated water. The Mar del Plata conference (1977) concluded that all people from different socio-economic levels of development have a right to access safe drinking water. The right to safe drinking water is echoed by Banks in the Report of the United Nations Water Conference in which he purports that people should have water in quantities commensurate to their need levels (Banks, 2009; United Nations, 1977).

Due to the lack of sanitation and proper sewage systems, raw sewage flows into wetlands and rivers in informal settlements. People relieve themselves in and near the rivers because there are few or no toilets or sewage system that supports toilets in informal settlements. Residents also use the same rivers for bathing and washing clothes. Waterborne diseases are rampant in rivers used for washing and exposed to untreated effluent (Hodgkinson & Wilson, 2007). The possibility of being infected by diseases from contaminated water is high where children live in areas without proper sanitation, sewage systems and clean water.

Grey water from bathing, washing clothes and dirty cooking utensils is randomly thrown in and around informal settlements due to the lack of sewer and drainage facilities. Grey water poses serious health hazards to children. The grey water may collect in puddles that can form breeding grounds for disease-causing pathogens. Under these conditions in informal settlements, children are more vulnerable to contracting diseases because they play in the puddles of dirty water outside their shacks.

Role overload and work inequalities are discriminatory subjections experienced by girls that often result in the loss of valuable learning time when they fetch clean water for the family. More girls than boys miss school because they have the responsibility of collecting water, which might be a distance away. In addition, girls often miss or drop out of school because of the lack of sanitary facilities to accommodate them, particularly during their menstrual cycle. In turn, their academic performance may be affected (World Health Organisation & United Nations Children's Fund, 2010).

Waterborne diseases affect family income through public and private health care costs. Parents also consult conventional and or alternative medical systems, such as traditional healers. Income is lost through public health care when parents pay for prescribed drugs for waterborne diseases. The prescribed drugs may not be available or may be out of stock at clinics or hospitals, so parents have to pay for the drugs from private pharmacies. Through private health care, parents may spend money when boarding taxis to private clinics, hospitals or spiritual healers and or herbalists if their children are required to do so. The meagre income of the parents is therefore reduced by having to pay for public and private health care usage. The majority of residents in informal settlements are poor, relying mostly on the government old age and child support grants (Rubin, 2007). The scenario creates challenges in accessing food and paid-for services such as schooling, childcare and electricity. As a result, family income is reduced, thereby exacerbating the families' poverty. This further compromises the general welfare of the children as little or no income will be left to care for them (Zawahri, Sowers, & Weinthal, 2011).

The extent of the social impacts of water pollution also differs within different informal settlements and from time to time. When contamination of water occurs extensively, fatalities can occur, and children are more susceptible in these circumstances. Under-serviced informal settlements face greater health risks. One of the leading causes of infant death in these areas is gastroenteritis. Poor sanitary conditions have resulted in rampant diarrhoeal diseases in a number of informal settlements in KwaZulu-Natal. Repeated use of contaminated water also weakens children's bodies, making them vulnerable to being attacked by many other diseases. It is further noted that half of childhood malnourishment comes from recurring diarrhoea, owing to drinking dirty water. This further reduces the young children's capacity to attend school regularly (Pruss-Ustin, Boss, Gore, & Bartram, 2008).

Kliptown informal settlement, located south-west of Johannesburg in Soweto, has children experiencing some adverse social impacts of water pollution. Kliptown is one of the oldest multiracial districts in Soweto. Until 1990, Kliptown was located outside the Johannesburg municipal area and the apartheid laws and regulations were not applied to the area. The Peri-Urban Health Board administered Kliptown's health services. As a consequence of being outside the City of Johannesburg's municipal boundaries, Kliptown developed independently and was not included in the investment and

infrastructure budget. As a result, Kliptown was left out and became overcrowded with backyard shacks. The natural environment of Kliptown has also been described as “severely degraded”, this is due to the lack of services, especially water, sanitation and waste management (Rubin, 2007).

There are no waterborne flushing toilets, and residents of the Kliptown informal settlement use chemical toilets and ventilated pit latrines. The bucket system of human waste disposal is also still being used in the informal settlement despite the call to stop the practice at the beginning of 2007. All these are unhygienic and out-dated methods of waste disposal that place a significant risk of water pollution related illnesses on children (González, 2008).

In 2005, the Johannesburg City Council announced plans to upgrade Kliptown in a R375 million project, which included a large-scale housing upgrade, improvement of road infrastructure, sewer and drainage systems, the supply of energy and quality water. To date, not much has been done about water supply and sanitation in Kliptown’s informal settlements (Gauteng Tourism Authority, 2014).

1.2 PROBLEM STATEMENT

In the Kliptown informal settlement, children are, physically and socially, adversely impacted by high levels of water pollution. These adverse impacts are due to inadequate sanitation and the low quality of water available to the residents.

1.3 RESEARCH QUESTION

What are the social impacts caused by water pollution on children in the Kliptown informal settlement?

1.4 AIM OF THE STUDY

The aim of the research is:

To identify and evaluate the social impacts of water pollution and the social impacts on children in the Kliptown informal settlement.

1.5 OBJECTIVES OF THE STUDY

The objectives of the study are to:

- Comprehensively define the key constructs in the study; informal settlements, water pollution and social impacts.
- Determine the factors that contribute to water pollution in Kliptown informal settlement.
- Investigate the relationship between water pollution and the social impacts of water pollution on children in the Kliptown informal settlement.
- Propose recommendations on how to minimise the social impacts of water pollution on children in the Kliptown informal settlement.

1.6 MOTIVATION OF THE STUDY

It has been established through informal interviews with residents of the Kliptown informal settlement that sanitation and potable water is generally lacking in the area. Inadequate water supply and sanitation exacerbates physical health-related risks and other social impacts related to water pollution. The study will allow people to gain a better understanding of the social impacts of water pollution on children in the Kliptown informal settlement. It will also make the residents aware of the health risks and their related social impacts associated with water pollution in the area. A better understanding of these risks helps devise sustainable mitigating processes to reduce the social impacts.

Information gained from the study of the social impacts of water pollution would also expand the knowledge base on this impact in informal settlements. Information on the social impacts would also serve as a foundation for further studies in other informal settlements in South Africa and elsewhere in environmental management in particular.

From an academic point of view, the study will help stakeholders such as policymakers, business and civil society to gain an insight into the factors that contribute to adverse social impacts on children in the Kliptown informal settlement. This study will focus on children, who are a vulnerable group that require protection from the dangers of drinking and using contaminated water. This study will also highlight the factors that contribute to adverse social impacts. This focus will auger well with the main aim of the study, which is to identify and evaluate the social impacts of water pollution on children in the Kliptown informal settlement.

In the long-term, knowledge gained from this study and future work is expected to help parents and guardians in reducing the social impacts of water pollution. The knowledge gained will allow them to understand the health risks and other social impacts of water pollution on children in informal settlements in South Africa. The findings from the study may also add a new dimension to the existing studies conducted on the social impacts of water pollution in informal settlements. The findings may also pave the way for further research within this field.

1.7 LIMITATIONS OF THE STUDY

The researcher relied on only one clinic (Kliptown Clinic) in Eldorado Park Extension 8. The choice of the clinic was fundamentally influenced by its central location as a health service centre for the area under study. It was therefore chosen on the basis of its geographical location that places it in a position of servicing health concerns of the area. Based on this premise, it would arguably possess the best records of health issues of Kliptown informal settlement including the social impacts of water pollution. The central location of Kliptown Clinic reduced the potential lack of validity and reliability of the data. The researcher based study findings on the records given by the matron at Kliptown Clinic. The records given by the matron were, however, detailed and helped the researcher to get a good picture of the social impacts of water pollution on children in the informal settlement.

The data collection was performed within a limited time frame. The researcher is employed full time and thus had to collect data on public holidays and weekends. Time allowing, a wider population sample and a larger sampling space could have been used to investigate the social impacts of water pollution in more informal settlements of Kliptown. Despite this limitation, the sample used gave the researcher good ground to make in-depth references between variables in the study of the social impacts of water pollution on children. The detailed findings obtained helped to paint an authentic

picture of the social impacts of water pollution on children and therefore enhanced validity and reliability.

I based the information received on the parents' answers to the questionnaire. Children could not be given questionnaires to answer because of ethical considerations. The parents' responses may have been affected by elements of bias because of the sensitive and confidential nature of health and sanitation issues. However, the interview with the matron mitigated these subjective biases. The investigation focused on children who were only represented by their parents or guardians, therefore excluding child headed families who could be part of the clinic statistics. Parents also reported on the academic performance of their children. This was self-reported data and could, therefore, have been subjective.

Using the questionnaire as a research instrument in the study had some limitations. On structured questions, some respondents gave acceptable responses due to social desirability. Social desirability could have been for the sake of pleasing the researcher by answering what the researcher wanted them to answer. Social desirability was, however, cross-referenced by additional sources such as health clinic data. The respondents could also have been influenced by the setup of the questions and limitations in literacy since the majority of the sampled population was Afrikaans speaking. The questionnaire was administered in English. This might have reduced the reliability of the responses.

1.8 DELIMITATIONS OF THE STUDY

The research focused on only a part of the Kliptown informal settlement (Tamatievlei, Mandela View and Valentine Village), and not all the 12 informal settlements of Kliptown. The study did not provide statistics on all the diseases that have a primary or secondary transmission source that is water and sanitation based. The statistics only covered the illnesses that were presented at the clinic for diagnosis, treatment and referral based on the matron's medical records at Kliptown Clinic. Malaria and bilharzia were not covered as they are vector-borne diseases with the vectors depending on the water for part of their life cycle. Kliptown is not a designated malaria area, nor are there records of bilharzia in the area. The study did not cover all the water pollution related impacts on children, but focused on these interrelated impacts as outlined below:

- Health-related impacts.
- Disposable income related implications as an economic factor.
- Time-related implications, including time spent fetching water and loss of school learning time due to water pollution related social factors.

1.9 ASSUMPTIONS

It is assumed that:

- All parents and guardians who responded to the questionnaires were not visiting the area at the time of the research and had stayed in the geographic research area for at least 12 months.
- The statistics from the clinic represented only residents of the geographic area, and if non-residents presented themselves at the clinic, their incidents were not statistically significant.

1.10 STUDY AREA

Kliptown informal settlement is in Kliptown, a suburb in Soweto, Johannesburg, Gauteng province. Kliptown is about 17 kilometres south-west of Johannesburg as shown in Figure 1. Johannesburg is found in South Africa, in Africa, in the southern hemisphere at 12°S and 4°E of the Equator.

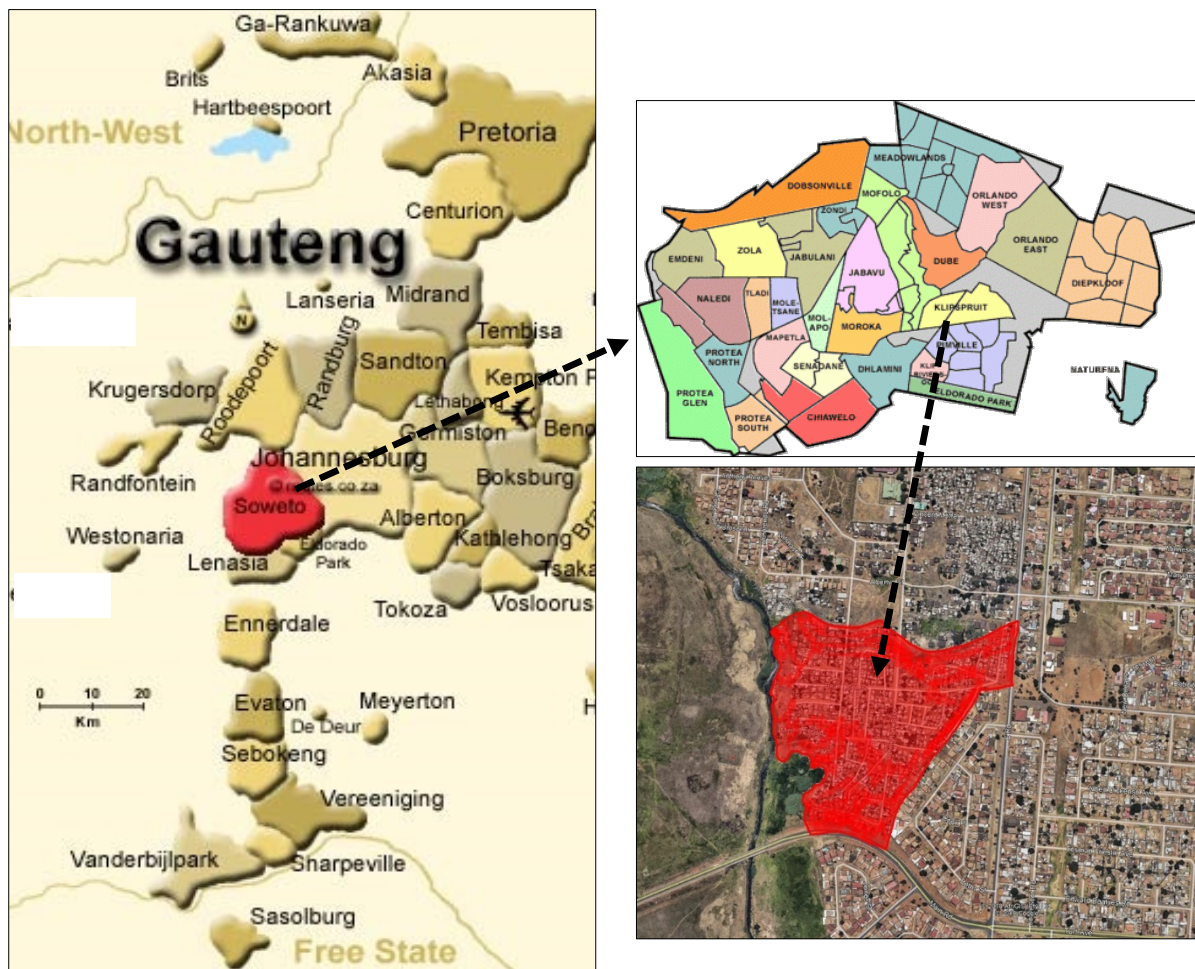


Figure 1 Soweto and Kliptown Informal Settlement in Gauteng context. (Source-Archideevzw.blogspot.com 16/09/2005; South African History Online; Adapted Google Earth Pro).

The climate of Soweto where Kliptown informal settlement is located can be described as warm and temperate. In winter, there is much less rainfall than in summer. The Koppen and Geiger Climate Classification classified the climate of Soweto as temperate, with an average temperature above 10°C (C). Winters are dry, with average monthly precipitation less than 30 millimetres (w). The warmest month has an average below 22°C, but with at least four months averaging above 10°C (b) (Cwb). The annual average temperature in Soweto is 15.8°C. The annual average rainfall is 750mm. The driest month is August with an average of 7mm rainfall. Most precipitation falls in January with an average of 136mm. The warmest month is January with an average temperature of 20.4°C. In June, the average temperature is 9°C (Climate-Data.org., 2015).

1.11 CHAPTER BREAKDOWN

Chapter one provides a background and introduction to the study, covering all pertinent issues, including the research problem, research questions, aims and objectives, motivation, limitations and delimitations. The chapter leads to the literature review.

Chapter two gives insight into the literature that needed to be reviewed. The literature is reviewed, focusing on previous studies on water pollution and its social impacts on children living in informal settlements. The chapter informed the choice of methods used to conduct the study in chapter three.

Chapter three discusses the process that the researcher and participants followed. The focus is on the research design, research population, data collection procedures, research instruments, validity and reliability, data collection procedures, data presentation and analysis procedures and the ethical considerations. The research methodology and design proposed in chapter three informed the case study method that was elaborated and presented in chapter four.

Chapter four justifies the use of the case study approach. It also provides the background of the Kliptown informal settlement, description of the study area, demographics of the participants and their challenges and opportunities. The data relating to the case study is then collected and presented in chapter five.

Chapter five focuses on the data collected, data presentation, data analysis and contextual discussion. The findings of the study are presented both in text and graphic presentation and led to the conclusions and recommendations in chapter six.

Chapter six summarises the findings and results in conclusive statements. Based on these conclusions, recommendations are suggested.

2 LITERATURE REVIEW

This chapter presents a literature analysis and review. It highlights the central issues and constructs of the study, which are informal settlements, water pollution and social impacts on children. The chapter begins by defining the key constructs in the study. The antecedents or precursors to social impact on children are identified and discussed. Thereafter empirical evidence on pollution and its associated biological, physiological, economic and social problems is explored. The review will highlight issues around water pollution and its impact on sociological issues on children. In concluding this chapter, a summary of findings emanating from the review of literature is presented.

2.1 DEFINITIONS OF CONCEPTS

In this section, key concepts are identified and defined, namely informal settlements pollution, water pollution, biological and physiological perspectives of pollution, socio-economic perspectives of pollution.

2.1.1 Informal settlements

As a starting point, it is critical to have a working definition of “informal settlements” to explicate an appropriate entity of research. There are a number of definitions from different academic and non-academic authorities, which have minor variances. Most of the definitions highlight the type of dwelling, ownership of land, land tenure and regulatory dynamics (Ali & Sulaiman, 2006; Housing Development Agency, 2013; Napier, 2000; Statistics South Africa, 2011; The National Department of Human Settlements - South Africa, 2009) ; City of Tshwane Metropolitan, 2016). Informal settlements

are areas where housing formations are constructed on land that the occupants have no legal entitlement to and therefore occupy their dwellings illegally. These are unplanned settlements in areas where housing is not in compliance with planning and building regulations of central government, provincial government and local authorities (Napier, 2000; Organisation for Economic & Cooperation and Development, 2001).

Informal settlements are characterised by lack of infrastructure and services such as potable water supply and refuse collection. There is zero or minimal control or administration of service provision from local authorities because of the challenges relating to the boundaries of these settlements. Informal settlements are not formally proclaimed nor demarcated, the boundaries of informal settlements are fluid, and their growth is not planned for. This problem of planning is particularly pronounced in informal settlements and creates sanitation challenges. Sanitation problems are prevalent because the water facilities and sewer coverage are inadequate (De Wet, Mathee, & Barnes, 2001). Furthermore, maintenance is difficult because overcrowding in the area prevents waste removal and repair of damaged sewer pipes. Hence, litter and waste (raw sewage, wash water, kitchen waste and other domestic wastewater) are either dumped on free land or straight into gullies or adjacent rivers (Swinburn, Goga, & Murphy, 2006).

An analysis of some definitions from the various authorities helps create a workable consolidated definition of the informal sector. Statistics South Africa (2011) defines informal settlements as unplanned settlements that are often found on land that has not been surveyed or proclaimed as residential, and they mainly consist of makeshift structures not approved by a local authority and not intended for a permanent dwelling (Statistics South Africa, 2011). The National Department of Human Settlements in their 2009 National Housing Code's Informal Settlement Upgrading Programme identified informal settlements on the basis of the following characteristics, illegality and informality, inappropriate locations, restricted public and private sector investment, poverty, vulnerability and social stress. This definition highlights key characteristics, (poverty, vulnerability and social stress) that strongly exhibit socio-economic dimensions relating to pollution in informal settlements.

From a local authority perspective, it is important to discuss their trajectory in defining informal settlements. The City of Tshwane Metropolitan Municipality defines informal settlements from a legal perspective, focusing on by-laws relating to the management and control of informal settlements. The Tshwane Municipality defines these settlements as any temporal shelter in the form of a hut, tent, dwelling, building or any structure for mainly residential purposes that does not comply with the provisions of the National Building Regulations and Building Standards Act, Act 103 of 1977 (Parliament of South Africa, 1998), the regulations promulgated under that Act and the Municipality's Building Control By-laws (City of Tshwane Metropolitan Municipality, 2016). This definition brings out more of the illegal nature of the formation and establishment of informal settlements. The City of Johannesburg Metropolitan Municipality's working definition is more aligned with the definition the National Department of Human Settlements (The National Department of Human Settlements - South Africa, 2009). The City of Johannesburg takes a socio- economic perspective defining informal settlements as "an impoverished group of households who have illegally or without authority taken occupation of a parcel of land (with the land owned by council in the majority of cases) and who have created a shanty town of impoverished, illegal residential structures built mostly from scrap material without provision made for essential services and which may or may not have a layout that is more or less formal in nature" (Housing Development Agency, 2013).

For the purpose of this research informal settlements are defined as "unplanned" human settlements consisting of buildings constructed from low quality building material, that do not meet basic planning and regulatory standards of rural and urban planning. Informal settlements are characterised by physical planning disorder, environmental degradation and pollution risks, poor social and economic

infrastructure and services due to lack of space and accessibility. Kliptown informal settlement has these characteristics highlighted above which will be further substantiated in the investigations in this research.

2.1.2 Pollution

The study aims to investigate the impacts of water pollution on children living in informal settlements. It is pertinent to define and briefly discuss pollution in general and identify other forms of pollution in order to distinguish and be target specific on water pollution. Secondary effects from the other forms of pollution on children can be identified. A deeper understanding of the types of pollution and their associated environmental pollution impacts help to create sustainable control measures to minimise pollution and the impacts. Pollution is defined as the impairment of the beneficial use(s) of the environment. The impairment results in quality depreciation of the environmental benefits (De Villiers, 1992). Environmental pollution is classified into three broad categories, namely atmospheric pollution, hydrosphere pollution and lithosphere pollution. Figure 2 highlights the different types of pollution that have some formations and effects that are interrelated. Of particular interest is the relationship between soil pollution and water pollution where soil contamination occurs when chemicals are released by spills or underground leakages. Among the most common soil contaminants are hydrocarbons, heavy metals, herbicides and chlorinated hydrocarbons. Water pollution is the contamination of water bodies, lakes, rivers, oceans, aquifers and ground water which can be caused by marine dumping, industrial waste, sewage, nuclear waste, oil contamination and underground storage leaks (Cunningham, Cunningham, & Woodworth Saigo, 2009; Nathanson & Scheinder, 2014; Watson, 2007). The causal effects outlined above indicate to a greater degree that polluted water can be a lubricant or distributor of soil contaminants and vice versa. These types of pollution have a multitude of effects on the environment and its inhabitants. The scope of the research is limited to water pollution, and therefore the next focus of the discussion will be on the definition of water pollution.

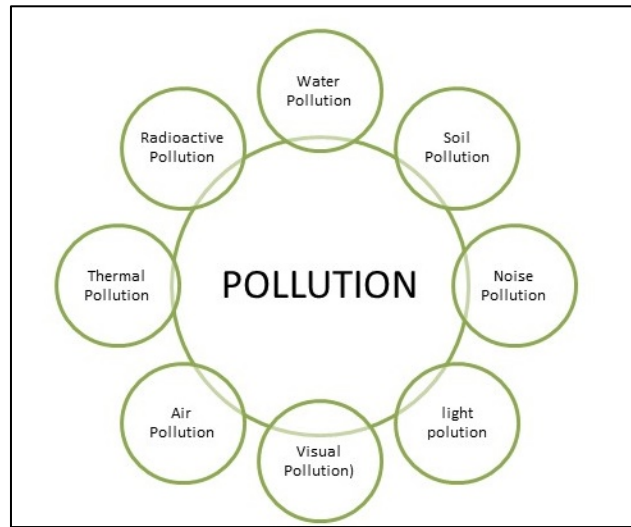


Figure 2: Types of pollution (Source- Adapted from (Reeve, 2002))

Water pollution is the contamination of water bodies, lakes, rivers, oceans, aquifers and ground water which can be caused by marine dumping, industrial waste, sewage, nuclear waste, oil contamination and underground storage leaks (Cunningham, Cunningham, & Woodworth Saigo, 2009; Nathanson & Scheinder, 2014; Watson, 2007). The causal effects outlined above indicate to a greater degree that polluted water can be a lubricant or distributor of soil contaminants and vice versa. These types of pollution have a multitude of effects on the environment and its inhabitants. The scope of the research is limited to water pollution, and therefore the next focus of the discussion will be on the definition of water pollution.

2.1.3 Water pollution

Water pollution can broadly be defined as the contamination of water by foreign bodies that include biological, chemical and physical contamination. Biological water pollution has two main forms, infectious disease from virus, bacteria, protozoa, algae and fungus and oxygen demanding waste. Chemical water pollution is caused by nutrients (fertilisers), toxic inorganic materials, and persistent organic pollutants. The third type of water pollution is physical agents which include sediments, thermal contaminants and solid waste (Chapman, 1996; De Villiers, 1992). Water pollution results from any input into the water cycle, which alters the water quality resulting in impaired water usage. Water pollution includes all of the waste materials that cannot be naturally broken down by water.

Pollution of water can be induced by nature in some circumstances, for example, when water flows through soils with high acid levels. Human actions are responsible for the pollutants that enter the water cycle (World Health Organisation, 2002).

Water pollution is mainly a deterioration of water quality seeing that the quality of any body of surface or ground water is a function of either or both natural influences and human activities. Nature induced water pollutants include bedrock minerals, atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, the leaching of organic matter and nutrients from the soil, hydrological factors that lead to runoff and biological processes within the aquatic environment (Stark et al., 2000). The classification of types of water pollution is critical in this research because it helps identify the prevalent type in informal settlements. The identification of the types of water pollution will also give guidance in analysing the effects of water pollution on socio-economic dynamics in the informal settlements. In this research, the focus is on human induced water pollution, which includes industrial waste, household waste, chemical fertilisers and pesticides. The scope of the paper is to investigate the social impacts of water pollution on children, therefore, from the discussion above water pollution will be defined from a quality deterioration and quantity assessment on the characteristics of the water relative to the beneficial usage of the water. The impairment of the water by household waste is the main focus in the discussion. The components of water pollution, which include types of pollution and the effect of pollution on water quality gives sufficient background to unpack the social impacts of water pollution on children living in informal settlements.

The effects of water pollution are numerous. Some effects are recognised immediately, whereas some do not show up for months or years. When toxins are in the water, they can enter the food chain and affect humans. Infectious diseases such as typhoid and cholera can be contracted from drinking contaminated water. This is called microbiological water pollution. The human heart and kidneys can be adversely affected if polluted water is consumed regularly. Other health problems associated with polluted water are poor blood circulation, diarrhoea, skin lesions, vomiting and damage to the nervous system. In fact, the effects of water pollution are said to be the leading cause of death for humans across the globe (Muhammad, Muhammad, Ismael, & Karamat, 2010).

Water pollution has adverse effects on the health and life of man, animals and plants alike. Of particular concern are the hazards occurring in informal settlements. In general, informal settlements are characterised by high-risk locations, ramshackle shelter, and inadequate access to basic environmental health services. Living conditions in informal settlements predispose residents to a wide range of ill health conditions (World Health Organisation, 1992). It is explicit in this discussion that housing, which includes shelter, water supply, sanitation and solid waste management aims to inhibit water pollution and improve the physiological and biological health of individuals. The biological well-being of an individual has an overarching influence on their socio-psychological development; pertinent issues around social impacts of water pollution will be discussed below.

2.1.4 Definition of social impacts

Social impacts may be defined, “as the consequences to human populations of any public or private actions that alter the ways in which people live, work, play, relate to one another, organise to meet their needs and generally cope as members of society” (Glasson, 2009). A similar sentiment is echoed by Burdge and Vanclay in that social impacts include all social and cultural consequences to humans that change the ways in which people live, work, play or relate to one another and generally cope as members of society (Rabel J Burdge & Vanclay, 1996). Social impacts include people’s environment, which includes the quality of water people use, availability and quality of food they consume, the adequacy of sanitation, their physical safety, their access and control over resources and their health and well-being among other things (R.J. Burdge & Vanclay, 1995; Vanclay, 2002, 2003). Social impacts may, therefore, be defined simply as how people’s lives are affected by developments, projects or actions and interfering with how they live, work, play or relate to one another.

Social impacts also include changes in how people live, their culture, community, political systems, environment, health and well-being, their personal and property rights and their fears and aspirations. Projects with significant social impacts include landfill and hazardous waste disposal sites (perceived health risks, loss of amenity); power and industrial plants (community stress from influx of work force, pressure on infrastructure); dams and reservoirs (lifestyle disruption resulting from relocation, land use alteration or long lead time to fill impoundment); and roads and linear developments (dislocation of activity networks and relationships) (Centre for Good Governance, 2006). Informal settlements are not immune to some of the project changes mentioned above.

The main types of social impacts that happen as a result of project-related changes mentioned above can be grouped into five overlapping categories. The five overlapping categories are lifestyle impacts, cultural impacts, community impacts, quality of life impacts and health impacts. Lifestyle impacts affect people’s behaviour and how they relate to family, friends and cohorts on a day to day basis. Cultural impacts affect shared customs, obligations, values, language, religious beliefs and other elements which distinguish a social or ethnic group. Community impacts affect infrastructural service provision and maintenance, voluntary organisations activity networks and cohesion. Quality of life impacts affect the sense of place, aesthetic and heritage, perception, belonging, security and liveability and aspirations for the future. Lastly, health impacts affect mental, physical and social well-being although these aspects also fall under the subject of health impact assessment (Centre for Good Governance, 2006). In informal settlements, all the five overlapping types of social impacts are found, and these tend to affect children more.

Social impacts affect a group of people or a community, not individual people as is the case in informal settlements. Social impacts have a common trend among a group of people. Societal challenges arising from water pollution can be varied in their intensity. The different societal stratification demographics are diversely impacted upon by water pollution. In this study, the focus is on children and, therefore, a brief reference to social impacts on children is presented.

Statistics SA indicate that just fewer than one million children under the age of 18 live in informal settlements accounting for 5% of all children in South Africa (Statistics South Africa, 2012). The age distribution of children living in informal settlements is illustrated in Table 1 below.

Table 1: Number and percentage of children by age group

Age group of children	Number of Children in informal settlements	Percentage	All children	Percentage
0-4	371 556	38%	5 685 452	31%
5-10	302 806	30%	5 733 976	32%
11-14	172 908	18%	3 680 661	21%
15-17	136 640	14%	2 967 882	16%
Total	983 910	100%	18 067 971	100%

Source- Statistics SA, 2011

Table 1 shows that there are a comparatively high proportion of very young children in informal residential areas compared to the other age groups. This reflection can be an indication of a high reproductive population and the need to accommodate the anticipated increase in children and growth in population. The definitions above summarise all elements that influence the way people live in a community or society.

Social impacts caused by water pollution on children in this study will include how the children's way of life and the manner in which they play and interact with one another is influenced (lifestyle impacts). Social impacts will also include the impact of the quality of water used, the adequacy of water, the adequacy of sanitation, access to and control over resources, dignity, and social interaction, access to basic services (health facilities, education and safe playing environment) and the health and well-being of children.

The study will also cover health-related impacts, disposable income related implications to children as an economic factor and time-related implications, including time spent fetching water and loss of learning time due to water pollution related social factors. For the girl child, there are issues of sanitary ware and work overloads, manifesting themselves as social ills.

In discussing social impacts, it is critical to look at constitutional provisions because the South African Constitution provides arguably the most sophisticated and comprehensive system for the protection and projection of socio-economic rights. Among other things, the Constitution of South Africa states that all people should have access to sufficient water (South African Parliament, 1996). This part of the constitution is a clear guideline relevant to the topic under discussion. Consequently, severe water pollution experienced in informal settlements is arguably threatening human health, with severe adverse impacts on children. This is because children are by nature vulnerable and susceptible to epidemics.

2.2 DRIVERS OF WATER POLLUTION

The following section addresses the drivers of water pollution. Sanitation, sewage and water as a medium for disease transmission are drivers of water pollution. Water pollution *per se* causes social impacts on communities.

2.2.1 Water and sanitation

Lack of access to proper sanitation is an affliction to the vulnerable and marginalised groups of the population, particularly children. Inadequate sanitation impairs communities' ability to mitigate the health-related impacts of water pollution in children. Due to inadequate sanitation, children are exposed to germs and bacteria which may result in them contracting diarrhoea. Children under the age of five account for 90% of all deaths that occur from sanitation-related diarrhoea, this is equivalent to 5000 children each day worldwide (Cumming, 2008). It is estimated that 1.2 billion people worldwide gained access to improved sanitation between 1990 and 2004, while an estimated 2.6 billion people including 980 million children had no toilets at home. If the current trend continues, there will still be 2.4 billion people without basic sanitation in 2015, and the children among them will continue to pay the price in lost lives, missed schooling due to disease, malnutrition and poverty. Using proper toilets and hand washing, preferably with soap, prevents the transfer of bacteria, viruses and parasites found in human excreta, which would otherwise contaminate water resources, soil and food (World Health Organisation & United Nations Children's Fund, 2010, 2015).

In 2010, it was estimated that 115 people, among them children in Africa, die every hour from diseases linked to poor sanitation, poor hygiene and contaminated water. Lack of access to safe water and sanitation kills more children than malaria, measles and HIV/AIDS combined (United Nations Children's Fund, 2010). It is, therefore, important to make sure that children have adequate sanitation and clean water, particularly in informal settlements.

Cumming added that the combined impact of inadequate sanitation as a driver of diseases- typically malnutrition, diarrhoea, endemic cholera and respiratory infections- might make the lack of sanitation

the biggest killer of children of less than five years old leading to the deaths of approximately 2.4 billion children each year (Cumming, 2008). The statistics on mortality are reported by different institutions. However, there are no sustainable solutions implemented to mitigate the crisis (World Bank, 2007).

In South Africa, there is a lack of water and sanitation services to households in informal settlements. Most informal households do not have basic water and sanitation services. In the Joe Slovo informal settlement in Langa, Cape Town, sanitation delivery was not planned, and the community uses self-provided pits. Children also play in a canal that is contaminated with faeces. Faecal contamination was evident in the canal in the form of visible faeces. 50% of the residents, particularly children, were found to have diarrhoea and 37% were infested with worms (Lagardien & Cousins, 2004).

In Imizamo Yethu informal settlement in Hout Bay, Cape Town, widespread use of the bucket system also posed serious health problems to children. In and around the informal settlement, grey water and solid waste contamination were evident. Waterborne toilets were in use, although they were inadequate and overburdened. Blockages and overflowing raw sewage were also evident. Continually leaking pipes also allowed sewage to seep into the river that the informal settlers use. Under these conditions, it is evident that children were exposed to unhygienic conditions and could easily contract waterborne diseases (Lagardien & Cousins, 2004).

One study at an informal settlement in Khayelitsha in Cape Town, South Africa, revealed that inadequate water supply and sanitation resulted in 316 children (96%) testing positive for having worms in their bodies in 1999. Ablution block facilities and container toilets were in use. All were too crowded, leading to overflows due to erratic emptying. Faeces were also found on the ground, and the soil contained worm eggs (Lagardien & Cousins, 2004).

In Nairobi, Kenya, many children died due to lack of adequate water supply and sanitation. According to a report by the African Population and Health Resource Centre (APHRC) in 2002, infant and child mortality risks were particularly high in the slums of Nairobi. For instance, the under-five mortality was 35% higher among slum residents in Nairobi than among the rural population in Kenya (Kimani-Murage & Ngindu, 2007). The report attributed this pattern to poor water quality and supply as well as inadequate sanitation in these slum settlements.

Another social impact of water pollution caused by lack of sanitation in informal settlements is a loss of valuable learning time. Scarce financial resources to meet family needs aggravate the strain on the resources required for school support. According to the UNDP Human Development Report of 2006, approximately 443 million school days are lost each year due to illnesses caused by a lack of access to water or access to a poor water source. (UNDP, 2006). It is further noted that water-related illnesses increase absenteeism rates in schools, depriving children of the well-being and education necessary for them to become productive citizens in the future (Adeleye, Okelola, & Medayese, 2014).

In Deh Mazang, a hillside settlement in west Kabul in Afghanistan, children also miss school by taking up income generating piece jobs because of water scarcity. Economic challenges faced by households in Deh Mazang related to water scarcity and pollution forced children in the informal settlement to seek income generating employment. Children occupied in income generating jobs have difficulties attending school regularly and do not perform well academically (Cooperation for Peace and Unity, 2011).

When children contract diseases due to inadequate water supply and sanitation, resulting costs of treatment of water-related diseases drain resources from their families. At the household level, the poorest families, as is the case in informal settlements, are forced to use scarce financial resources from government subsidised grants, piece work and informal activities for health services. The limited

financial resources would have otherwise been spared to other important needs such as children's education or to save money for unexpected occurrences (Adeleye et al., 2014).

2.2.2 Sewage contamination of water

In informal settlements, disease-causing germs can be spread from sewage if it is not disposed of properly and threaten vulnerable groups such as children. The disease-causing germs and parasites can be spread directly by people coming into contact with sewage or toilet waste. This can happen, for example, if children walk through sewage which has leaked onto the ground from overflowing mobile toilets. The practice of walking through sewage is common, as over spilling sewage is almost a permanent feature in informal settlements and it exposes children to water-related infections (Lucas & Gilles, 2002).

If people do not practice proper toilet hygiene (cleanliness), disease-causing germs from sewage can also be spread. The practice of not washing hands after using the toilet can help to spread germs to food. Proper toilet hygiene should be practised to avoid the spread of diseases. Proper toilet hygiene entails washing hands after using the toilet. In informal settlements, there are no taps outside the mobile and bucket system toilets, a scenario which exposes children to unhygienic conditions (Australian Government Department of Health and Ageing, 2010).

Indirectly, the disease-causing germs and parasites can be spread by people coming into contact with insects such as flies and cockroaches which carry germs and parasites in or on their bodies. Dogs and cats can carry germs and parasites too. Children are more vulnerable to contracting diseases as they play with pets like dogs and cats at home. Refuse that has accrued also enhances the breeding of rodents. Man cannot be set apart from refuse generation. Refuse stems from the activities of man. In informal settlements, the administrative boundaries are not clearly defined which inhibits the provision of basic services. Refuse and domestic waste accumulates because of inconsistent refuse removal. Lack of physical infrastructure such as roads in informal settlements worsens the problem. Heaps of refuse favour the breeding of rodents and vectors as they tend to live and breed in improperly disposed rubbish. Poor disposal of refuse impacts negatively on human health, particularly children as they tend to play on roads filled with garbage that accrues as a result of not being collected regularly (Lucas & Gilles, 2002).

Pollutants such as human waste and sewage can cause disease in communities. Human waste and sewage contain bacteria that decompose these wastes in water, thereby degrading the water quality. By drinking water contaminated with human waste, children are especially vulnerable to the acquisition of giardiasis, an infection of the intestines that can lead to vomiting and intense nausea. Some children may not show the symptoms of giardiasis but may pass the infection to other children. Giardia-infected children have the risk of having stunted and poor psychomotor development. This negatively affects their learning process. Tyler-Miller (2003) identifies the problem of waste contaminated water as one of the reasons for inhibitive participation in extracurricular activities at school (Tyler-Miller, 2003).

The Umtata River catchment area in the rural Eastern Cape of South Africa, which is mostly used for domestic and recreation purposes, is heavily polluted by human and animal waste. People defecate in the river and animals drink from the same river that people use for their domestic purposes. The risk of contracting waterborne diseases like diarrhoea in rural communities, particularly to children, along the Umtata River is very high if no immediate action is taken to stop the growing water pollution. Children face the risk of contracting water-related illnesses because they cross the river daily when going to school. Chances are very high that children are tempted to drink water from the river on their journey to or from school (Fatoki, Muyima, & Lujiza, 2001).

Animal waste from domestic animals kept in informal settlements also poses serious health risks to children. Animals defecate in and around the informal settlement, and due to poor water supply, hygiene and poor water storage, water pollution may result. In addition, animal faeces may also seep into nearby streams that the inhabitants use. Defecation from domestic animals that include dogs, sheep, goats, cattle, pigs, chickens, ducks, turkeys, donkeys, horses and others is a common problem in informal settlements in developing countries. Many of these animals roam about in the settlements while some of them reside in smallholdings in the backyards. Children are also at risk of trampling on the faeces produced daily by these animals (Owusu-Asante & Ndiritu, 2009).

The majority of the owners of these domestic animals rarely clean up or properly dispose of the waste from domestic animals. As a result, bad odour from the animal waste is a serious problem in these communities. Children are exposed to unhygienic conditions in their surroundings in terms of *E. coli* bacteria and pungent odour from the animal faeces. The assertion that bad odour influences a child's health was supported by the Agency for Toxic Substances and Disease Registry. This agency noted in 2016 that odours could become a nuisance and bother children causing symptoms such as a headache, nausea, nasal congestion, chest tightness, eye, nose and throat irritation, coughs and drowsiness among other symptoms. Bad odour also attracts flies and fleas which in turn transmit bacteria on food and water sources (Agency for Toxic Substances and Disease Registry, 2016).

2.2.3 Water as a medium of disease transmission

There are identified four categories of water pollution induced diseases. These categories are water-washed, water-based, waterborne and water-related insect vector (Cairncross & Feachem, 1994). Banks noted that the lack of clean water could cause occurrences of water-washed diseases (Banks, 2009). Water-washed diseases include scabies, trachoma, shigella and conjunctivitis. Water-washed diseases are contact diseases which are spread when children wash or play in the dirty water. Skin and eye infections were found to be a consequence of inadequate hygiene and poor sanitation in informal settlements in Tanzania. A study of 678 households in eight villages in the Kongwa District in Tanzania concluded that latrine use was greatly linked to a reduction in trachoma cases in children (Montgomery, Desai, & Elimelech, 2010). Inadequate hygiene was also a risk factor with high rates of trachoma infections in children in Dodoma being significantly linked to unwashed faces (McCauley, Lynch, Pounds, & West, 1990). Inadequate water supply and sanitation combined with poor hygienic practices were thus blamed for the occurrence of skin and eye infections in informal settlements of Tanzania.

Schistosomiasis (bilharzia) is another water-based disease that is transmitted by snails in fresh water. Water can be contaminated by larva forms of the (Schistosomiasis) parasite, especially in communities without access to safe drinking water. Inadequate hygiene and contact with infected water make children especially vulnerable to infection (World Health Organisation & United Nations Children's Fund, 2015).

Schistosomiasis poses serious health risks to children. Schistosomiasis can cause anaemia, stunting and a reduced ability to learn, although the effects can be reversible with treatment. The number of deaths due to Schistosomiasis is difficult to estimate because of hidden pathologies such as liver and kidney failure and bladder cancer. Estimates of Schistosomiasis vary from 20,000 and 200,000 deaths per year worldwide (World Health Organisation & United Nations Children's Fund, 2015).

Water pollution and poor sanitation increase the prevalence of waterborne diseases. They are mainly spread by consumption of unhygienic handling of food and water. The common waterborne diseases are cholera, typhoid and dysentery (Cairncross & Feachem, 1994). Drinking water which has been contaminated with sewage also increases the spread of disease-causing germs and parasites. Children can, for example, pass out diarrhoea in open places. Disease-causing germs and parasites can transmit

the germs from diarrhoea passed out by children to food which in turn can make the children sick (Lucas & Gilles, 2002).

Water-related insect vector diseases are spread by insects, for example, mosquitoes and tsetse flies. In many places, the transmission of malaria is seasonal, with the peak during and just after the rainy season (World Health Organisation, 2015). In informal settlements, mosquitoes breed in pools of stagnant water. Pools of stagnant water are a common feature. Grey water is randomly disposed of because of the absence of sewers and drainage pipes. Under these conditions, puddles of water may collect due to frequent disposal, thereby creating conditions for disease-causing organisms to breed. Children are more vulnerable to contracting diseases since they play around these dirty water sources. Mintz, Bartram and Lochery noted that sustainable water management practices help to combat incidents of water-related epidemics (Mintz, Bartram, Lochery, & Wegelin, 2001).

2.2.4 Gender implications

In informal settlements, access to sanitation is a serious challenge. The burden of inadequate access to sanitation weighs more heavily on women and vulnerable groups like children than any other category of the population. Gender inequality damages the health of millions of girls and women across the globe. In Sub-Saharan Africa, the cultural values place immense responsibilities on women and girl children. They are responsible for collecting water and maintaining proper hygiene at the household and community levels. Communities and households, on the other hand, provide inadequate sanitation for women and girls thereby enhancing gender discrimination. Women and girls are forced to use indecent sanitation facilities because sanitation facilities are inadequate or do not cater to them. There is thus a need to increase access to sanitation facilities that address the needs of various groups of vulnerable poor women and children, especially in informal settlements (Kakuru & Dauda, 2010).

The girl child suffers more if there is a lack of safe water and sanitation. This is mainly because women and girls tend to spend more time fetching safe water for the whole family rather than being in school or paid employment. Culturally, it is the duty of women and girls to fetch water for the family. This is because they use water for household chores. The practice makes women and girls collect more water than do their male counterparts. This responsibility burdens women and the girl child. This comes about when the girls have little or no time to do their school work due to fetching water at home after school. The gender gap between the male and female children is thus widened (UNDP, 2016; United Nations, 2008),

In Deh Mazang, for example, it was noted that the girl child has to fetch clean water for the family to use for their daily needs. Hence poorer households and ones located further away from water points or wells are victims of the bad water circumstances. The households located far away from the water points and wells mean that their girl children would take longer to fetch water from water points to their homes, from twenty minutes to two hours (Cooperation for Peace and Unity, 2011). The time consuming nature of fetching water takes most of the girl child's time, making it difficult to make time for other activities. The fact that the girl child fetches the water from very distant areas is also not a guarantee of the cleanliness of the water. The prevalence of illnesses due to polluted water still exist. Children are forced to walk long distances to fetch water because governments fail to put water and sanitation as priorities for all (Adeleye et al., 2014).

A decline in access to safe drinking water has a negative impact on education, particularly of the girl child. Illnesses related to drinking water and the time spent collecting water can in some cases prevent children from attending school. There is a positive correlation between school attendance and distance from water sources. In Tanzania, for example, school attendance levels were 12 % higher for girls who live within 15 minutes of a source than girls who live an hour away (Fogden, 2009).

There are several risks associated with girls fetching water from distant sources. The risks include the indignity of being forced to defecate in the open, the risk of assault and rape and the risk of injury due to the rugged terrain where children pass through when fetching water (Suskind, 2008). Distant water fetching by girl children also exerts physical strain that can create shoulder and back pain illnesses. Exhaustion and pain caused by fetching water from distant sources affect a child's school attendance and performance. Furthermore, the long queues at the water points and wells may be a source of conflict and violence among girl children standing in the lines at the water points and wells. Conflicts between children further lead to conflicts between families (Cooperation for Peace and Unity, 2011).

Children, particularly girls, are denied their right to education because their schools lack private and decent sanitation facilities for them. In some cases, boys and girls share the same toilet facilities. In such instances, girls fail to attend school regularly (particularly when menstruating) because there is no privacy when boys and girls share the same toilet facilities. The affordability and financial capacity to provide sanitary pads in these poor communities where unemployment rates are high, are non-existent. Absenteeism from school among girls is higher than boys due to sanitation and personal hygiene barriers in schools and at home. At a social level, girls do not participate in extra curricular activities because they have no access to sanitary pads. It also widens the gap in performance and opportunities afforded to girls and boys (Adeleye et al., 2014).

Indirectly, the lack of sanitation hinders the achievement of girls compared to boys. This is because, in the absence of toilets, girls will stay at home rather than go to school. In this case, the girl child is likely to perform badly in school due to continuous absenteeism. Absenteeism is prompted by the need to fetch clean water for themselves during their monthly periods (US Department of Health and Human Services - Office on Women's Health, 2008). Aggregation of this discussion shows that gender implications are a critical obstacle in the provision of socio-economic provisions that are impacted by water pollution. The rights to education, rights to water and sanitation and the rights to housing are violated.

2.3 FACTORS CONTRIBUTING TO WATER POLLUTION

2.3.1 Unplanned nature and inconsistent application of the policy of service provision in informal settlements.

The main factor contributing to high levels of water pollution in informal settlements is the fact that informal settlements are illegal and unplanned and so do not have proper water and sanitation facilities. Lack of legal status of informal settlements typically arises because of the informal settlers encroaching and living on land owned by the government. Housing developers are not willing to invest in non-permanent structures which informal settlers build, as they may be demolished at any given time (Katukiza et al., 2010).

Informal settlements are not planned so they lack basic infrastructure and vital services. Among other things, they lack proper sanitation and water supplies (Banks, 2009). A study in the Langas slum in Kenya, echoed the same sentiments. In this case, informal settlements had many challenges resulting from a lack of basic infrastructure. The lack of water and sanitation infrastructure resulted in unhealthy environments that favoured the proliferation of epidemics. Children were not spared from the unhygienic conditions and diseases associated with the unsanitary conditions in these informal settlements (Kimani-Murage & Ngindu, 2007).

Many governments view informal settlements as problematic areas associated with many challenges such as poor housing, sickness, malnutrition and crime among other challenges. Consequently, most municipal authorities tend to ignore addressing informal settlement infrastructural needs (Lloyd,

1979). This, coupled with the fact that the demand for services far outstrips the municipal capacity to meet these needs, poses a strain on remedial programmes (Joyce, Perez, & Solo, 1993)). Informal settlements do generally see *ad hoc* regularisation, but this happens far too slowly (Dagdeviren & Robertson, 2009). Until regularisation occurs, lack of safe water and sanitation remains a critical problem.

South Africa has a policy to address the needs and priorities of people living in informal settlements though the policy is applied inconsistently. People in informal settlements in South Africa are provided with sanitation, although it is inadequate. Other informal settlements also take too long to receive services. Some of the sanitation facilities are overburdened, and blockages are frequent (SA Cities Network, 2006). Table 2 below shows the percentage of sanitation needs in informal settlements in South Africa by province in 2011.

Table 2: Percentage sanitation needs: Informal Settlements in 2011

Province	Percentage of population without adequate services	Percentage of population with adequate services
Eastern Cape	91%	9%
Free State	12%	88%
Gauteng	41%	59%
KZN	10%	90%
Limpopo	69%	31%
Mpumalanga	84%	16%
North-West	99%	1%
Northern Cape	24%	76%
Western Cape	4%	96%

Source-Adapted from (Department of Water Affairs - Sanitation Services, 2012).

The above findings show that sanitation is generally lacking in North-West, Northern Cape, Eastern Cape, Mpumalanga, Limpopo and Gauteng provinces in South Africa. The implication is that the unavailability of sanitation creates obstacles to basic hygiene around the home, especially for children. As a result, children are prone to acquiring diarrhoea, worm infestations and other infectious diseases spread via contaminated water and unhygienic practices.

2.3.2 Lack of roads, sewer and ablution facilities

Lack of basic infrastructure and services for collection and safe disposal of solid and liquid waste in informal settlements has contributed to water pollution which has a negative social impact on children. The lack of proper roads, sewer and ablution facilities and infrequent disposal of refuse is a challenge. Refuse removal trucks fail to collect the solid waste from informal settlements due to lack of proper roads.

In slums where there is no free movement for vehicles or where owners are not able to pay for the service of a vacuum tanker, local contractors manually empty pit latrines on the side walls of the faecal sludge chamber. The practice affords health risks to the workers who may step over human waste. There is also no control over the disposal of the excavated material (Katukiza et al., 2012). Despite the fact that it is relatively cheap to keep the pit latrines operational, it is unhygienic and exposes children

to human excreta in their living environment. Unfortunately, pit latrines are the dominant type of excreta disposal facilities in urban slums and continue to threaten children's health.

The absence of sewer and ablution facilities for bathing and washing clothes force the residents to throw their grey water in and around the informal settlement. Some grey water is also disposed of on garbage which will have accrued at different points within the settlement. As garbage continues to pile up, it becomes a haven for disease-causing germs in the human environment. Children are more susceptible to contracting diseases that are spread by germs since the germs are present in their playing environment (Puling & Van der Merwe, 2004). It, therefore, becomes necessary to implement environmental degradation awareness programmes. Improper refuse collection constitutes a threat to children's health (Lucas & Gilles, 2002).

2.3.3 Lack of money and space to install sanitation and water services

Another factor that contributes to the negative social impact of water pollution on informal settlements is the high cost of installing sanitation and space. The high cost of installing sanitation is compounded by the fact that informal settlements continue to grow daily. According to the Cape Town Water Services Development Plan (in Lagardien and Cousins, 2004), provision of basic services to households living in informal settlements is expected to require an expenditure of R5million per annum. There are approximately 18 100 households without adequate water services and 53 000 households without adequate sanitation services at present. The actual investment in sanitation and water provision, however, changes due to unanticipated growth in informal settlements. Unanticipated growth in informal settlements is due to the ever increasing housing backlog and rural-urban migration (Lagardien & Cousins, 2004).

The rapid growth of urban slums over the last 15 years has been uncontrolled in Sub-Saharan Africa. As a result, small investments in improved sanitation have not been able to reduce the percentage of the urban subserved population. The percentage of subserved population in informal settlements is expected to rise due to rural-urban migration. Coupled with the low priority given to sanitation by urban authorities, the rapid growth of slum settlements in Sub-Saharan Africa has been accompanied by on-site sanitation and use of underground water. On-site sanitation and underground water use were seen as affordable options since governments failed to provide adequate services. On-site sanitation is problematic in that it contaminates underground water sources with faecal bacteria which then serves as the household's water source (Kimani-Murage & Ngindu, 2007).

The high cost of installing sanitation in informal settlements has prompted people to build and use pit latrines in urban slums of Africa, Asia, Latin America and the Caribbean islands (World Health Organisation & United Nations Children's Fund, 2014). Pit latrines do not require water to function. They can also be constructed and repaired with locally available materials. Pit latrines have very low operating costs and can be modified to suit many users, such as squatting, anal washing and wiping). It should be noted that pit latrines could contaminate underground water sources during the rainy season (Kulabako, Nalubega, & Thunvik, 2007). It was further noted that factors like the high water table, flooding and poor drainage in most informal settlements increases the risk of contamination of drinking water sources (Katukiza et al., 2012).

The budget reserved for sanitation, however, is very low in many developing countries (Isunju, Schwartz, Schouten, Johnson, & van Dijk, 2011). Governments seem to avoid investments in sanitation and prioritise water supply instead (Moe & Rheingans, 2006). Though policy makers see sanitation as the key to public health, they do not make it a priority. The progress with respect to the meeting of Millennium Development Goals, now Sustainable Development Goals, and the sanitation target is made difficult by the slow rate of provision of improved toilet facilities in urban slums (World Health Organisation & United Nations Children's Fund, 2010).

Sanitation as a Millennium Sustainable Development Goals target suffers from the fact that it is still not accessible to many people. Any sanitation facility used by more than one household is seen as unimproved. An improved sanitation facility is defined by the World Health Organisation (WHO) as one that hygienically separates human excreta from human contact and is not shared by more than one household (World Health Organisation & United Nations Children's Fund, 2010). In almost all informal settlements and slums, pit latrines and mobile toilets are shared by more than one household. This scenario predisposes households, and in particular children, to unhygienic sanitary conditions, which may encourage diseases to spread.

Limited space in informal settlements also forces households or families to share sanitation facilities. It is common practice for many households to share a single pit latrine. Landlords who lease their properties to many tenants do not provide more toilets to their tenants. They, therefore, fail to consider the high user-load and are only after making lots of money from the tenants (Katukiza et al., 2010). Congestion in the Kenyan urban slums also does not allow for an adequate distance between wells and the pit latrines. The limited distance allows pathogens to contaminate underground sources. Exacerbating the problem, poor sanitary practices, for instance, disposal of human excreta in open spaces in these slum areas led to contamination of water and consequently waterborne diseases in Kisumu informal settlement in western Kenya (Opisa, Odier, Jura, Karanja, & Mwinzi, 2012).

2.3.4 Availability of quality and sufficient water

The high cost of buying water from the street vendors is another factor that contributes to negative social impacts of water pollution in informal settlements. Given that most of the inhabitants in informal settlements are poor, unemployed or depend on government grants for a living, it becomes very expensive for them to buy the water. Studies show that the urban poor in informal settlements can spend between 9% and 20% of their income on water (Rubin, 2007)..

In South Africa, the poor have been observed to de-prioritise payments towards clean water for food and electricity. Thus, the urban poor living in informal settlements do not value using clean water, thereby exposing themselves and their children to many health risks (Peters & Oldfield, 2005).

In a bid to avoid the high cost of buying water in informal settlements, the poor informal settlers prefer to spend more time fetching "free" water than to incur costs at water kiosks. In one study in informal settlements, close to half of the sampled population had hidden illegal connections to a nearby water supply (Galiani, González-Rozada, & Schargrodsy, 2009). It can be argued that illegal water connections reduce water pressure to affected formal settlements. Illegal water connections are usually poorly connected and often prone to bursting thereby compromising water delivery services in informal settlements. Furthermore, sewage can contaminate water through burst pipes leading to outbreaks of diarrhoea which can cause serious problems in children in the informal settlements (Jagals, Grabow, & Williams, 1997).

Shallow or hand dug wells used by informal settlement dwellers due to economic and financial constraints on affordability to buy water are equally a health hazard. In order to combat this challenge, other informal settlement dwellers buy water from formal residents' populace. However, the cost of getting water for all household chores becomes highly prohibitive. Others hence either try illegal connections or dig shallow wells on nearby rivers. Unfortunately, most of the rivers are heavily polluted with sewage and threaten children's health (Kimani-Murage & Ngindu, 2007).

In a study of the Langas slum in Kenya, Kimani-Murage and Ngindu posited that the distance between pit latrines and wells should be 15 metres. In most informal settlements though, the distances are below 15 metres, as was the case in 40% of the cases Langas slum (Kimani-Murage & Ngindu, 2007). The implications of this state of affairs are far-reaching in so far as compromised health standards and

water quality is concerned. This partly explains the prevalence of waterborne diseases such as diarrhoea in informal settlements. Having said this, it can be argued that children are vulnerable and become victims of water pollution related diseases.

2.3.5 Lack of strict legislation on water pollution

Lack of strict legislation on water pollution is another factor that contributes to water pollution in informal settlements that are located near mining areas. In many mining areas of the world, particularly in developing countries, disposal of waste from mining is a challenge. Waste from mining tends to pollute rivers which people use, particularly those living in informal settlements and rural areas. Stricter laws on water pollution from mining waste need to be developed. A South African Human Rights Commission report on the right to access sufficient water and decent sanitation in South Africa stated that,

“Madibeng in the platinum-rich North-West province where mining companies, agribusiness and tourist industries surrounding the four dams pay less per kilolitre than poor households, yet they use and pollute most of the water with little or no government regulation.”(South African Human Rights Commission, 2014).

In addition to lenient environmental policy on water in South Africa, water is also viewed as ‘economic goods’ or a commodity by government departments and the private sector. Most of South Africa’s water is used by business, especially the agribusiness and mining sectors at a very low cost per kilolitre compared to poor households. By not holding businesses that pollute and waste water to account, the government is not protecting water as a basic human right. At the same time, people who cannot afford to pay for water are denied access, and their bodies bear the cost through illness linked to serious chemical pollution (South African Human Rights Commission, 2014).

2.3.6 Flooding

Flooding is yet another factor that contributes to water pollution in informal settlements. Flooding in informal settlements is mainly due to the haphazard development of housing within the river valleys and flood plains. Most informal settlements in South Africa and elsewhere are located on poor marginal land and flood plains. Since the repealing of the apartheid laws which restricted movement for the black population, there has been considerable population increase in many black townships. This has also resulted in overcrowding and growth of many informal settlements in South Africa (Greater Johannesburg Metropolitan Council, 2000). Storm water management in most areas of South Africa predominantly focuses on collecting runoff water and channelling it to the nearest water course. This process prioritises quantity management with no preservation of the environment. The practice results in environmental degradation and water pollution (Debo & Reese, 2003).

Soweto-On-Sea, an informal settlement located in the floodplain of the Lower Chatty River, near Port Elizabeth, experiences annual flooding (Mompoti S. & Viljoen, 2003). This is also true for informal settlements around Johannesburg. For example, informal settlements developed on the Jukskei River banks in Alexandra Township suffer from floods every year during the rainy season. An estimated 7 500 households living in these areas in very high densities are in run the risk of flooding (Greater Johannesburg Metropolitan Council, 2000).

Floods in the informal settlements of Cape Town are a common problem during winter. During the month of July 2007, heavy rains of over 120 millimetres over a period of five days affected 8 000 households (38 000 residents). The households are located in the informal settlements of Khayelitsha and Phola Park Philippi. The informal settlements are located in a flood plain that is prone to flooding if heavy rains persist. When floods occur, there is water logging as well as ground and surface water pollution in the informal settlements. The problem of flooding increases surface water pollution when

uncollected refuse and garbage is swept within the informal settlement. Flooding also reduces the water quality in rivers where children sometimes swim or play in. In the process, children's health and safety is also compromised (Bouchard, Goncalo, Susienka, & Wilson, 2013).

Informal settlements in Zanzibar, also located along flood plains experience flooding during the rainy season. In Zanzibar Town during the rainy season, pit latrines and septic tanks tend to overflow, and water and sewage lines deteriorate as toxic waste is washed away. This leads to the contamination of both drinking water and underground water. The water also becomes polluted with sewage from pit latrines and waste from septic tanks. The emergence of waterborne diseases such as cholera, dysentery and diarrhoea are increased. These diseases are spread easily and quickly throughout the population. Under these conditions, children become more susceptible to disease because they play with dirty water quite often (Zanzibar Sustainable Programme, 2000a, 2000b).

Lack of storm water drainage in rapidly increasing informal settlements is a major cause of flooding. This is because as the population increases, water runoff from roofs of buildings alters the urban land cover and land surface, including blocking existing natural storm water drains. Poor solid waste management further complicates the problem of flooding. Solid waste which is not collected over long periods of time accrues and blocks movement of water resulting in heavy water accumulation. The end result is water logging, ground and surface water pollution as well as blocked accessibility in the informal settlement. Water quality used by the informal settlers is greatly reduced (Sakijege, Lupala, & Sheuya, 2012).

In Dar es Salam, haphazard construction of warehouses and housing on the Keko river valley also worsened flooding in Keko Machungwa informal settlement. Ruby Road Ways constructed a warehouse across the Keko stream leaving a small hole for storm water. Similarly, OilCom Company reclaimed part of the river by filling up part of a plot with soil and then constructing a wall. The reclamation of land and construction of a wall necessitated shifting of the river course from its natural path towards residential areas. The partial blocking and shifting of the stream contributed greatly to flooding of the surrounding informal settlement areas of Keko Machungwa (Sakijege et al., 2012).

Haphazard dumping of waste in Keko Machungwa informal settlement also contributed to flooding in the area. Flooding was prompted by improvised storm water drains which were not coordinated. As a result, water flooded because the area had small natural streams which could not drain water away from houses. Furthermore, the absence of proper solid waste management prompted residents to dispose of waste into drains and natural streams. After heavy rains, accumulated solid waste starts to decompose and leach. Leaching wastes usually end up mixing with underground water. As a result of flooding both surface and ground water in Keko Machungwa were polluted. The wells became totally submerged, and shallow wells were filled up with storm water, which was mixed up with raw and untreated human excreta from pit latrines and solid waste. This scenario resulted in the emergence of waterborne diseases and children were not spared (Sakijege et al., 2012).

2.3.7 Poor water storage facilities

Poor storage of water collected from communal taps within the informal settlement is also a factor that contributes to serious health risks to children in informal settlements. This is because the water is collected from the taps and stored in open containers for future use. The containers have no covers, and the water is prone to pollution from various environmental pollutants. It can be argued that the quality of water in containers rapidly deteriorates thereby endangering the lives of families in informal settlements who have little or no choice but to use the water. In this entire scenario, children by being young and vulnerable are the major victims of using poor water quality (Jagals et al., 1997).

2.4 INTERVENTIONS TO MITIGATE SOCIAL IMPACTS OF WATER POLLUTION-IMPROVING SANITATION AND WATER SERVICE

2.4.1 Sanitation

Though progress has been made in the Sustainable Development Goal for sanitation in South Africa, there are still millions of people without adequate sanitation in towns, cities and informal settlements. Limited funding, as well as the ever increasing numbers of people in informal settlements, has slowed down the pace. After 1994, the South African government committed to providing basic services to all people particularly sanitation. Significant effort was made to reduce the number of people without sanitation from 50% of households in 1994 to 21% in 2015 (Septien, 2015).

As a way of improving sanitation services, sustainable sanitation is being practised in Durban in several ways. Mainly, low cost options are being used. Low cost options or low water allocations are applied to ensure sustainable distribution of the water for sanitation purposes. The Municipality of Durban is using pit latrines, urine diversion dry toilets and pour flush toilets. When using pit latrines, human excreta are collected in a pit located directly below the toilet. For urine diversion dry toilets, waste is separated into two different compartments while pour-flush toilets use a small amount of water (half a litre to two litres) to flush away the excreta and for anal cleansing (Septien, 2015).

In the informal settlements of Durban, the local Municipality also set up 30 000 ventilated improved pit latrines and 80 000 dry toilets in the metropolis, although this is still inadequate. A strong partnership was also established between the Municipality of Durban and local academic institutions. The partnerships attracted co-funding from a few national and international institutions. Through the partnerships, the Municipality has developed the dehydration pasteurisation machine. The machine allows faecal sludge from ventilated improved pit latrines to be processed. The machine can dry and pasteurise the sludge using infrared radiation. The product can also be used sustainably in agriculture. Another product of partnerships in Durban was the use of the larvae of black soldier flies for faecal material degradation. Black soldier flies' larvae are used to degrade faecal material which can later be used as a poultry feed or for biodiesel production. Black soldier flies' larvae can be used because they are rich in fatty acids and proteins. The Municipality of Durban also undertook a project that focused on the treatment of urine to obtain reused water fertiliser (Septien, 2015).

In informal settlements of Cape Town, space is a major constraint which limits construction of more toilets. The City of Cape Town is, however, addressing space constraints by fostering engagement between residents and local government through a process called "re-blocking". "Re-blocking" is being facilitated by a Non-Governmental Organisation (NGO), the Community Organisation Resource Centre. Re-blocking involves mapping and self-enumeration by residents. Residents take a household census by themselves with the help of the NGO. The aim is to change the space layout of the settlement so that more space is created to connect services, improve accessibility, reduce fire hazards and improve safety among other things. Re-blocking, however, has one major limitation. Re-blocking has been unsuitable for in situ upgrading (City of Cape Town, 2013).

The City of Cape Town Human Settlements Department is developing a "development matrix" which will be used to guide the city's strategy towards upgrading informal settlements, which will, in turn, influence the type of sanitation system selected. Settlements are being categorised according to a variety of physical, technical and environmental risk factors which underpin the ability to upgrade in situ or the need for relocation (City of Cape Town, 2013).

The development of the "development matrix" offers a chance for long-term as opposed to ad hoc approaches to the provision of sanitation services. At the same time, the "development matrix" has a danger of propagating top-down strategies which tend to exclude non-government stakeholders. The

“development matrix” as a planning tool should thus be used in conjunction with other planning strategies which are more inclusive. This is because planning and design experts are often in a different socio-economic group and live in a different environment from residents in informal settlements. Their different socio-economic background compared to that of informal settlement dwellers may limit their ability to relate to circumstances in informal settlements, and this may hinder the overall success of the sanitation system (McConville, Kain, Kvarnström, & Ulrich, 2014).

At national level, the government of South Africa could propose the updating of the White Paper on Water and Sanitation Policy to categorically include specific measures for sustainability and equity of sanitation in both formal and informal areas of the city (City of Cape Town, 2013).

On a global scale, great strides have also been made in terms of sanitation services provision though funding remains a major constraint. In Kigali, Rwanda, decentralised sanitation systems have been used. Decentralised sanitation systems include simple pit or traditional pit latrines, ventilated improved latrines, ecological latrines, pour-flush latrines and water closet toilets. The majority of informal settlement dwellers in Kigali use pit latrines. Pit latrines are preferred because they are more cost effective than flush toilets and have sanitary benefits (Satterthwaite, 2004). Pit latrines, however, can collapse if heavy rains fall, especially if they are not lined. Pit latrines are also difficult to empty when they fill up.

Flush toilets connected to septic tanks which offer comfort, can also be used in informal settlements. The major drawback is that septic tanks are expensive. Flush toilets, however, fail to work if overused. Faeces may accumulate when overused and blockages may occur. When this happens, serious health risks are posed to children in informal settlements (Sano, 2007).

Small scale household de-composting and other decentralised systems are also seen as an option for the provision of adequate sanitation in informal settlements in developing countries (Scheinberg, Spies, Simpson, & Mol, 2011). Unlike conventional sewers which require a large waste water system and costly equipment before there can be any reuse and redistribution, decentralised systems are cost effective. They also allow more efficient separation of liquids and solids for reuse by communities living near the site where they are used (Sano, 2007; Van Vliet, Spaargaren, & Oosterveer, 2010).

Decentralised systems are also suitable in informal settlements because they use less space and do not need emptying by vacuum tankers and pre-treatment or composting. They thus have less harmful effects on the environment. Use of all these methods call for hygiene education among residents so that proper use of the facilities is increased (Van Vliet et al., 2010).

In 2007, the Sustainable Sanitation Alliance was adopted to combine the efforts of a number of sanitation activities. This was done by endorsing a collaborative platform from several units all over the world. In 2011, the Bill and Melinda Gates Foundation was established and funded to reinvent the toilet challenge. The foundation aimed to provide hygienic and low water consumption sanitation systems. The low water sanitation systems also did not rely on connections to the sewage and electric grids. The first two phases of the foundation have already been successfully implemented in Dakar, Senegal. Other efforts being made worldwide include upgrading toilet prototype facilities and strategies, standardising laboratory methods in research on sanitation services, launching social programmes and establishing adequate business and diversified funding resources in sanitation among others (Septien, 2015).

2.4.2 Water

Water supplies in informal settlements remain a problem despite government efforts to make sure people have adequate water facilities. Worse still, informal settlements continue to grow daily posing serious problems for the city fathers. Owusu-Asante and Ndiritu propose that social issues such as

non-payment, vandalism of water services, lack of awareness and community involvement in water quality issues can be managed in many ways in Alexandra's informal settlements in Johannesburg. These include education awareness programmes offered to the residents in the informal settlements in conjunction with economic empowerment, service delivery and improvements in maintenance of water facilities (Owusu-Asante & Ndiritu, 2009).

This viewpoint is supported by Esrey and others (1988), who claimed that improved water supply in informal settlements of Lesotho should be coupled with health education to encourage people to use only the improved water supplies for cooking, drinking as well as bathing (Esrey, Habicht, Latham, Sisler, & Casella, 1988). Further, these water supplies must be maintained to ensure continual functioning, a critical requirement often missing in water supply projects. The installation of more taps closer to individual homes could make the informal settlers avoid the use of contaminated water supplies and cultivate the exclusive use of improved water supplies for cooking and drinking purposes. Future studies on the health impacts of water pollution should measure factors affecting water use such as distance to the tap, number of families per tap and reliability of the operation of the new or improved water supplies (Esrey et al., 1988).

The local authority in Alexandra is also formalising the settlement through relocation of many households. The process will relieve pressure on water supplies in the informal settlement. Relocation will also involve the provision of public spatial structure to provide relief from overcrowding, the creation of public gathering places and riparian buffers, catchment erosion and sediment controls. De-densification and formalisation of the settlement were launched in a seven-year project (Alexandra Renewal Project) in 2001. After formalising the settlement, illegal connections to storm drains could be removed to deal with pollution from the grey water waste stream. Much has been done, though more needs to be done to achieve this goal (Owusu-Asante & Ndiritu, 2009).

Another way of ensuring adequate water supply in informal settlements is water kiosks. In Kenya, 10 communal water selling points (kiosks) were constructed in Mukuru informal settlement in Nairobi. The communal water kiosks were constructed by Athi Water Services Board which is financed by the African Caribbean and Pacific-European Union (ACP-EU) water facility. The EU financed project supports the Kenyan government and the Nairobi water company to enter into informal settlements where proper sanitation is lacking and where costs of informal drinking water services are high (Willems, 2011).

In Kenyan slums, the government called for vaccination of children to reduce incidences of typhoid fever in addition to the promotion of the use of safe water, sanitation facilities and hygiene. Incidences of typhoid fever are high in the informal settlements due to poor water supplies and sanitation (Breiman et al., 2012).

Rain water harvesting (RWH) is another way in which water supply can be improved in informal settlements. RWH as a form of water supply has a lot of advantages. Among others, RWH provides water at or near the point-of-use, thereby saving on time, effort and cost. RWH can be a backup in times of emergency or breakdown of regular supply systems. Rain water quality is also fairly acceptable requiring little or no treatment, thus making it chemical or biological hazard free. Above all, RWH can be used in conjunction with other sources of water, thereby relieving pressure on the other water sources. Sadly though, politicians do not yet recognise RWH as an alternative water source particularly in informal settlements. RWH is therefore not included in water policies thus leading to a lack of support, finances and required building codes for new houses, particularly in informal settlements (Academy of Science of South Africa, 2009).

2.5 EXTENT OF THE SOCIAL IMPACTS OF WATER POLLUTION

The extent of the social impacts of water pollution differs from place to place and from time to time. The developing world, specifically Sub-Saharan Africa, has been grappling with the issue of inadequate access to water and sanitation for decades. The need to improve access to water and sanitation for both men and women dates back to the 1977 UN Water Conference (United Nations, 1977). Similar sentiments were expressed at the International Drinking Water and Sanitation Decade (1981-1990) and the Dublin International Conference on Water and the Environment (1992). It is also implicated in the Water for Life Decade (2005-2015) and the Sustainable Development Goals (Kakuru & Dauda, 2010).

Globally, water pollution due to inadequate water supply and sanitation has become a serious concern as it affects humans, particularly children. According to the Grinning Planet, 2006, in developing countries, water-related diseases are most frequent because of either inadequate sanitation or its non-existence. Diseases including typhoid, cholera, intestinal parasites (amoebiasis, giardiasis, ascariasis and hookworm) enteric and diarrhoeal diseases caused by bacteria and viruses have occurred. It has been estimated that 200 million people have been affected by these waterborne diseases in 70 countries (Grinning Planet, 2006).

In the following sub-sections, selected accounts of countries that have witnessed social impacts of water pollution due to inadequate water supply and sanitation are provided.

2.5.1 Kampala, Uganda

In the informal settlements of Uganda, provision of adequate water supply and sanitation is a challenge. Unclean water and poor sanitation are a major cause of morbidity and mortality among children living in poor informal urban settlements. Uganda as a country spends more than \$10 million every year on treatment for water and sanitation-related diseases (Kyalimpa, 2009). Coverage and accessibility to water supply in Uganda is estimated at 63 % (Uganda. Ministry of Water and Environment, 2007).

The majority of the subserved population in Kampala mostly living in informal settlements use water bought from vendors or natural springs. According to the Kampala City Council, over 65% of springs in the city are contaminated with *E.coli* bacteria. Furthermore, 64% of the population shares pit latrines, with 6% having no sanitation facilities at all. The above scenario results in frequent cholera outbreaks in the informal settlements of Uganda. Water bought from street vendors is not reliable because, in most cases, the street vendors collect the water they sell from unprotected sources. People buy the water, because of ignorance. As a result, they expose themselves and their children to disease (Kobel & Del Mistro, 2012).

2.5.2 The Middle East and North Africa

In the developing countries of the Middle East and North Africa, children and women suffer most from the impacts of contracting waterborne diseases. This is because they live in rural areas where they consume water from unprotected sources. On the other hand, their male counterparts are based in towns where mechanisms are in place to provide safe and clean water. Males, therefore are less likely to be affected by waterborne diseases. Seventy five percent of water-related diseases is felt in rural areas. High incidences of waterborne diseases have long-term effects on families in terms of their income. This is the case because mothers have to take care of their sick children, leading to loss of their productive working time. The above issue has a negative impact in terms of family income that has to meet the basic needs of the family (World Bank, 2007).

2.5.3 South Africa

Serious cases of contamination of water from sewage waste, resulting in diarrhoea were experienced in South Africa between 2004 and 2006. Pathogens in contaminated water caused severe diarrhoea in children and adults leading to fatalities in KwaZulu-Natal. In Delmas, Mpumalanga, there were 380 cases of diarrhoea, 30 suspected cases of typhoid fever and nine confirmed deaths (Mail and Guardian, 2004). The outbreak originated in the water supply of a farm, which was contaminated with human faeces. Diarrhoea is the most common health hazard experienced after drinking polluted water. Pruss-Ustin, Boss and Bartram (2008) put it on record that recurring cases of diarrhoea coupled with childhood malnutrition result from poor water and sanitation services. Consequently, it can thus be concluded with a degree of certainty that the quality of water has a positive correlation with infant mortality incidents. In essence, clean water and sanitation infrastructure could reduce epidemics and therefore mortality among children in informal settlements (Bos, Gore, & Bartram, 2008).

In addition to diarrhoea, typhoid is another waterborne disease that is common in South Africa. Typhoid fever is endemic to many parts of South Africa, particularly in KwaZulu-Natal, Limpopo and Transkei. This is mainly because of repeated incidents of sewage waste disposal in rivers. This means that both adults and children are at risk of contracting diarrhoea and typhoid from drinking contaminated water. Diarrhoea and typhoid are endemic to these areas because people drink the contaminated water (Momba, Osode, & Sibewu, 2009).

2.5.4 United States of America (USA)

In the United States (USA) beaches, rivers, estuaries and lakes are infested with microbial or chemical contaminants. Recreational waterborne disease outbreaks in swimming pools, lakes, ponds, rivers, canals, decorative fountains and springs were reported in the (USA). During the 2005-2006 reporting period, 78 recreational waterborne outbreaks were reported with 4 412 illnesses and five deaths, the largest number of recreational water-associated outbreaks to occur since reporting in 1978 (Meinhardt, 2006). Swimming in local rivers also exposes children to recreational waterborne diseases. Children are at risk of contracting recreational waterborne diseases because they frequent recreational facilities to engage in water sports such as swimming. In some instances, they also accidentally ingest the contaminated water while swimming, thus further increasing the chances of contracting other health-related illnesses.

In rural areas of the USA, productive time and money were lost due to water-related illnesses. When epidemics occur, rural communities also have to incur costs for treatment of the diseases further spending income needed by children for some basic needs. After the outbreak of waterborne cryptosporidiosis in Wisconsin, USA in 1993, productive time was lost, and the country spent a substantial amount of money on treatment. In the Milwaukee rural community, 725 000 productive days were lost, costing \$54 million in lost time and expenses (Meinhardt, 2006). Waterborne diseases also affect family income through the increased cost of public and private health care. The social welfare of the children is compromised because little or no money is left to meet their needs (Zawahri et al., 2011).

2.5.5 Zanzibar and Tanzania

As in many other developing countries, Zanzibar which is part of the United Republic of Tanzania has been experiencing the phenomenon of rapid urbanisation. Urbanisation and demographic increases have been the driving forces of the mushrooming of informal settlements on the fringe areas of its urban centres. In the informal settlements of Zanzibar, the lack of a centralised sewage system presents a sanitation challenge. Liquid waste which includes water from washing laundry, kitchen, bath and domestic uses is haphazardly discharged within the informal settlements. This disposal

practice pollutes the groundwater and marine environments and is a major cause of waterborne diseases in children (Ameyibor et al., 2003).

Diseases caused by inadequate water, sanitation and hygiene (WASH) result in 4.2% of global deaths, and 90% of that burden is borne by children under-five years of age (Bartram & Cairncross, 2010). In Tanzania, 99% of all mortality in children younger than five years of age is due to diarrhoea (World Health Organisation & United Nations Children's Fund, 2010). This was an improvement on the health status in 2000-2003 when it was estimated at 17% (World Health Organisation, 2002).

Cholera is endemic in several regions of Tanzania: Tanga, Kigoma, Mwanza, Singida, Dar es Salaam, Zanzibar and Mara . Additional risk factors identified in children in Zanzibar included using open water containers for drinking water and non-protective behaviours such as not washing hands after using the toilets (Masauni et al., 2010). Lack of access to improved sanitation in informal settlements has been significantly associated with higher instances of cholera in children (Penrose, De Castro, Werema, & Ryan, 2010).

2.5.6 Zimbabwe

The water and sanitation crisis in Zimbabwe's capital city Harare in 2008 placed millions of residents at risk of waterborne diseases (Human Rights Watch, 2013). Cholera remains a major global challenge to countries where access to safe drinking water and adequate sanitation are still lacking, and Zimbabwe is not an exception. In 2008, a large cholera epidemic broke out in Zimbabwe, and an estimated 95 531 cases of cholera and 4 282 deaths due to cholera were reported. Widespread contamination of drinking water due to a broken sewage pipe was blamed for the outbreak. Sewage water found its way into the country's water supply resulting in people drinking contaminated water (Ahmed et al., 2011).

Five years after cholera killed over four thousand people and sickened almost 100 000 more, the conditions that allowed the epidemic to flourish still persist in Harare's high-density suburbs. The 60-page report, *'Trouble water: burst pipes, contaminated wells and open defecation in Zimbabwe's capital'* describes how residents have little access to potable water and sanitation services. Residents often resort to drinking water from shallow, unprotected wells that are contaminated with sewage and to defecate outdoors. The conditions violate children's rights to water, sanitation and health (Human Rights Watch, 2013).

In Zimbabwe's informal settlements, water and sanitation services are typically inadequate or non-existent (Nhapi, 2009). In agreement, Manase and Fawcett (2010) noted that informal settlements are characterised by inadequate water supplies, poor sewage and drainage with residents relying on unimproved pit latrines for human waste disposal (Manase & Fawcett, 2010). By 2010, open defecation was rampant with up to 70% of households in informal settlements having no latrine at all. The situation had a severe impact on human health particularly that of children in terms of diarrhoea outbreaks via faecal-oral transmission (Makhetha Development Consultants, 2007).

The worsening situation in recent times as a result of increased population in older informal settlements and creation of new ones suggests that informal settlements will be transmission epicentres of future diarrhoeal disease outbreaks in children (Ministry of Water Resources, 2012). The mix of poor sanitation, contaminated and crowded water supplies, scarce drainage facilities and inadequate waste disposal mechanisms was a catalyst for the fatal outbreaks of cholera in 2008 and typhoid in 2010 in Zimbabwe's major towns, cities and informal settlements (Brocklehurst, Malik, Sebunya, & Salama, 2013).

2.6 SUMMARY

The relationships between the aspects of social impact of water pollution are on children are indicated in Figure 3.

The above cases provide evidence of the manifestation of social impacts of water pollution. In the case of Uganda (cholera), South Africa (diarrhoea), USA (cryptosporidiosis), Zanzibar and Tanzania (cholera) and Zimbabwe (cholera and typhoid), medical conditions and infections present pollution related impacts which then directly affect social impacts such as provision of quality and adequate quantities of water, rights to medical services and the right to education. There is no doubt that the extracts and findings in this literature review show that the social impacts of water pollution on children are substantial and continue to have negative impacts.

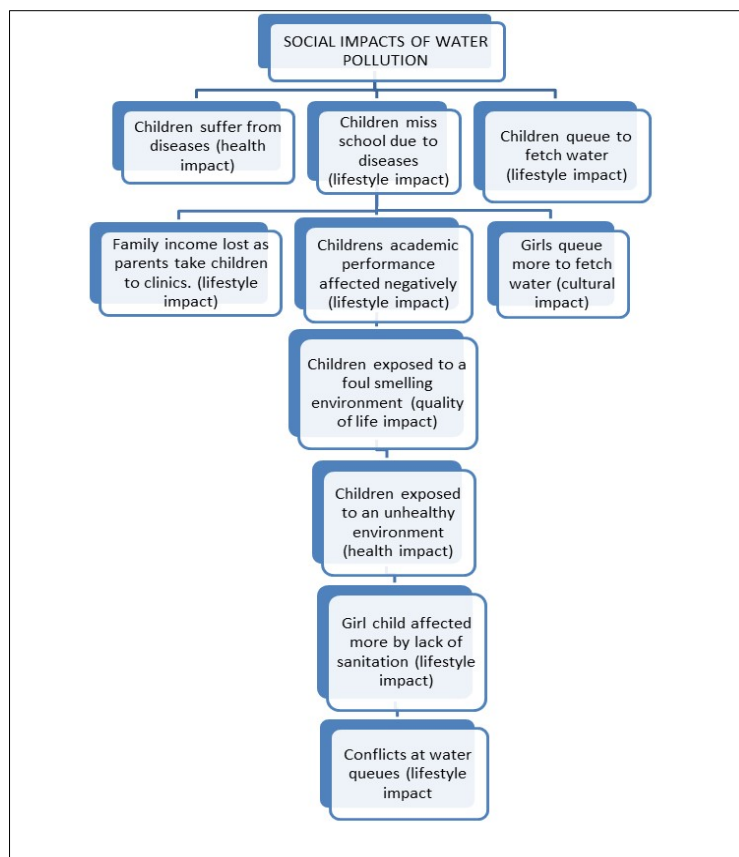


Figure 3: Social impacts of pollution (Source- Adapted from (Centre for Good Governance, 2006)

3 RESEARCH METHODOLOGY

This chapter presents the research design and methodology which will be executed in investigating the impact of water pollution on social health determinants of children in the Kliptown informal settlement.

3.1 TYPE OF RESEARCH: ETHNOGRAPHIC RESEARCH

Ethnographic research involves the study of people in their own environment using methods such as participant observation and face to face interviews. Ethnographic research is a valuable tool, and when used properly, it can elicit an enormous amount of information that can facilitate effective policy implementation and interpretation and or challenge or contest the accepted “truth”. This is because ethnographic research is performed in an attempt to elucidate human behaviour. By conducting ethnographic research, the researcher looks at society and cultures as integrated systems with interrelationships existing between communities and structures within and around them. In so doing, ethnographic research allows the researcher to “see” the community through the eyes of those who live in the community (Brown, 2001). An ethnographic approach was chosen because it provided an in-depth understanding of the topic under study. It gave the researcher an opportunity to observe, use the interview as well as documentary sources and other existing data. The parents of Kliptown informal settlement, as well as the matron at Kliptown Clinic, were asked descriptive and exploratory

questions because ethnographic research is qualitative and aims to provide an in-depth study of a group of people or community (Mouton, 2001). The ethnographic approach extrapolated sufficient data to achieve the main aim of the research which is to identify and evaluate the social impacts of water pollution on children. The ethnographic approach allowed the researcher to view the problem from a multicultural perspective in order to unearth all the factors influencing the social impacts of water pollution in the area of study. Kliptown informal settlement is a multicultural community with diversified cultures which may have an influence on the perceptions of respondents on the topic under study. The ethnographic research satisfied the main objective of this study, which was to generate data through observation and listening to people in their natural setting and to discover their social meanings and interpretations of their actions (Gray, 2004).

3.2 RESEARCH PARADIGM: DESCRIPTIVE

In the search for an appropriate paradigm, three key issues are identified

- **Ontology:** The nature of reality, or how things really are and how things really work;
- **Epistemology:** How the reality is known, or knowledge claimed. In other words, the relationship between the inquirer, the inquired and the known (reality);
- **Methodology:** How should the inquirer go about the finding the knowledge.

This research approach focuses on understanding rather than predicting phenomena. The research consists of people's subjective experiences. Therefore the adoption of intersubjective or instructional epistemology and the use of a methodology that includes interviews, observation and secondary data can be applied. The researcher made use of structured and open-ended questions to answer the research aim of identifying and evaluating the social impacts of water pollution on children. The paradigm is interpretive and aims to explain subjective reasons and meanings that lie behind the social action being investigated.

3.3 RESEARCH APPROACH: MIXED

For the purposes of this study, research data included data in the form of statistics, observations, images, interviews and questionnaires. Descriptive, numerical and visual data were also used in the research findings. The data collected was computed and presented in tables, graphs and pie charts. The quantitative analysis formed part of the demographic questions in the questionnaires. The comments are analysed to determine the similarities and dissimilarities with the cases of Uganda, Zanzibar, South Africa, and Zimbabwe in the literature review.

3.4 THE RESEARCH DESIGN: FLOW DIAGRAM

The research methodology followed an organised sequence of the research objectives as shown in Figure 4. Objective number one was to identify the social impacts of water pollution on children in the Kliptown informal settlement. Objective number two was to determine the factors that contributed to water pollution in Kliptown informal settlement. Primary data from sampled respondents was extracted through carefully and objectively designed questionnaires, a structured interview schedule and observation checklists and rubrics.

Secondary data from books, internet journals and reports were also used. Primary and secondary data gathered was compared and evaluated to enhance crosschecks on one another. The last objective

identifies gaps and recommends improvements on social impacts of water pollution on children in the Kliptown informal settlement.

The researcher conducted a face to face interview with the matron at Kliptown Clinic. A structured interview schedule was used to get information from the matron at Kliptown Clinic. Questionnaires were also given to parents or guardians of children in the Kliptown informal settlement to complete. The researcher also collected data from the natural setting in the informal settlement through observation. The researcher was, therefore, able to use data from records at the clinic, observation checklists as well as questionnaires from parents on social impacts of water pollution on children in the Kliptown informal settlement.

Primary and secondary data sources were used to conduct the study. Primary data was gathered using questionnaires, a structured interview guide and observation checklists and rubrics. Secondary data was sourced from books, journals and reports to enhance the data obtained from primary sources. To

maintain credibility, reliability, validity and currency, the focus in the literature review was on recent literature and seminal works. Preference listed was given to academic articles and textbooks. Unidentifiable internet and Wikipedia references were not used.

3.4.1 Questionnaire

One questionnaire was designed to collect qualitative and quantitative primary data on the social impacts of water pollution and the factors that contributed to water pollution on children in the Kliptown informal settlement. This formed the main instrument of analysis. Both closed and open-ended questions were used in the questionnaires to obtain subjective and objective aspects of the study. Pretesting of the questionnaire was performed to give the researcher the opportunity to make amendments before the main research was done (Gwimbi & Dirwai, 2003). Copies of the questionnaires are attached in Appendix 1.

3.4.2 Questionnaire pretesting

The research instruments should be revised to eliminate ambiguities and clarify some questions (Kitchin & Tate, 2000). Accordingly, the questionnaire was pretested in the three informal settlements under study to test the validity and reliability of the questionnaire as a research instrument. As part of the pre-test, the researcher undertook a reconnaissance visit to the Kliptown informal settlement to consult with stakeholders. The pilot questionnaires were given to fifteen people to answer in order to test their understanding of the questionnaire and iron out any ambiguities before full rollout.

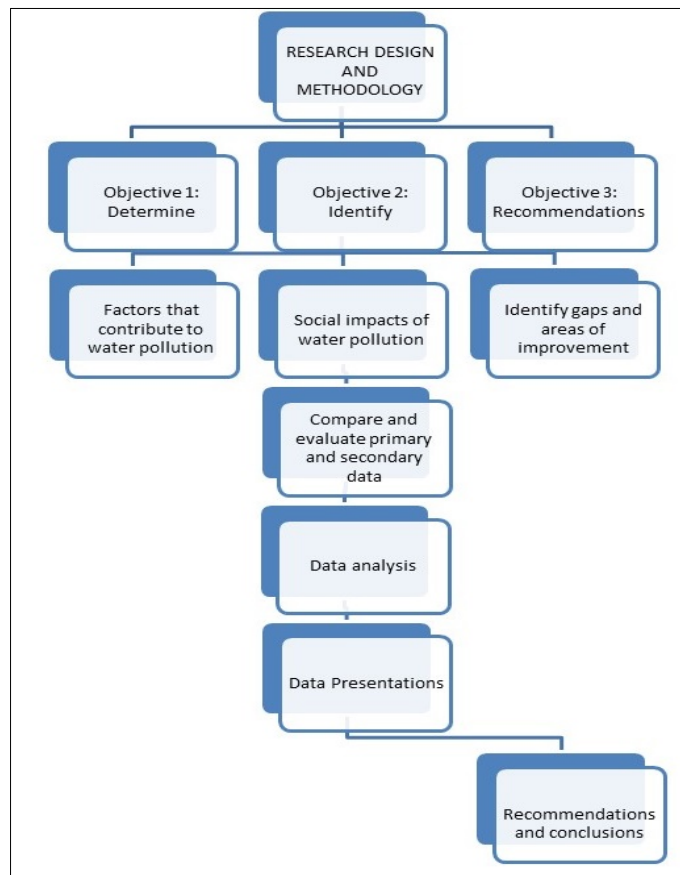


Figure 4: Research methodology flow diagram

The questionnaires were issued in Afrikaans, English, IsiZulu and Sotho in the three informal settlements of Kliptown under study because these are the languages that are mainly spoken there. After analysing the pretested questionnaires, the researcher discovered that English was preferred as the medium of communication by most of the inhabitants. The inhabitants spoke Afrikaans, Sotho and IsiZulu. The researcher was also able to establish the relevance of individual questions as well as errors and clarity. Pretesting helped the researcher to clarify questions on possible causes of waterborne diseases and what should be done to reduce the frequency of water-related illnesses. The pretesting of the questionnaire helped the researcher to draw up revised questions in English. On the whole, pretesting was done to check the viability of the questionnaire as a research instrument.

3.4.3 Structured interviews

An interview was held with the matron at the Kliptown Clinic in Eldorado Park Extension 8 which is near the informal settlement. Residents of the Kliptown informal settlement use this facility for most of their health and wellness related issues. A structured interview schedule with some open-ended questions at the end was used. The use of structured and open-ended questions enabled the researcher to gather information on water-related diseases that affect children in the informal settlement. A copy of the interview is attached in Appendix 3.

3.4.4 Observation method

The researcher used cameras to photograph variables on the ground and these were used as evidence in the research. The pictures were taken at various times of the day between 8 o'clock in the morning and 5 o'clock in the evening. An observation checklist and rubrics were used to compare the responses obtained by using other research instruments.

3.5 VALIDITY AND RELIABILITY

The researcher made sure that there was a fair representation in terms of the sampled population that was used for the study. A reasonable number of males (65) and females (75) were given questionnaires to complete. The female population in Kliptown's three informal settlements under study comprised of more women than men, hence the larger female sample used. A fair representation of the sampled population ensured that both genders had an opportunity to express themselves. Systematic sampling was used when choosing the respondents. The researcher chose respondents that resided near the Klipspruit River (Tamatievlei), in the central part of the informal settlement (Mandela View) and along the main road that separates Kliptown informal settlement (Valentine Village). Fair representation of the sampled population and systematic sampling in terms of where the respondents lived eliminated bias and in the process promoted the validity of the research results. This was the case because the researcher's sampled population was from all sections of the informal settlement. This was done to determine the section where most children were affected by the social impacts of water pollution.

To ensure reliability in the study, the researcher constructed and asked questions that were in line with the objectives of the research. This was to ensure that the study remained consistent even if the same study was conducted in another or different informal settlement.

Open-ended questions were used to ensure reliability. Open-ended questions would elicit responses that are more reliable, truthful or objective because they had space for the respondents to air their views freely. The respondents are thus not restricted in terms of expressing their views on the questionnaire which has space for them to write their opinions. Open-ended questions allowed

respondents to answer truthfully and objectively. The respondents were also able to answer freely and honestly since their identity was concealed.

The observation method as a research instrument was also used to enhance reliability. Observations by the researcher and photographs were taken, showing the social impacts of water pollution. Photographs offered a highly reliable record.

3.6 RESEARCH POPULATION

In this study, the population comprised the male and female parents of Kliptown informal settlement and the matron at Kliptown Clinic. The researcher collected information from a sample of the population under study.

3.7 SAMPLING

Kliptown informal settlement's (Tamatievlei, Mandela View and Valentine Village) and the Kliptown Clinic have an estimated population of 1400 people. The three informal settlements were chosen because they are close to the Klipspruit River where most water pollution was evident. Approximately 10 % of the total population of 1400 people, which translated to 141 people (140 parents and one matron), was used for the study. This sample size is considered sufficient to obtain results that can be generalised to the study. The 10% sample ensured that all three informal settlements under study were represented thereby ensuring the validity and reliability of the research findings.

The stratified and systematic sampling methods were used to sample the population of Kliptown because there are different population groups (strata) making up the total population. The different population groups were determined by the location of the respondents. Households in three different sections within the Kliptown informal settlement (Tamatievlei, Mandela View and Valentine Village) formed the strata of the sampled population. From each stratum, a systematic sampling system of selecting parents from different sections of the Kliptown informal settlement was used. By systematically selecting every 20th household along roads within Kliptown's different sections, (Tamatievlei, Mandela View and Valentine Village) a total number of 140 parents were selected. 65 male parents or guardians and 75 female parents or guardians in the Kliptown informal settlement were selected as the sampled population. The parents were given questionnaires to complete. Using the interview method, only the matron was interviewed using a scheduled interview guide. Although information on the social impacts of water pollution and factors that contributed to water pollution were required, statistics on water-related illnesses were also needed. Hence it was convenient to interview the matron as she is the head of the clinic and in charge of the records.

3.8 DATA PRESENTATION AND ANALYSIS PROCEDURES

The research is in the main qualitative and therefore data analysis relies mainly on qualitative methods (Corbin & Strauss, 2008; Leedy & Ormrod, 2010), with a view to exploring the connections between various issues, as well as consolidating lessons that could guide the development of sustainable strategies to mitigate the impacts of water pollution on children. Thematic coding techniques were used to summarise and analyse themes and constructs related to the study (Holahan, Moos, Holahan, Cronkite, & Randall, 2001). Qualitative data was described in words, themed, categorised and ranked.

The data analysis was supported by field notes which were taken during the data collection process. By triangulating field notes, observation data, and secondary data, the data analysis is able to extract

consistencies that give a better understanding of social impacts. The quick-tally format was used to summarise the data that was collected. The analysed data was expressed in percentages. Quantitative data was analysed using Microsoft Excel 2010.

3.9 ETHICAL CONSIDERATIONS

Ethical acceptability forms the basis of data collection. Therefore, it should be taken into account. All participants need to be informed about their roles in the research project (Strauss & Myburg, 2003). All participants (Kliptown informal settlement parents and the matron at Kliptown Clinic) were informed of their roles after they were systematically selected. The researcher also signed an ethics application form from the College of Agriculture and Environmental Sciences at the University of South Africa. The ethics application form gave the researcher the approval to undertake this research project which involved human participants, the environment, biomedical and other living organisms (Appendix 5).

3.10 CONSENT

The researcher first obtained consent from Kliptown informal settlement residents as well as the matron from the Kliptown Clinic before obtaining data from them. All people who participated and provided information gave their consent. They were informed about where (Kliptown informal settlement and Kliptown Clinic), when (during working hours and a public holiday) and how (by means of a questionnaire and interview schedule) the data was to be collected (refer to Appendix 2) for the consent forms.

3.10.1 Ensuring confidentiality

Participants' names did not appear on the research document. Written documents that ensured participants' confidentiality were issued to participants when needed. Cameras were used while monitoring devices such as video and digital recordings were not used.

3.10.2 Language

The language used to communicate to participants was English. The matron at Kliptown Clinic was interviewed in English. Informal interviews on social impacts of water pollution on children in the Kliptown informal settlement were also conducted in English. Parents and guardians of Kliptown informal settlement were given questionnaires to complete in English. This was because pretesting of the survey questionnaire indicated that respondents preferred to be surveyed in English.

3.10.3 Safeguard measures

Participants were not at risk or harm physically, legally, socially, economically or mentally during the course of the research. All activities surrounding the acquisition of information from parents and the matron about the social impacts of water pollution in children in the Kliptown informal settlement took place within the informal settlement premises and Kliptown Clinic premises respectively.

3.11 SUMMARY

In this chapter, the research design, data collection techniques, validity and reliability of data, the population and sampling techniques, data presentation and analysis procedures and ethical considerations for the study were explained. In the next chapter, secondary data on Kliptown informal

settlement is presented to give insight on the characteristics that qualify this settlement as an informal settlement.

4 BACKGROUND OF KLIPTOWN INFORMAL SETTLEMENT

4.1 INTRODUCTION

This chapter gives a background of the Kliptown informal settlement. The information presented in this chapter is based on secondary data. Kliptown was used as a case study to assess the social impacts of water pollution on children in informal settlements in general. The case study approach was preferred on the basis that it concentrates on the specific case in its context (Gwimbi & Dirwai, 2003). In addition to that, a case study is very important as it clearly influences decision making by policy makers. In the same vein, a case study on social impacts of water pollution on children would arguably cause apprehension among policy makers at any level to take relevant measures to reduce existing and potential social impacts of water pollution on children.

Consequently, studying case studies is as good as studying the whole population in the sense that the researcher obtains data from a natural context. Generalisations derived from the findings of the research are also true of the area under study. The generalisations and information obtained can also be used to solve problems elsewhere in similar setups. The case study approach allowed the researcher to make an in-depth analysis of the problem under investigation by looking at the size of the study area and the population involved. As a result, recommended solutions apply to the area under study.

4.2 CASE STUDY BACKGROUND

Kliptown is the oldest multiracial residential informal settlement in Soweto and was first laid down on land that formed part of the Klipspruit farm (later Pimville). The farm was named after the Klipspruit, a rocky stream that runs nearby. Kliptown was originally established in 1891 as a residential apartheid buffer zone between Soweto and Johannesburg. Since 1903, the area has been home to informal settlements (Aigbavboa & Thwala, 2013). Kliptown was administered outside Johannesburg's municipal boundaries, so it was excluded from investment and infrastructure. It, therefore, did not receive government services such as water, sanitation and waste management (Rubin, 2007).

The historical significance of Kliptown is that it is the site of the adoption of the Freedom Charter, which was signed in June 1955. The Freedom Charter set out the aims and aspirations of the opponents of apartheid (Statistics South Africa, 2011).

The area now contains a mixture of purpose-built housing, with a large number of shacks in the 12 informal settlements. In these informal settlements, there are poor road networks, poor sanitation and water supply (Himlin, Engel, & Mothoho, 2008). Potable water is available through very few communal water taps, household taps and water kiosks. Sanitation facilities are also limited with the majority of residents relying on communal mobile and bucket system toilets. A few households use pit latrine toilets. Flushing toilets are available in purpose-built households (Rubin, 2007). Conditions in most of the area are aptly captured in its description as a "backyard town" where "tin shanties litter the backyards of the more formal brick housing, rows of chemical toilets, stand outside homes and the untarred roads that run with streams of filthy water" (Himlin et al., 2008)David (2004).

4.3 STUDY AREA

Kliptown informal settlement is located between the residential areas of Eldorado Park, Pimville, Dhlamini and Klipspruit West. The study area comprises informal housing and few purpose-built houses. This study focused on three informal settlements namely, Tamatievlei, Mandela View and Valentine Village. The three informal settlements are located in the south-west part of Kliptown. The Klipspruit River and its floodplain form the western boundary of Kliptown where these three informal settlements are found (Refer to the shaded area in Figure 5).



Figure 5: Kliptown Informal Settlement (Source: Google EarthPro and Research Results)

The study area comprises informal housing units as shown in Figure 6 below. The houses in the Kliptown informal settlement have also been built in the hazardous area within the floodplain of the Klipspruit River. The Klipspruit River and its floodplain form the western boundary of Kliptown where Kliptown informal settlement is located. The Klipspruit River floodplain, showing part of the Kliptown informal settlement is shown in Figure 7 below.



Settlement



4.4 DEMOGRAPHICS OF PARTICIPANTS

The population of Kliptown is between 38 000 and 45 000 people (Aigbavboa & Thwala, 2013). It was estimated at 39 195 people in 2001 but has since increased by 38% (Parliamentary Monitoring Group, 2013). This means the population has grown to over 54 000 inhabitants between 2001 and 2013. The number of shacks, households and the population are shown in Table 3 below.

Table 3: Informal settlements in Kliptown

Informal settlement	No. of shacks/ households	No. of people	No of people per household	SD
Freedom Charter Square	3000	11984	4	0.141
Kliptown Angola	700	3200	5	0.173
Kliptown Johnson Stop	500	2000	4	0.141
Kliptown Ngubane	200	640	3	0.458
Kliptown Tamatievlei	500	2500	5	0.173
Kliptown Vaalkamers	500	2050	4	0.141
Chris Hani/ Chicken Farm	2000	6200	3	0.458
Fred Clark	300	936	3	0.458
Race Course	177	885	5	0.173
Winnie Camp	200	800	4	0.141
Valentine Mandela Square/Mandela View	900	8000	9	1.42
Total	8977	39195	4.5	1.612

Source-Adapted from (Himlin et al., 2008)

The statistics above show a very high concentration of people in the informal settlement dwellings which applies pressure to the sewer and sanitation facilities. The average number of people per household is 4.5 persons. In low-density suburbs, the average number per household is five persons in a five bedroomed house, whereas in informal settlements, most of the dwellings are one roomed, accommodating four persons (SA Cities Network, 2006). The mean is 4.5, the mode is 4, and the median is 4, these values strongly align with the central tendency of occupants of informal sectors to 4. This is supported by the standard deviation values noted in each of the areas. The deviation in Mandela View is greater than one, far above all the other areas. An average of nine persons per household is recorded which a serious cause for concern.

The racial composition of Kliptown consisted of 68.2% Black African people of the total population. The Coloured people make up 30.6% of the population, while 0.8% of the total population of Kliptown are Indians or Asians. Only 0.1% of the population are Whites, and 0.4% consisted of other population groups. The majority of the population in Kliptown (32.4%) speaks Afrikaans, 20.5% speak Sotho while 14.2% speak Zulu. A smaller number of people in Kliptown speak Tswana (6.8%) while other languages are spoken by 26% of the total population of Kliptown (Statistics South Africa, 2011). The demographics can be said to be representative of the racial composition of the country.

4.5 SOCIAL CHALLENGES AND OPPORTUNITIES

Residents of the Kliptown informal settlement face quite a number of social challenges. There are no formal educational facilities such as primary and secondary schools (Himlin et al., 2008). There are only two informal crèches in Kliptown's Johnson Stop and Mandela View informal settlements. As a result, educational opportunities are limited in Kliptown. Children have to travel outside the informal settlement to attend school. For primary and secondary education, children have to travel to the

surrounding suburbs of Pimville, Eldorado Park and Dhlamini. It is a challenge for children to walk long distances to attend school.

The level of education among the youth of Kliptown informal settlement is lower than the national average. The consequences of the lack of past educational opportunities and current economic dynamics have meant that a large proportion of the residents in the informal settlement live off piecework, informal activities and social grants provided by the government. In 2005, the unemployment rate stood at 72% (Rubin, 2007).

Clinic or health centres are also not available in Kliptown except for one in the Angola informal settlement. The Angola informal settlement is another informal settlement in the other part of the Kliptown informal settlement. It is about ten kilometres away from Tamatievlei, Mandela View and Valentine Village, which were used in this study. Most informal residents' In Tamatievlei, Mandela View and Valentine Village board taxis to access health services at Kliptown Clinic in Eldorado Park. The nearest hospital, Chris Hani Baragwanath Hospital is located 15 to 20 kilometres away (Himlin et al., 2008).

Access to free clean drinking water and sanitation are also challenges in Kliptown's informal settlements. Communal water taps are very few. There is erratic maintenance of communal and household water taps. Some communal taps are also far away from their households (over 200m away). Water kiosks where people buy water have also been set up in some informal settlements of Kliptown. Sanitation facilities are also very few in Kliptown's informal settlements. In Freedom Charter Square, for example, there are 200 communal taps for 3 000 shacks and 250 communal mobile toilets for 3000 shacks (City of Johannesburg, 2004).

Lack of space to build formal housing with adequate water supply and sanitation has posed serious constraints in developing a strategy to accommodate the poor people in the Kliptown informal settlement. Although formal houses have been built on a rental and rent-to-buy basis, between 2006 and 2007, the residents were too poor to afford to live in them. Lack of housing delivery and lack of affordability of the housing units led to protests in 2007. The residents protested because they did not see any benefits to gain from the development of housing units in the area (Johannesburg Social Housing Company, 2016)).

Opportunities for Kliptown informal residents to have proper water supply and sanitation in formal housing units are therefore limited. Residents of the Kliptown informal settlement have had to put up with limited water supply and sanitation for years.

4.6 SUMMARY

Despite being the oldest informal settlement in Johannesburg and the site of the Freedom Charter signifying the aims and aspirations of black people mainly, living conditions are still very poor. After 22 years of democracy, residents of the Kliptown informal settlement still live in squalid conditions and lack educational facilities, health services, potable water and sanitation. The poor conditions are worsened by poor hygiene, which results in water pollution. Water pollution in the informal settlement arguably poses serious health risks and other social impacts on children.

5 DATA PRESENTATION AND DISCUSSION

5.1 INTRODUCTION

This chapter discusses study findings concerning the social impacts of water pollution on children in the Kliptown informal settlement. The data collected through questionnaires and interviews is presented, analysed and discussed. The questionnaire was used to gather data from parents on the social impacts of water pollution. It was also used to determine the factors that contribute to water pollution and the extent of the social consequences of water pollution on children. Statistics on diarrhoea, skin rashes and eye infection trends were collected from the matron at Kliptown Clinic, where Kliptown informal settlement residents seek treatment.

5.2 DATA COLLECTION AND ANALYSIS PROCEDURES

Data collection procedures were guided by the aim and objectives of the study. The data collection procedures included a questionnaire survey, a structured interview, a personal field observation, primary records from the clinic and records and secondary literature analysis.

5.3 QUESTIONNAIRE SURVEY

A questionnaire survey aimed at assessing and evaluating the social impacts of water pollution on children in Kliptown informal settlement was undertaken and presented in English. The framework of the questionnaire was determined by the factors that contributed to water pollution, mainly water supply and sanitation. Social impacts of water pollution on children were also examined. Questions were based on observations of the area by the researcher, information obtained from interviews with the matron and information from the literature review. Both closed and open-ended questions were used to obtain subjective and objective aspects of the study.

Questionnaires were distributed among three different sections of households in Kliptown informal settlement (Tamatievlei, Mandela View and Valentine Village, refer to Table 4). Households were used as a sampling unit. For purposes of the survey, the total number of households were determined by examining the study area with the relevant township layout plan dated April 2005 (refer to Table 4). The layout plan was used as a sampling frame. A total number of 140 households were distributed over three housing segments indicated in Table 4 below.

Table 4: Detailed account of housing areas in Kliptown informal settlement and sample size

Informal settlement	Number of households	% sample	Sample size
Tamatievlei	500	9.6 %	48
Mandela View	450	10.2 %	46
Valentine Village	450	10.2 %	46
Total	1400	10 %	140

Source-Adapted from (Himlin et al., 2008)

A sample size of 140 households was decided upon as a suitable number. Every 20th house was selected systematically. The method of sampling used was stratified sampling for the three different housing segments in Kliptown informal settlement (Tamatievlei, Mandela View and Valentine Village). The three informal settlements were used as the population strata. In Kliptown informal settlement

where a conventional street pattern was absent, sampling was done in a linear fashion. It was done along a number of regularly spaced roads going through the area with the sampling interval still maintained at 20. In cases where the occupants of the 20th dwelling refused to participate or were not present or had no children, the 21st or the 22nd dwelling was approached. This scenario was experienced in six incidences. All the houses sampled had children. The questionnaire survey was carried out in the three different housing segments of Kliptown informal settlement. Interviews were held with the parents of the selected households. Answers to the various questions were filled-in in the spaces provided in the questionnaire document prepared by the researcher. The questionnaire covered the following aspects: personal information, the location of respondents, type of sanitation and water sources used, social impacts of water pollution and factors that contributed to the social impacts of water pollution on children.

Responses from parents in the questionnaires served as a basis for review in the analysis. The data was processed using Microsoft Excel and compiled in tables and graphs.

5.4 STRUCTURED INTERVIEW

A structured interview was undertaken with the matron at Kliptown Clinic. The interview was centred on the factors that contribute to the physiological incidents (cases of diarrhoea, cholera, skin and eye infections and bilharzia) and social impacts of water pollution on children in Kliptown informal settlement. The scheduled interview consisted of closed and open-ended questions. Open-ended questions allowed the matron to provide a thorough description of factors that contributed to water pollution in children, diseases that resulted from water pollution and inadequate sanitation. The interview was conducted on the 8th of May 2015. Attendance registers were also used to source recorded data and statistics.

5.5 FIELD OBSERVATION AND SECONDARY LITERATURE ANALYSIS

Field observation involved personal field observation of Kliptown informal settlement and its different segments according to location. During the field observation, the researcher took notes and photographs of the factors that contributed to the social impacts of water pollution on children as well as the social impacts of water pollution on children. Photographs were taken on the 6th of April 2015. There was also an analysis of the literature on the social impacts of water pollution, factors that contributed to water pollution and the extent of water pollution in different parts of the world. Secondary literature was analysed with the aim of further substantiating information from the interview with the matron, personal observation and the questionnaire survey.

5.6 SECTION A: QUESTIONNAIRE RESPONDENT ANALYSIS

5.6.1 Response rate

A total of 140 questionnaires were distributed among parents in Kliptown informal settlement. All the 140 copies were returned. The high response rate was because the researcher personally administered and collected the questionnaires.

5.6.2 Analysis of demographic data

Section A of the questionnaire was mainly aimed at collecting the demographic details of the parents in Kliptown informal settlement. The primary demographic variables raised in this section were

gender, ages of children and source of income of the parents. The demographic variables helped the researcher to relate them to the social impacts of water pollution on children. The ages of children were used to determine their vulnerability to disease as a result of inadequate water supply and sanitation in the informal settlement. Sources of income of parents were used to determine how parents could care for their children in case they suffered from disease due to inadequate water supply and sanitation.

5.6.2.1 Question 1: What is your gender?

The researcher gave questionnaires to 65 different male parents and 75 different female parents. Thus, a total of 140 parents were given questionnaires to complete. This was done to get balanced views and opinions on the social impacts of water pollution from both male and female parents. The researcher ensured that both male and female parents were given questionnaires to complete. If both male and female parents were present, the researcher would give the questionnaire to the male parent to complete because the number of female parents found in each household tended to be more than male parents. The researcher discovered that most households were headed by women. The number of male parents given questionnaires was therefore outnumbered by the number of female parents. Questionnaires were given on a public holiday to ensure that all parents would be available at their homes.

5.6.2.2 Question 2: What is your source of income?

From the survey conducted, the results showed that parents in the Kliptown informal settlement were very poor. The results are indicated in Figure 8. Most of the parents (51%) lived off the child support and old age pensions grants while 42% of the parents relied on doing piece work. Only 4% relied on informal activities such as selling vegetables, fruits, sweets and cigarettes. 3% of the respondents are in formal employment outside of Kliptown. The findings showed that high levels of unemployment and poverty are rife in the informal settlement. These findings view that unemployment and poverty are rife in informal settlements was supported by Rubin (2008) She noted that unemployment and poverty are attributed to the consequences of lack of past educational opportunities and current economic possibilities which left a large proportion of residents in informal settlements relying on government subsidised grants, piecework and informal activities (Rubin, 2007).

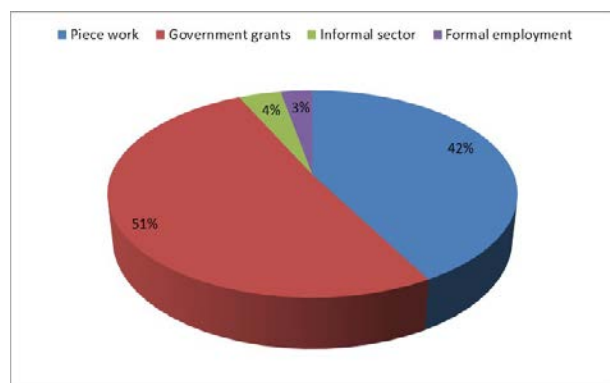


Figure 8 Income of Respondents (Source- research data)

5.6.2.3 Question 3: What ages of children are most affected by the physiological impacts of water pollution?

Ages of children in Kliptown were analysed to determine the age group that was more vulnerable to disease as well as other social impacts of water pollution. Children from various sections of the informal settlement (Tamatievlei, Mandela View and Valentine Village) were included in the sample. This was done to ensure that results were not biased to only one section of the informal settlement. Parents revealed that children aged between zero and four years were affected more by water-related diseases like diarrhoea (42%) (findings from the research appear in Figure 9). The five to eight years age group was less affected (34%) while the nine to 12 years age group was less affected at 18%. The 13 years and above age group was least affected by the impacts of water pollution as indicated by 6%

occurrence rate. The zero to four years age group was affected most because they played everywhere within the informal settlement, picked up dirty things to eat and were more vulnerable and ignorant of the impacts of playing in a polluted environment. The young ones at the crawling stage also crawled around the polluted toilets and environment.

The researcher observed young children playing in littered surroundings. The visual observation supports the information above gathered from the parents presented in Figure 9 which highlights 42% prevalence rate in children below four years of age. In Valentine Village, 11 children were observed of which five children (equivalent to 45.4%) were approximately below four. In Mandela View, 12 children were observed, and five children, equivalent to 42%, were presumed to be under four years of age. In Tamatievlei, 13 children were observed, of which 6 (41.7%) seemed to be in the under 4 years category. The researcher applied discretionary judgement as she could not interview the minors on their actual ages due to ethical considerations. The litter visually observed included empty cans mainly alcohol and beverage drinks, plastic, paper, cardboard, advertisement pamphlets, human and animal faeces, empty bottles, broken glass, used sanitary products, condom packaging and used condoms, broken asbestos sheets, rusty remnants of corrugated iron and polystyrene packaging.

The researcher concluded from this observation that the children under the age of four (4) are more vulnerable to contracting pollution related illnesses. The five to eight years age group was also fairly exposed to overflowing filthy toilets as opposed to the nine to 12 years age group which was able to use the toilets well and bath themselves. Children below the age of five years were most affected by water-related diseases, particularly diarrhoea because of their vulnerability.

The findings are summarised in Figure 9. The assertion that children below the age of five years were most affected by water-related diseases, particularly diarrhoea because of their vulnerability was supported by Cumming (2008). Cumming pointed out that the lack of sanitation is an affliction of the vulnerable and marginalised groups of the population particularly children below the age of five years. It further noted that children under the age of five account for 90% of all deaths that occur from sanitation-related diarrhoea, amounting to 5000 children dying each day worldwide (Cumming, 2008). It is evident from the results that some children of school going ages were affected; the information on absenteeism from school was verified with the interview with the matron.

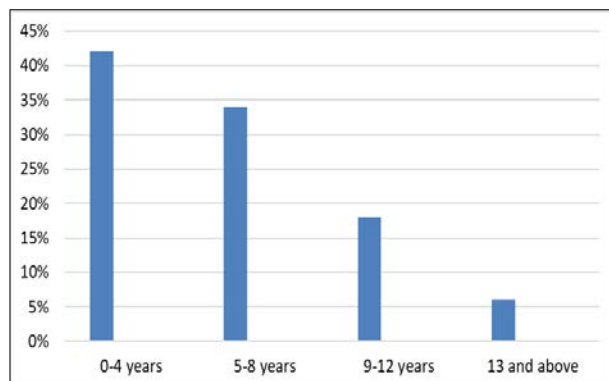


Figure 9: Ages of children affected by the physiological impacts of water pollution (Source- research data)

5.6.3 Social Impacts of water pollution

Section B of the questionnaire was aimed at analysing the social impacts of water pollution in Kliptown informal settlement.

5.6.3.1 Question 4: Do your children queue to fetch water?

Children in Kliptown informal settlement queued to fetch water from the communal and household taps because the water supply was inadequate to meet their needs. Queuing for water was also prompted by the fact that parents had small containers to store water and that the taps were very few. The small containers children used caused them to make many trips to the communal and household taps when water got used up in the homes. The results of the research findings revealed that (67%) of children queued to fetch water for daily needs in their homes. Only 33% of children in

the Kliptown informal settlement did not queue to fetch water because they were too young to queue for water (Table 5). Queuing for water in the informal settlement also showed that the residents of the Kliptown informal settlement, more so children were denied the access to water as a basic human right. The communal water taps were very few that is why children queued. Children’s rights to adequate water supply were therefore violated.

Table 5: Percentage of children queuing for water (Source-research data)

Responses	Yes	No	Total
Number	94	46	140
Percentage	67%	33%	100%

The parents were asked about the frequency of visits to water points, as a follow up question if they had answered yes. The results are tabulated in (Table 6).

Table 6: Frequency of visits to water points and times of the day (Source-research data)

Respondents	Morning before school - before 07.30	Mid morning from 07.30 to 1200)	Afternoon from 12.00 to 15.30	Evening from 15.30 to 20.00	Total
Male	18	12	12	15	57/61%
Female	14	8	8	7	37/ 39%

Some 60% of the parents that indicated that their children fetched water from water points were males. This could be because these families had no mother figure in the house to do the gender related duties of fetching water. Only 37% of the 94 respondents who indicated that they send children to fetch water were female. The male respondents also send their children to fetch water in the early hours and in the evening. Table 7 below presents data on the gender of the children that fetched water according to a follow up question that was asked to all the 94 respondents that answered yes to the question, “Do your children queue to fetch water”.

Table 7 shows that the percentage of females going to fetch water is 82% of the 94 reported incidents. This is a clear indication of the gender bias towards females. It is also evident that the majority of them, 29%, fetch water before they go to school and this gives an unfair advantage to the boy child because he goes to school without attempting the water fetching routines. 22% of the girls fetch water after school as well, which is also a deprivation of their social interaction and preparations for the next day of school. The graphical presentation of the above tables in graphical format highlights the social inequalities of the girl child in informal settlements.

There is a marked difference between the male children who fetch water at any given time of day with marked differences in the morning and evenings. This is supported by the visual observation outlined above.

Table 7: Gender of the children sent to fetch water (Source-research data)¹

¹ % Rounded off.

Gender	Morning school before	Mid morning (From 07.30 to 1200)	Afternoon (From 12.00 to 15.30hrs)	Evening (From 15.30 to 2000)	Total
Female	28 (30%)	12 (13%)	16 (17%)	21 (22%)	77 (82%)
Male	5 (5%)	3 (3%)	3 (3%)	6 (6%)	17 (18.%)

The burden on the girl child is therefore substantiated by the information shown in Figure 10.

The researcher visually observed that children were strained by queuing and carrying water to their home and deduced that the queuing for water would encroach on children’s valuable time to do other activities, including compromising their ability to do schoolwork.

The notion that the activity of fetching water was an arduous task for children was supported by feedback from focus groups in Deh Mazang, a hillside settlement in west Kabul (Cooperation for Peace and Unity, 2011). In this publication it was noted that the activity of fetching water by children is physically taxing causing children to suffer from back pain, shoulder pain and physical exhaustion as the result of carrying heavy loads of water on a daily basis. It also caused conflicts, violence and bullying by other children. Children found it difficult to make time for other activities because of fetching water (Cooperation for Peace and Unity, 2011).

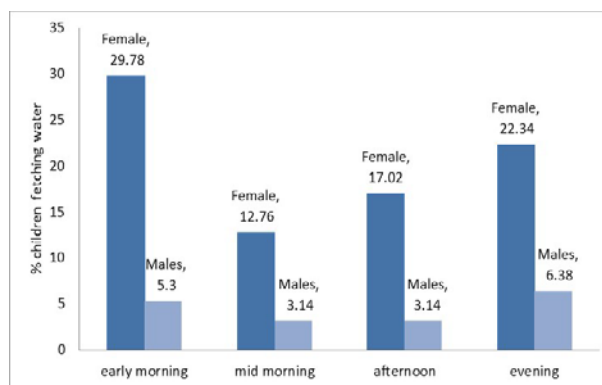


Figure 10: Girls versus Boys fetching water at different times of the day (Source-research data)

5.6.3.2 Question 5: Have your children been absent from school due to waterborne diseases?

Children in Kliptown informal settlement sometimes missed school because of sickness due to waterborne diseases. Findings from the study are indicated in Figure 11.

The research revealed that 73% of the children were absent from school for a number of days to be treated for various waterborne diseases. This is a significant percentage. Missing school affects children’s learning progress as they tend to lag behind in their school work.

As a result, their academic performance will go down and their future aspirations may not be fulfilled. The view that absenteeism impedes learning progress and future prospects of children was supported by the UNDP. From an international perspective, it was pointed out that water-related diseases cost 443 million school days each year (Watkins, 2006).

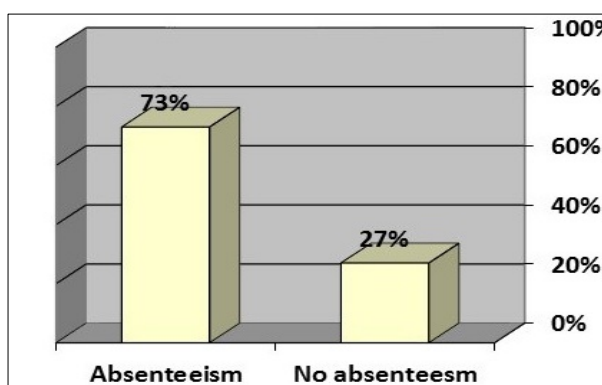


Figure 11: Absenteeism due to water-related diseases (Source-research data)

5.6.3.3 Question 6: Did missing school due to being treated for waterborne diseases affect your child’s academic performance?

Missing classes due to illnesses related to water pollution affected children’s academic performance negatively. Most children’s work went down as they could not cope when they returned to school.

The information presented in Figure 12 confirms the assertion that the girl child is more affected by illnesses that are water-related.

The total number of children that were sick is 140 and 130 did not attend school and of the 130 that did not attend school 106 girls were absent from school. The impact of water borne diseases on the girl child is very evident from these figures. The parents of children who continually missed school confirmed decreased academic performance on their children due to recurring water-related illnesses.

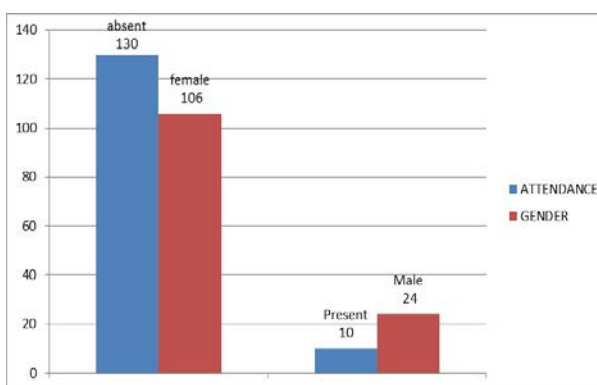


Figure 12: School absenteeism due to water-related illnesses and gender implications. (Source-research data)

As the result of continually missing school, children lose out on a number of concepts and find it difficult to catch up with the others. The notion that academic performance goes down due to absenteeism was noted by Borkowski (2006) Borkowski stated that due to suffering from water-related diseases, children frequently miss school and their cognitive potential is reduced. These adverse impacts hurt their prospects for future earnings and make continuing poverty more likely (Borkowski, 2006).

Results in Table 8 below showed that 93% of children who missed school in Kliptown’s three informal settlements under study suffered decreased academic performance while 7% of the children’s academic performance was not affected by missing school.

Table 8: Percentage of children with low academic performance due to absenteeism (Source-research data²)

Responses	Yes	No	Total
Number	130	10	140
Percentage	93%	7%	100%

5.6.3.4 Question 7: Which gender queues more for water?

Although children generally queued to fetch water because of inadequate water supply and sanitation in Kliptown informal settlement, results from findings in the study revealed that the girl children queued quite often to fetch water more than their male counterparts did (82%). The results are shown in Figure 13. Only 18% of boys queued to fetch water.

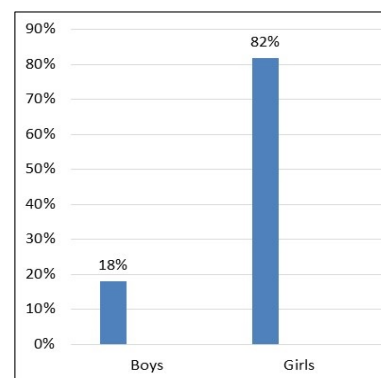


Figure 13: Gender implications of queuing for water (Source-research data)

The researcher’s own observation at communal and household taps also showed that girls were always queuing to fetch water at in the informal settlement. The visual observation did not exercise a physical count of the participants the researcher was trying to eliminate reactive effects because human subjects are usually inert. The view that girl children tend to fetch more water than boys because of inadequate water supply and sanitation was supported

² % Rounded of.

by Kakuru and Dauda (2010). They noted that the responsibility of collecting water and maintaining proper hygiene at the household level is placed greatly on women and girl children. Culturally, it is also the norm for the women and girl children to fetch water. The practice promotes gender inequalities between boys and girls in terms of opportunities in life (Kakuru & Dauda, 2010).

5.6.3.5 Question 8: Which gender is affected more by lack of sanitation and water supply?

Lack of sanitation and water supply in informal settlements affects the girl child more than the boy child. The girl child tends to suffer more if there is a lack of potable water and sanitation. At times, the girl child has to miss school, particularly when menstruating to collect more water for their personal hygiene.

Survey results revealed that all of girls in Klijtown's three informal settlements under study missed school due to lack of sanitation and water supply when they were menstruating. The children's parents attested to this.

In Nigeria, it was found that girls are denied their right to education because of a lack of decent sanitation facilities at home (Adeleye et al., 2014). Absenteeism among girls is higher than that of boys due to sanitation barriers at home. In the process, this widens the gap in performance and opportunities afforded to girls than boys.

5.6.3.6 Question 9: Are children exposed to bad odour from toilets in Klijtown?

Children in the Klijtown informal settlement were exposed to a bad odour that came from the mobile and bucket system toilets. A physical observation while distributing the questionnaires revealed that of the 140 households visited, 72 chemical communal toilets were less than 4 metres from their main dwelling, 14 had communal pit latrines less than 10 metres in average from their main dwelling, 54 had the bucket system a metre from the main dwelling. The rest used any of the available facilities.

Children were mostly exposed when they played on the roads, in front and at the back of their shacks where the bucket and mobile system toilets were located. Study findings showed that all children were exposed to the bad smell. The smell brought some ill effects to children. The children complained of headaches, nausea, drowsiness, dizziness and their parents confirmed this.

Children were, however, forced to live with the smell as they played at the back of the shacks, in the garden and in the roads where most of the toilets were located. Depending on the level and time of exposure, the symptoms differed from child to child. The bad odour brought some degree of uneasiness. This was also confirmed by Klijtown Clinic records which showed a pattern of these conditions in children from the Klijtown informal settlement.

The assertion that a bad odour influences a child's health was supported by the Agency for Toxic Substances and Disease Registry. The agency noted that odours might cause children to suffer from various ailments, which include headache and nausea, nasal congestion, chest tightness, eye, nose and throat irritation, coughs and drowsiness among others (Agency for Toxic Substances and Disease Registry, 2016).

5.6.3.7 Question 10: Are children exposed to rotting garbage from rotting refuse and domestic waste due to erratic waste removal in their playing and living environment in Klijtown?

Children in Klijtown informal settlement were also exposed to an unhealthy living environment. The conditions in which children lived and played, mostly in the roads, around the garden and other areas are characterised by mounds of uncollected refuse and domestic waste.

Results from the findings of the study revealed that all of the parents agreed that their children were exposed to an unhealthy environment that was characterised by mounds of rotting refuse and

domestic waste. The researcher observed that refuse and domestic waste were also infested with worms and flies. Largely because of the absence of a sewer system and drainage facilities, grey water from homes was constantly disposed of on the roads and at the back of the shacks. Refuse and domestic waste from homes was also thrown randomly in and around homes and roads in the informal settlement.

5.6.3.8 Question 11: Is refuse regularly collected by responsible authorities?

Asked whether refuse was regularly collected by responsible authorities, all parents agreed that refuse was not collected regularly. Refuse accrued at various points and areas where children played because there was no proper refuse collection system due to impassable roads.

As a result, grey water mingled with the refuse and in some cases creating breeding grounds for disease-causing pathogens. Heaps of uncollected refuse and grey water exposed children to many hazards such as flies, rodents and germs that could exacerbate the transmission of the disease-causing pathogens in children.

Children's hand-to-mouth activities as they played on the dirty ground made them vulnerable to contracting diseases from bacteria, viruses and parasites. The view that uncollected domestic waste negatively affects human health, particularly that of children was also established by Lucas and Gilles (Lucas & Gilles, 2002).

Their findings support the researcher's view that heaps of improperly disposed of refuse, mixed with water; enhance breeding of rodents, vectors and emission of bad odours which are transmitters of various forms of the disease. At these random dumping sites filled with water, vectors like flies are also implicated in the transmission of faecal-oral diseases.

5.6.3.9 Question 12: Have you ever had cases of your children drinking contaminated water and eating contaminated food?

Cases of children drinking contaminated water and eating contaminated food were witnessed in Kliptown informal settlement from time to time. The results of the research regarding cases of children who drank contaminated water and ate contaminated food are shown in Figure 14.

Results from the research indicated that 68% of children had at some point drunk contaminated water or eaten contaminated food in all the three informal settlements under study. Thirty two percent of the respondents said their children did not drink contaminated water or eat contaminated food.

High incidences of drinking contaminated water and eating contaminated food were largely a result of erratic water supply when taps broke down, inadequate sanitation and poor water storage facilities. Limited water supply prompted children to reuse dirty water for bathing and washing dishes. The scenario exposed children to disease-causing germs and parasites from using dirty water.

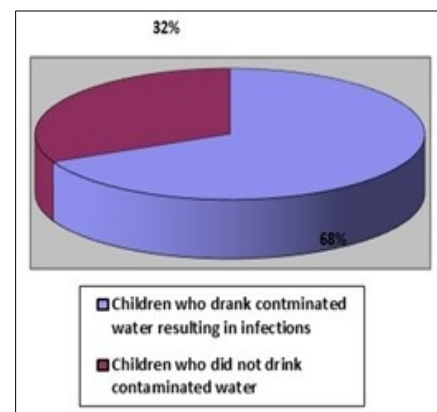


Figure 14: Cases of children drinking contaminated water and eating contaminated food (Source-research data)

5.6.3.10 QUESTION 13: When your children suffer from water-related illnesses, do you take them to the clinic, spiritual healers or traditional herbalists?"

When children suffered from water-related illnesses, their parents took them to various places for treatment. Results from the findings of the study revealed that 85% of the parents took their children

to the Kliptown Clinic for treatment. 9% of the parents took their children to spiritual healers while 6% took children to traditional herbalists. The results are shown in Figure 15.

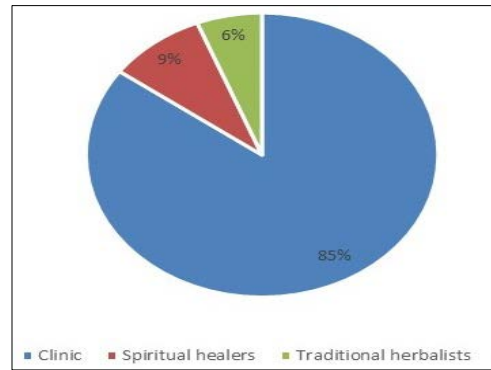


Figure 15: Treatment areas for water-related illnesses (Source-research data)

The researcher found out that the parents who took their children to spiritual healers and traditional herbalists did so because of religious and cultural beliefs. It was their belief that spiritual or ancestral powers could heal their children. In areas where sanitation and water supply are lacking, children have been exposed to health-related risks by drinking contaminated water.

5.6.3.11 Question 14: “Have you ever had cases of diarrhoea in children in 2015?”

Children in Kliptown informal settlement suffered from diarrhoea at some point in 2015. The conditions in which the children lived made them vulnerable to the disease. Results from the study showed that 64% of the children at some point suffered from diarrhoea in 2015. A smaller number of children (36%) did not suffer from diarrhoea in 2015. This is illustrated in Table 9 below.

Table 9: Percentage of cases of diarrhoea (Source-research data)

Responses	Yes	No	Total
Number	89	51	140
Percentage	64%	36%	100%

Diarrhoea cases in children in the Kliptown informal settlement were caused by unhygienic conditions. The unhygienic conditions were largely a result of inadequate sanitation and water supply. Children were vulnerable, especially within the zero to four years age group. This age group crawled around the polluted living environment and were exposed to overflowing mobile toilets. The nine to twelve years age group relieved themselves in the unclean mobile and bucket system toilets which were soiled with human excreta on the toilet seat as well as the floor. Worse still, there are no taps for children to wash their hands after using the toilets. The persistent presence of soiled toilets was due to erratic emptying by the responsible authorities.

Uncollected rotting refuse and domestic waste in Kliptown informal settlement also increased incidences of diarrhoea as rodents, flies and cockroaches helped to contaminate food. The narrative comments from the parents were indicative of a heavily rodent infested area, which was substantiated by visual observation. The prevalence of diarrhoea was also identified in the literature in the cases of Zanzibar and Tanzania.

5.6.3.12 Question 15: Have your children suffered from cholera in 2015?

Cholera is a serious waterborne pollution disease. Findings in the study area revealed that there were no cases of cholera in children. However, cases of cholera were reported in one of Kliptown’s 12 informal settlements. On 21 April 2008, an IRIN newspaper report by Laura Lopez González confirmed that two people living in the Chicken Farm informal settlement in the Kliptown area had died after contracting the waterborne disease. The community blamed local government’s failure to provide basic services like clean water and sanitation(González, 2008).

5.6.3.13 Question 16: Did taking your child to the clinic, spiritual healers or traditional herbalists for waterborne diseases affect your family income?

When children got sick due to diarrhoea and other water-related illnesses, their parents took them to the nearest clinic in Eldorado Park Extension 8 or to spiritual healers or traditional herbalists outside the Kliptown informal settlement. There is no clinic in Kliptown informal settlement. Results of the study revealed that 77 % of the parents' income was greatly affected by taking their children to the clinic, spiritual healers or traditional herbalists out of Kliptown informal settlement.

This is shown in Figure 16. Twenty three percent of the parents said taking their children for treatment affected their income to a smaller extent. With a high percentage of people on social grants payments of medical fees means they have to sacrifice one or more of their basic needs to afford the medical fees of the traditional healers.

Family income was adversely affected by paying transport and medical costs. The respondents who had sick children said they had to borrow money in order to board taxis for some days to receive treatment.

There is no clinic in the informal settlement. Most of the parents struggled to find money to take their children to the council clinic, government clinics, spiritual healers and traditional herbalists. Family income diminished, and children's needs were not adequately met. In Johannesburg, it was found that residents of informal settlements are poor and relied on meagre old age pension grants, child support grants, piece work and informal activities for a living (Rubin, 2007).

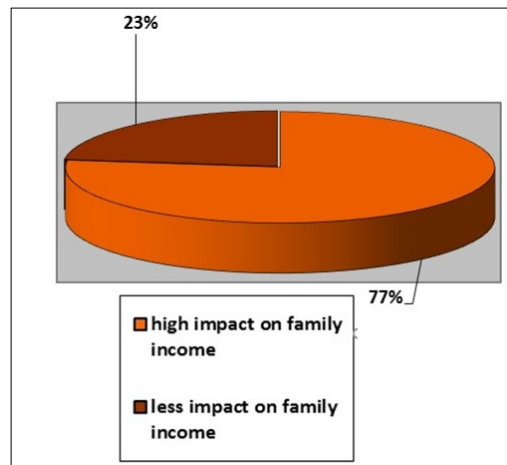


Figure 16: Percentage of children taken to Kliptown Clinic, spiritual healers or herbalists (Source-research data)

5.6.4 Factors contributing to water pollution

Section C of the questionnaire analysed the factors that contributed to water pollution in Kliptown informal settlement.

5.6.4.1 Question 17: "Which part of Kliptown informal settlement do you live and have your children at any point suffered from waterborne diseases in 2015?"

The researcher used the survey data to compare the areas of Tamatievlei, Mandela View and Valentine Village in terms of reported frequency of pollution related diseases. The location of parents' homes influenced children's exposure to various social impacts of water pollution. Children whose parents lived near the Klipspruit River in Tamatievlei (A in Figure 17) were affected more by waterborne diseases like skin rashes and eye infections. The skin rashes and eye infections came as a result of continuous use of the Klipspruit River for bathing and washing blankets.

Parents of children who lived near the Klipspruit River also confirmed that their children often suffered from these diseases. Parents whose children lived in the central part



Figure 17: Location of respondents in Kliptown informal settlement.

of the Kliptown informal settlement in Mandela View (C in Figure 17) confirmed fewer cases of skin rashes and eye infections. Very few cases of skin rashes and eye infections were confirmed in children who lived along the main road, Valentine Village (B in Figure 17) which separates Kliptown informal settlement and Eldorado Park. In a bid to eliminate bias on the results of the study, the researcher sampled the population of the Kliptown informal settlement in almost three equal parts. Of the sampled households, roughly one-third resides in each of the three housing areas, namely Tamatievlei (33%), Mandela View (34%) and Valentine Village (33%).

The sampled population used for the study is shown in Figure 18. Children who lived near the Klipspruit River used the Klipspruit River for bathing and washing blankets. The polluted river water made children develop allergies that resulted in them contracting skin rashes and eye infections. The matron at Kliptown Clinic confirmed that the skin rashes and eye infections were a result of allergies due to the use of the poor water quality in the Klipspruit River as well as dirty water. The researcher also noted that high cases of skin rashes and eye infections were found in children who lived close to the Klipspruit River.

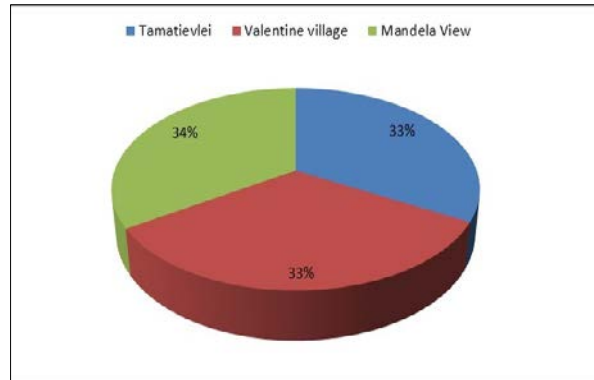


Figure 18: Spatial distribution of respondents according to zones in Kliptown informal settlement (Source-research data)

5.6.4.2 Question 18: Which type of toilet do you and your children use?

Children in Kliptown informal settlement use mobile and bucket system toilets for sanitation. Both mobile and bucket system toilets are located haphazardly within the informal settlement. Some mobile and bucket system toilets are located in front of the shacks, some at the back of the shacks, some near the river and most of them along the roads within the informal settlement. Findings on the types of toilets children in Kliptown informal settlement use revealed that 51% of the respondents used mobile toilets, while 39% used the bucket system. Only 10% said they used pit latrines, as shown in Table 10 below.

Table 10: Sanitation (Source-research data)

Type of sanitation	Number	Percentage
Mobile toilets	72	51
Bucket system	54	39
Pit latrines	14	10
Total	140	100

5.6.4.3 Question 19: Are the mobile toilets adequate and in good condition?

Study findings in Kliptown informal settlement revealed that mobile toilets were very few and not in good condition for children to use. All respondents who used mobile toilets (51%) said there were not enough to meet their needs. The mobile toilets were thus inadequate to meet the needs of the children in the informal settlement. The fact that toilets in front of shacks or at the back of shacks were sometimes locked to prevent passers-by from using them forced children to use more filthy mobile toilets which are located in the streets or along the river. The locking of the mobile toilets compounded the problem of inadequateness of the toilets.

Study findings also revealed that the mobile toilets were emptied only two times a week, on Mondays and Thursdays and this was not enough to keep the toilets clean. All parents who used mobile toilets (51%) attested to that. This resulted in the overuse of mobile toilets, particularly on public holidays and weekends when many friends and relatives visited the informal settlement. As a result, the mobile toilets got messed up with human excreta around the chamber that people used as well as on the floor. The mess created by the overuse of the mobile toilets, exposed children to serious health risks.

5.6.2.20 Question 20: Are the bucket system toilets adequate and in good condition?

Findings from the study also revealed that bucket system toilets were very few and too dirty to be used by children in the informal settlement. All parents who used bucket system toilets (39%) attested to this. The problem of inadequateness of the bucket system toilets was also worsened by parents who locked the toilets in front or at the back of their shacks. Sometimes children also forgot to lock the bucket system toilets. Forgetting to lock the bucket system toilets enabled passers-by to use the bucket system toilets resulting in overuse. The study findings further revealed that human waste was left to accumulate for a month or more before being emptied. This was attested by all (39%), of the sampled population who used the bucket system toilets. Among other things, the respondents raised the following concerns; that the bucket system toilets spilled over because the responsible authorities took longer to dispose of the human waste and that the bucket system toilets were inappropriate. The respondents who used pit latrines (10%) had no comment on the adequacy of mobile and bucket system toilets since they did not use them.

Taking into account the aforementioned conditions, one can summarise that the use of the bucket system together with mobile toilets which were poorly maintained by responsible authorities exposed children to human waste, poor hygiene and widespread incidents of disease.

5.6.4.21 Question 21: Which water facilities do you and your children and use in Kliptown informal settlement?

Children in Kliptown used communal water taps, household taps and other facilities. Communal water taps were located at designated points within the informal settlement mainly at Valentine Village (along the main road) and Mandela View in the central part of Kliptown informal settlement. Household taps in use were mainly found at the few formal houses in the central and southern parts of the informal settlement (Mandela View). In Tamatievlei near the river, communal water taps were also found.

Findings from the study revealed that the majority of children (69%) used communal water taps. 16% of children used household taps and 15% of the children used other sources. The results of water facilities and use in Kliptown are shown in Table 11. The statistics below indicate a high level of usage of communal taps. This reflects the concentration of individuals on the taps and high probability of conflicts arising from accessing the taps. The visual observation during the researcher’s distribution of the questionnaires confirmed the high concentration of youths around communal taps.

Table 11: Water facilities used in Kliptown informal settlement (Source-research data)

Responses	Communal water tap use	Household tap use	Other
Number	96	23	21
Percentage	69	16	15

At all locations in Kliptown informal settlement and along the Klipspruit River, children relied on communal taps. Direct observation by the researcher revealed that children placed their bucket handles on taps. The practice of putting bucket handles on taps caused the taps to break easily. When the taps broke down, families who used the taps contributed funds to replace the broken taps. Due

to low levels of income, high crime and theft in the informal settlement, communal tap users bought cheap plastic taps which also broke down easily due to overuse. Copper taps which they used to buy were stolen during the night. Furthermore, water pipes leading to communal taps leaked and took time to be repaired. As a result, children failed to get a steady supply of water and longer queues ensued at other communal water taps.

Some 15% of children sometimes used the polluted Klipspruit River for bathing and washing blankets. The inadequacy of communal water taps posed a serious problem in Kliptown informal settlement as people queued for water, including the children.

5.6.4.22 Question 22: Are the water supply facilities adequate?

Survey results on water facilities used in Kliptown informal settlement revealed that they were inadequate. All the parents agreed that the water supply facilities were inadequate. Inadequateness of the communal water taps was also compounded by the fact that the communal water taps were sometimes broken due to overuse. This was evident at the three informal settlements of Mandela View, Tamatievlei and Valentine Village.

Consequently, it can be argued that inadequate water supply caused people to resort to using other unsafe and unprotected water sources like the Klipspruit River. The inadequacy of the water is an infringement of the socio-economic rights of individuals. Access to clean and safe drinking water is a basic right of individuals. The use of unprotected water sources combined with inadequate hygiene also exposed children to allergies which resulted in them contracting skin rashes and eye infections.

5.6.4.23 Question 23: Do your children sometimes use water from the Klipspruit River for bathing and washing blankets?

The Klipspruit River was used by children in Kliptown informal settlement for other uses like bathing and washing blankets. The Klipspruit River is a tributary of the Klip River. The two river catchment areas are known as the Klipspruit-Klip River systems. Findings from the survey questions completed by the parents revealed that 41% of children used water from the Klipspruit River for bathing and washing blankets. 59% did not use water from the Klipspruit River for bathing, washing their blankets or anything else. This is shown in Figure 19. Results from the survey revealed that distance correlated with the use of the Klipspruit River.

Survey results showed that children who lived close to the river (Tamatievlei) and fewer from the central part (Mandela View) of the informal settlement used the river to wash blankets as well as to bath. Children who stayed further away from the river did not use it. The researcher also visually observed children defecating in the Klipspruit River.

The evidence of floating human faeces in the Klipspruit River system is an indication of the possible infestation of the river with *E. coli*

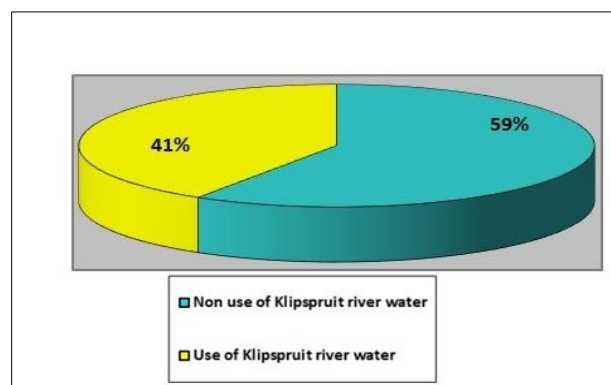


Figure 19: Use of the Klipspruit River (Source- research data)

bacteria. It is possible that South African rivers that pass through or those close to informal settlements with no waterborne sanitation and meagre water supplies are severely contaminated by faecal pathogens (Dallas & Day, 2004). *E. coli* bacteria decrease the water quality of river water and further increases incidents of diarrhoeal infections if children ingest the polluted river water accidentally. The practice of using polluted river water exposes children to many health-related

diseases like diarrhoea, gastrointestinal disease, cholera, dysentery and hepatitis A. Skin rashes and skin infections may also affect children bathing and washing clothes in polluted river water.

Children who stayed near the Klipspruit River tended to suffer more from water-washed diseases like skin rashes and eye infections. This was confirmed by their parents. Staying near the river thus correlated with the high incidents of waterborne diseases reported in the same area. Consequently, social impacts of water pollution seem to have had a ripple effect on the community as evidenced by a decrease in such cases with increased distance from the Klipspruit River. The assertion that bathing in dirty water can affect the health of people, particularly that of children was supported by Banks. Banks noted that clean water is not readily available in informal settlements, so children may contract diseases like scabies due to using dirty water for bathing (Banks, 2009).

5.6.4.24 Question 24: Where do you dispose of your grey water?

Grey water was disposed of in almost every part of the informal settlement. It was disposed of in the roads, at the back of the shacks, in the garden and in front of the shacks. Findings of the research revealed that 71% of the parents disposed of their grey water in the road where children mostly played, 19% in front of the shacks, 7% at the back of the shacks and 3% in the garden and other areas (Figure 20).

Grey water was disposed of in the areas where children played especially in the roads, in the front of the shacks and the back of shacks. At the back of the shacks, water accumulated in puddles which were possible areas where disease-causing germs could breed. Disposal of grey water in places where children played polluted the environment. Disposal of grey water also exposed children to an unhygienic environment.

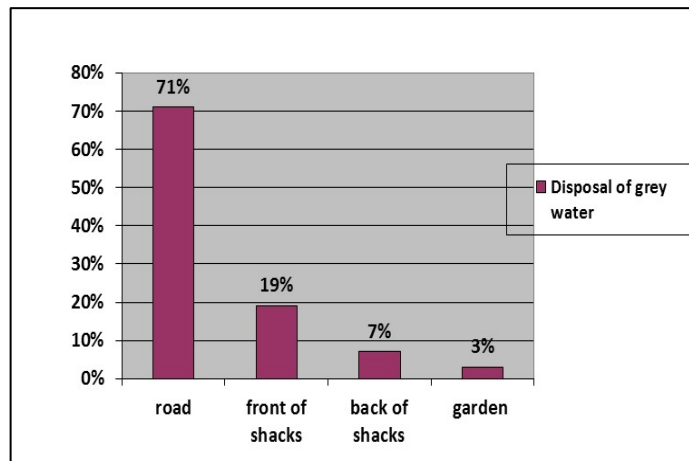


Figure 20: Disposal of grey water (Source-research data)

5.6.4.25 Question 25: What do you think should be done to improve water supply and sanitation in your area?

Parents gave different views and opinions on what should be done to improve water supply and sanitation in the informal settlement. The results of these opinions are shown in Figure 21.

Results from the study revealed that the majority of the parents wanted more communal taps and mobile toilets to be installed in the informal settlement (43%).

The other 33% lamented that they needed more communal taps. Some 24% of the parents opted to have houses built for them. Of interest is that 24% of the respondents did not answer the questions directly. Trying to specify the reasoning behind the 24% response would be speculative.

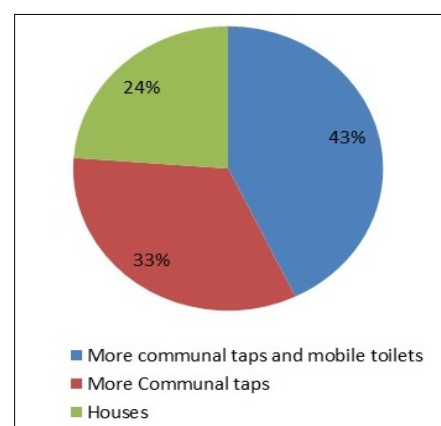


Figure 21: Recommendations by parents (Source-research data)

5.7 RESPONSE FROM THE INTERVIEW

The researcher conducted an interview with the Matron of Kliptown Clinic on the 8th of May 2015. The interview was conducted to authenticate and complement some of the responses obtained from parents from Kliptown informal settlement on health issues arising from water pollution.

The researcher had scheduled to interview two sisters-in-charge at Kliptown Clinic but managed to conduct only one interview with the matron. The researcher interviewed the matron only because she was responsible for the compilation of statistics on health issues and epidemics arising from water pollution in the area of study. Interviewing the matron gave the researcher a broader picture of health issues arising from water pollution in Kliptown informal settlement. The interview provided both qualitative and quantitative data. The interview authenticated most of the responses and the gravity of social impacts as found in respondents' responses.

5.7.1 Diarrhoea, skin rashes, eye infections, malaria and bilharzia

The matron confirmed that there were numerous cases of diarrhoea, skin rashes and eye infections from Kliptown informal settlement in 2015. According to the matron, there were approximately 20 cases of diarrhoea in children every month from the informal settlement. Diarrhoea affected 70% of children in the informal settlement. In some instances, the matron said they had to refer serious cases of diarrhoea to Chris Hani Baragwanath Hospital which is 15 kilometres away. The matron attributed the diarrhoea incidences to inadequate sanitation, unsafe water and poor hygiene in the informal settlement. The matron said there were very few cases of skin rashes and eye infections from the informal settlement every month, only ten or fewer cases per month. Patterns of children complaining of headaches, nausea and dizziness owing to a malodorous environment from the mobile toilets were also confirmed by the matron.

The matron pointed out that the skin rashes and eye infections were a result of using dirty water. Children developed allergies as a result of using the dirty water. The matron revealed that there were no cases of malaria and bilharzia from children in the Kliptown informal settlement. Malaria and bilharzia are vector-borne diseases with the vectors being dependent on the water for part of their life cycle. The diseases themselves are not borne by water and are not caused by pollution. The matron pointed out that other diseases like malaria, bilharzia, shigella, conjunctivitis and trachoma did not present at the clinic. This was because the area was too cold to support the breeding of mosquitoes and bilharzia parasites in the water. Kliptown informal settlement in Soweto experiences a temperate climate. The WHO stated that malaria and bilharzia are found in hot areas with Schistosomiasis (bilharzia) is prevalent in tropical and sub-tropical areas (World Health Organisation & United Nations Children's Fund, 2015). The WHO pointed out that most malaria cases and deaths occurred in Sub-Saharan Africa (World Health Organisation, 2015).

Prevalence of water pollution related illnesses as per statistics from the interview (according to children under 12 years of age who visited the clinic) is shown in Table 12 and Figure 23 below. The statistics exclude those that did not come to the health facility and those that sought other unconventional medical interventions such as spiritual healers and or herbalists.

Table 12: Prevalence of water pollution related illnesses (Adapted from Kliptown Clinic records 2015)

	Diarrhoea	Eye infections	Skin related	Headaches, dizziness, drowsiness	Monthly Total
Jan	56	12	17	23	108
Feb	47	8	10	20	85
Mar	51	9	13	21	94
Apr	54	11	14	21	101
May	46	12	15	23	96
Jun	47	11	12	21	91
Jul	46	12	14	22	94
Aug	49	13	14	23	98
Sep	50	12	13	24	99
Oct	53	10	15	26	104
Nov	56	13	16	26	111
Dec	57	12	18	23	110
Total	612	134	171	273	1190
Average	51	11.16	14.25	22.75	99.17
Absenteeism as per sick notes issued	54 8.8%	9 6.71%	14 8.18%	21 7.69%	98 8.23%
Referrals to district hospital	79 12.9%	13 9.7%	8 4.67%	15 5.49%	115 9.66%

From Table 12 and Figure 22 it can be deduced that diarrhoea is the biggest water-related problem among children in Kliptown accounting for 51.4% of reported cases. Diarrhoea also accounts for 55.10% absenteeism due to water pollution related illnesses.

The records from the clinic indicated a total figure of 134 sick notes issued in the period from January to December 2015 and of these, 73% were due to water pollution related illnesses. It can be confidently concluded that water pollution is a problem because it accounts for 73% of the absenteeism in schools.

It is also observed that diarrhoea increases in the months of November, December and January, which coincidentally are the high rainfall months in Kliptown. The constant (without any peaks) occurrence on the graph of headaches,

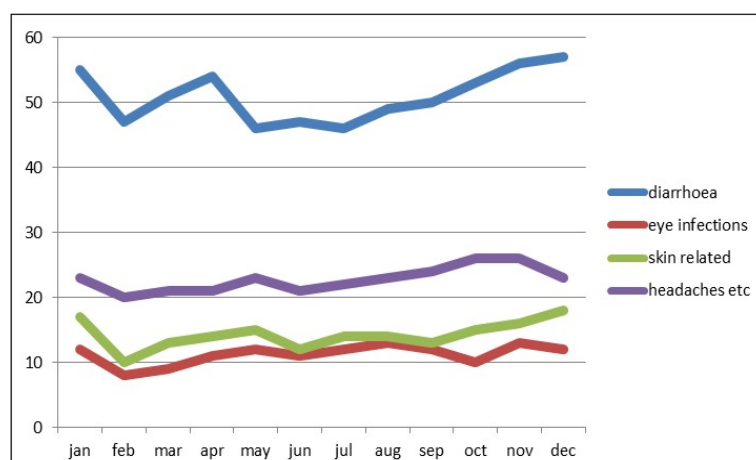


Figure 22: Graphical presentation of the prevalence rates of waterborne related illnesses (Adapted from Kliptown Clinic records 2015)

dizziness, drowsiness and nausea may be attributed to the fact that sewerage problems and ablution facilities inadequacies are a permanent feature in the community of Kliptown informal settlement. They therefore constantly affect the community irrespective of seasonal changes and other variables. Referrals to other institutions of health were 186 for the calendar year 2015 while water pollution related illness were 115 an equivalent of 68.8%. The figures above reflect a fundamental problem of water pollution and its impact on health (illnesses) and social structures (absenteeism from school). The strain due to the burden of water pollution related diseases is evident.

5.7.2 Factors that contribute to social Impacts of water pollution

The matron noted that inadequate water supply and poor sanitation resulted in children living in an unhygienic environment. The unhygienic environment was blamed for the frequent diarrhoea outbreaks. There are no taps outside the bucket and mobile system toilets for children to wash their hands after using the toilets. As a result, infectious diarrhoea was spread to children by bacteria like *E. coli* and shigellosis.

The matron pointed out that there was a close relationship between water quality and sanitation. She stressed that poor sanitation in the informal settlement led to water contamination. The main source of water contamination in the informal settlement was sewage from over spilling mobile toilets and human waste. Unsafe water which was infested with various pollutants due to lack of container tops to cover their water containers and inadequate sanitation affected children living in the informal settlement. Water supply was erratic when taps broke in the informal settlement.

If water supply improved in the informal settlement, children would be a step out of water-related diseases. Skin rashes and eye infections were a result of bathing with dirty water as a result of limited water supply when communal and household taps broke. Limited water supply forced children to reuse dirty water for bathing and washing dishes. Skin rashes and eye infections were also a result of bathing with dirty water from the Klipspruit River and other unprotected sources.

5.7.3 Measures to improve water supply and sanitation

The matron pointed out that more mobile toilets and communal taps should be provided in the informal settlement to reduce incidences of waterborne diseases. The matron further noted that ablution facilities and drainage sewers were also needed in the informal settlement so that the parents could desist from throwing grey water in the streets and around their shacks.

5.8 THE OBSERVATION METHOD

The researcher conducted a field observation of Kliptown informal settlement with the purpose of identifying evidence that supports that children were affected by the social impacts of water pollution. The observation method was also used to verify the authenticity of some of the responses given by the parents of Kliptown informal settlement in the questionnaires that were issued. The researcher observed the factors that contributed to the social impacts of water pollution as well as the social impacts of water pollution on children. Photographs showing the social impacts of water pollution on children were taken by the researcher on the 6th of April 2015.

Through observation, the researcher saw quite a number of social impacts of water pollution on children in the Kliptown informal settlement.

5.8.1 Exposure to a polluted and unhygienic environment

The researcher observed that children were exposed to a polluted and unhygienic environment where they played as shown in Figures 23 and 24.



Figure 23: Children playing in grey water at the back of the shack (Source-research data)



Figure 24: Children playing along a dirty road (Source-research data)

In and around these areas where children played, there was rotting garbage from domestic waste. The garbage was manifested with flies, worms and rodents. The researcher observed visually that there was liquid and solid waste.

There were empty bottles, plastic papers, plastic orange bags, empty cans, old clothes, human faeces and some unidentifiable decomposing items. The pictures above depict a sad and bleak situation of social decay. The children are denied their right to safety.

5.8.2 Children queued to fetch water

Another social impact observed by the researcher was that children queued to fetch water because the communal water taps were not adequate. Queues of children fetching water are seen in Figure 25

The activity also monopolised their time and resulted in conflicts with other children as well. The size of the water containers vary from very small to very big. Carrying the large containers filled with water was quite strenuous for children. In this picture, only girls are queuing for water.



Figure 25: Children queuing for water at a household tap in Mandela View (Source-research data)

5.8.3 Over flowing and bad smelling toilets

The researcher observed that mobile toilets spilled over because there were not enough to meet the needs of Kliptown informal settlement residents. This was due to overuse and erratic emptying by the responsible authorities. Children's health was greatly threatened as this made them more vulnerable to contracting waterborne diseases. Figure 26 below shows an overflowing mobile toilet.

As observed by the researcher, the playing environment of children in Kliptown informal settlement was also polluted with a foul smell from both mobile and bucket system toilets. Children were forced to live with the smell that came from these toilets.

The dirty and unhygienic conditions in the playing area can inhibit the children's social interaction. Most, if not all mobile and bucket system toilets were located behind or in front of shacks, along roads

and near the river. Figure 27 shows a foul smelling bucket system toilet where children are playing with ease.



Figure 26: Over flowing mobile toilet (Source-research data)



Figure 27: Bucket system toilet (Source-research data)

Observation checklists with assessment rubrics that evaluated outcomes of the observation were completed by the researcher. Refer to Table 13 to Table 15.

5.8.4 Factors that contributed to water pollution in the Klipspruit River

Table 13: Checklist to observe factors that contributed to water pollution in Klipspruit River (Source-research data)

Activities	Often practised	Rarely practised	Never seen in practice
Throwing materials in the river	✓		
Washing blankets in the river	✓		
Children relieving themselves in the river	✓		
Digging pit toilets	✓		

5.8.5 Factors that contributed to the social impacts of water pollution in Kliptown informal settlement

Table 14: Rubric to assess checklist of factors that contributed to water pollution in Kliptown informal settlement (Source-research data)

Items covered	Excellent	Average	Poor
Degree of pollution	The environment in and around Kliptown informal settlement is cared for excellently. No pollution of any kind is visible	The environment in and around Kliptown informal settlement is partially cared for. There are few polluted areas	✓ The environment in and around Kliptown informal settlement is a dumping area of the community. The area is highly polluted
Pollutants	No visible pollutants in the area	Fewer pollutants such as papers are visible in the area	✓ The area is highly polluted by things such as domestic waste, grey water, rubble, tins, plastic
Sanitation facilities	There are enough mobile and bucket	There are few mobile and bucket system	✓

Items covered	Excellent	Average	Poor
	system toilets for the community	toilets for the community	Mobile and bucket system toilets are inadequate to meet the needs of the community
Communal water taps	There are enough communal water taps for the community	There are few communal water taps for the community	✓ Communal water taps are inadequate to meet the needs of the community
Disposal of grey water	Few places with grey water. Playing area for children is not filled with grey water	Most places have grey water. Playing area for children filled with grey water	✓ Grey water disposed of everywhere. Playing area for children filled with grey water

5.8.6 Social impacts of water pollution on children in Kliptown informal settlement

Table 15: Rubric showing social impacts of water pollution on children in Kliptown informal settlement (Source-research data)

Items covered	Excellent	Average	Poor
Do children queue to fetch water at communal water taps	Not at all	Less frequently	✓ Very frequently
Are the mobile and bucket system toilets emptied frequently	Emptied as per responsible authorities stipulated days	Stipulated days sometimes followed	✓ Stipulated days sometimes not followed
Are the mobile and bucket system toilets clean most of the time?	Very clean	Often clean	✓ Heavily messed up on the floor
Is the environment where children play free from the smelling mobile and bucket system toilets	It does not smell at all	Tolerable smell comes from the toilets	✓ Intolerable smell from toilets
Do children miss school due to illness such as diarrhoea, stomach disorders, typhoid, body rash, vomiting, dysentery	Never missed school	At times have been absent from school	✓ Missed school often

5.9 OBSERVATION ANALYSIS

From the field observation conducted by the researcher, the researcher saw that Kliptown informal settlement is a dangerous site for human settlement, particularly for children. Water in the Klipspruit River was seen to be highly polluted to be used for any domestic purpose. The visual appearance showed that there were different items floating in the river which included packaging, plastic bottles, polystyrene and there was a pungent smell.

The overflowing mobile toilets were seen to be a major health threat to children playing around them. Litter and rubbish were seen to collect at various undesignated dumping sites within the informal

settlement in close proximity to the dwellings. The overflowing toilets and garbage posed serious health risks to children in particular. Children played where some of the garbage was laden with flies and worms which could transmit bacteria to children’s food and water.

The researcher’s findings and observations clearly indicate that adequate water supply and sanitation is needed for children in Kliptown informal settlement in order to alleviate water pollution problems.

5.10 SUMMARY

The findings raised in this chapter are summarised in Figure 28.



Figure 28: Summary of research findings (Source-research data)

6 SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 SUMMARY OF FINDINGS

The research was carried out with the aim of identifying and evaluating the social impacts of water pollution on children in the Kliptown informal settlement.

The aim and objectives of the study were achieved by administering questionnaires to parents of children in Kliptown's Mandela View, Tamatievlei and Valentine Village informal settlements. The three instruments (Observation, Interviews and Questionnaires) collaborate the information sources from secondary sources and the literature review. The findings of this research indicated that:

- High levels of poverty and unemployment are rife, owing to a lack of past educational support and limited current economic possibilities.
- Children queued to fetch water in the limited communal water taps as well as household taps in the informal settlements. Queuing for water meant that children were denied access to a major basic right, which is adequate water supply. From a constitutional perspective, children's rights were compromised. The process of queuing also resulted in children getting physically strained.
- Girl children also queued more to fetch water for family needs, particularly in the morning before school and in the evening. Culturally, it is the norm that women and girl children are expected to do more household chores like fetching water compared to boys and men. The practice promotes gender inequalities between boys and girls in terms of opportunities in life because girls lack time to do schoolwork due to household chores like fetching water.
- Children sometimes missed school due to water-related illnesses as they sought treatment at Kliptown Clinic, traditional herbalists and spiritual healers. Children were absent from school to be treated for diarrhoea, skin rashes and eye infections, all of which are induced by water pollution. That children below five years were most affected by diarrhoea. Additionally, more girls than boys missed school due to waterborne diseases, which created gender imbalances between the girl and boy child.
- The parents confirmed decreased academic performance due to recurrent illnesses.
- Lack of sanitation and water supply is a major problem. More than one household was sharing one mobile toilet. Bucket and mobile toilets used were few and infrequently emptied.
- Lack of adequate sanitation and water supply affected girls more than boys as girls needed more water for personal hygiene and sanitation during menstruation. This made girls miss school due to inadequate sanitation at home.
- Children were exposed to bad odours always present in their playing and living environment as the mobile and bucket system toilets were emptied infrequently.
- Children were exposed to rotting garbage and uncollected domestic waste. This further compromised children's living space and environment and further exposed them to serious health risks.
- Cases of children drinking contaminated water and eating contaminated food were found in 2015. Cases of diarrhoea were also recorded in 2015.
- Taking children to the clinic, traditional herbalists and spiritual healers also affected family income as the majority of parents in the informal settlements are poor and rely mostly on government grants, piece work and informal activities. Family income was lost as parents and their children boarded taxis to take their children for treatment at the clinic in Eldorado Park Extension 8, to spiritual healers and traditional herbalists outside Kliptown informal settlement. There is no clinic

in Kliptown informal settlement. Children's social welfare was compromised as little or no money was left to meet some of their needs. Poverty is a social challenge in Kliptown informal settlement.

- Children living near the Klipspruit River suffered more from water-related illnesses. Proximity to the river contributed to increased use of the river for washing blankets and bathing.
- Grey water from bathing, washing clothes and dishes was disposed of mainly in the roads where children played. Children's play environment and health were further compromised.

6.2 CONCLUSION

The social impacts of water pollution on children in the Kliptown informal settlement have attracted considerable attention from the civic society and the general public as reported in some newspapers. Various studies have attempted to explain the dynamics of provision of water and sanitation in informal settlements. There is consensus that the prevalence rate of water pollution related illnesses and social stress is on the increase. There is a general agreement that the problems of water pollution, sanitation and access to clean water are heightened by the lack of planning and demarcation in informal settlements. The problems identified in the research are not peculiar to Kliptown informal settlement as evidenced by the cases reviewed.

Social impacts in the Kliptown informal settlement have largely been attributed to lack of sustainable water supply and adequate sanitation facilities. The challenge is how do we mitigate the escalation of these problems and is there substantial urgency from the concerned policy directors? In the cases reviewed, it is concluded that the actions taken were reactive to specific epidemic outbreaks and therefore deeper assessment of existing policies in terms of implementation is required. It is however noted with regret that despite being the oldest informal settlement in the City of Johannesburg, which was established in 1903, adequate water supply and sanitation is still lacking. Although the social impacts of water pollution on children may be linked to high population growth within the informal settlement and urbanisation, local authorities are struggling to provide basic services in informal settlements. This is aggravated by the sprouting of many informal settlements in and around Johannesburg, which causes many budget constraints to meet the demand for social services.

6.3 RECOMMENDATIONS

The following recommendations on how to minimise the social impacts of water pollution on children in the Kliptown informal settlement are made:

- Installing more taps closer to individual homes in the informal settlement in an effort to avoid congestion at water points and reduce the workload for the women and girls. There have been positive outcomes in Lesotho informal sectors when they increased taps.
- To foster the exclusive use of improved water supplies for drinking and cooking through environmental education campaigns against the dangers of drinking contaminated water. This could help to reduce incidences of children suffering from diarrhoea.
- To recommend that responsible authorities explore adjoining water supply for pooling some into Kliptown informal settlement. To reduce the prevalence of waterborne diseases, the supply of water must be alternatively managed by means of transportation or treated with mobile water treatment units or otherwise supplied in packaged form. It is recommended that pollution reduction strategies begin with the people of Kliptown informal settlement, "think globally and act locally".

- De-densification and formalisation of Kliptown informal settlement so that pressure on water and sanitation facilities is relieved. This is being done in phases in Kliptown but the process should cater for the poor parents by building affordable housing which they will be able to pay for. The same is being done in Alexandra through a seven-year project. After formalising the settlement, illegal connections to storm drains can be removed to deal with pollution of the grey water waste stream.
- Community involvement in water quality issues through improvements in maintenance and timeous service delivery so that informal settlement dwellers do not protest in the streets against poor service delivery.
- Adopting low cost options for sanitation that also promotes sustainable sanitation such as pit latrines, urine diversion dry toilets and pour flush toilets. Pit latrines use no water as human excreta is located in a pit located below the toilet. Urine diversion dry toilets are also sustainable as they separate waste into two different compartments. Pour-flush toilets also use less water to flush away the excreta and for anal cleansing. Low cost options for sanitation were used successfully in Durban's informal settlements.
- Installing taps outside communal mobile and bucket system toilets so that children will be able to wash their hands after using the toilets.
- Providing more mobile toilets for girls and women in informal settlements so that they have a more private place to change their sanitary napkins and avoid ridicule by boys and men when forced to share toilets with men and boys.
- Putting sanitary bins in female toilets so that hygiene is maintained in toilets in informal settlements.
- Putting lockable doors as well as lights in mobile toilets to promote security and dignity for women when using the mobile toilets at night.
- The City of Johannesburg should also partner with local academic institutions as was done by the Municipality of Durban so that technologies like the dehydration pasteurisation machine can be developed. Technologies help in promoting sustainable sanitation. Partnerships with NGOs and other civic organisations can also help in terms of getting funding to set up and maintain water and sanitation facilities.
- Addressing the sources of pollution in the Kliptown informal settlement. It was identified that the main causes of water pollution in Kliptown are to do with the lack of infrastructural planning and provision of services. The second key issue is the lack of regulatory compliance with planning and building regulations. It is recommended that measures be put in place to reduce the levels of water contamination for sewage overflows. These measures may include design containment methods which confine grey waste and sewage as well as exploring new methods in environmental engineering.
- Setting up three or four mobile clinics to treat children in the informal settlement so that they do not have to travel far to access health services in Eldorado Park.

It can be concluded that informal settlements have been found to be heavily affected by water pollution. The magnitude of the burden of water pollution is large and significant. Water pollution has also been found to be negatively affecting the social fabric of particularly the girl child and the size of the impact is significant. It would be of benefit to the leadership of Johannesburg to evaluate and consider how they can urgently improve sanitation and availability of safe water in informal settlements.

7 REFERENCE LIST:

- Academy of Science of South Africa. (2009). *Local Economic Development in Small Towns, Housing Delivery and Impact on the Environment. Forum proceedings*. <https://doi.org/978-0-9814159-1-8>
- Adeleye, B., Okelola, O., & Medayese, S. (2014). Assessing the Problems of Water Supply and Sanitation in Kpakungu Area of Minna, Niger State, Nigeria using GIS. *Globalism Journal of Culture, Politics and Innovation*, 2014(2). <https://doi.org/10.12893/gjcpi.2014.1-2.9>
- Agency for Toxic Substances and Disease Registry. (2016). Agency for Toxic Substances and Disease Registry. Retrieved February 23, 2016, from <https://www.atsdr.cdc.gov/odours/faqs.html>
- Ahmed, S., Bardhan, P. K., Iqbal, A., Mazumder, R. N., Khan, A. I., Islam, M. S., ... Cravioto, A. (2011). The 2008 Cholera Epidemic in Zimbabwe: Experience of the ICDR, B Team in the Field. *Journal of Health, Population and Nutrition*. <https://doi.org/10.3329/jhpn.v29i5.8909>
- Aigbavboa, C. O., & Thwala, W. D. (2013). Residents' Perception of Subsidised Low-income Housing in South Africa: A Case Study of Kliptown, Johannesburg. *Journal of Human Ecology*, 42(1), 17–23. <https://doi.org/10.1080/09709274.2013.11906577>
- Ali, H. M., & Sulaiman, S. (2006). The Causes and Consequences of the Informal Settlements in Zanzibar. In *TS 35 - Informal Settlements: Policy, Land Use and Tenure, XXIII FIG Congress, October 8 – 13, 2006*.
- Ameiybor, S., Basteck, T., Bierbaum, C., Frommeld, N., Giaourakis, N., Hackenbroch, K., ... Vorberg, T. (2003). Informal Settlements Development on Zanzibar A Study on the Community Based Provision of Storm Water Management Participants. *University of Dortmund:Spring Working Papers*, 21. Retrieved from http://www.ips.raumplanung.tu-dortmund.de/cms/Medienpool/documents/F03_Informal_Settlements_Development_on_Zanzibar.pdf
- Australian Government Department of Health and Ageing. (2010). *Environmental Health Practitioner Manual: A resource manual for Environmental Health Practitioners working with Aboriginal and Torres Strait Islander Communities*. Canberra: Australian Government Department of Health and Ageing. Retrieved from <http://www.health.gov.au/internet/main/publishing.nsf/content/ohp-enhealth-manual-atsi-cnt>
- Banks, B. (2009). *Safe Water in Informal Settlements. Why it matters and how to get it?* Canberra: Capstone Editing.
- Bartram, J., & Cairncross, S. (2010). Hygiene, Sanitation, and Water: Forgotten Foundations of Health. *PLoS Medicine*, 7(11), e1000367. <https://doi.org/10.1371/journal.pmed.1000367>
- Bond, P. (2010). South Africa's "Rights Culture" of Water Consumption: Breaking Out of the Liberal Box and into the Commons?". In B. R. Johnston, L. Hiwasak, I. Klaver, & V. Strong (Eds.), *Water, Cultural Diversity and Global Environmental Change: Emerging Trends, Sustainable Futures* (Johnston,). Paris: UNESCO.
- Borkowski, L. (2006). *UNDP on the Wrl'd's Water Challenge*. New York.
- Bos, R., Gore, F., & Bartram, J. (2008). Safer Water, Better Health: Costs, Benefits and Sustainability of Interventions to Protect and Promote Health. *World Health Organization*. <https://doi.org/ISBN9789241596435>
- Bouchard, B., Goncalo, A., Susienka, M., & Wilson, K. (2013). *Improving Flood Risk Management in Informal Settlements of Cape Town | FARMD: Forum for Agricultural Risk Management in Development*. Worcester Polytechnic Institute . Retrieved from <https://www.agriskmanagementforum.org/doc/improving-flood-risk-management-informal-settlements-cape-town>

- Breiman, R. F., Cosmas, L., Njuguna, H., Audi, A., Olack, B., Ochieng, J. B., ... Feikin, D. R. (2012). Population-based incidence of typhoid fever in an urban informal settlement and a rural area in Kenya: Implications for typhoid vaccine use in Africa. *PLoS ONE*. <https://doi.org/10.1371/journal.pone.0029119>
- Brocklehurst, C., Malik, M., Sebuya, K., & Salama, P. (2013). Engineering in the time of cholera: overcoming institutional and political challenges to rebuild Zimbabwe's water and sanitation infrastructure in the aftermath of the 2008 cholera epidemic. *Journal of Water Sanitation and Hygiene for Development*. <https://doi.org/10.2166/washdev.2013.143>
- Brown, A. L. (2001). *African American churches as ethnographic resources*.
- Burdge, R. J., & Vanclay, F. (1995). Social impact assessment. *Environmental and Social Impact Assessment*, (1994), 31–66. Retrieved from http://www.hardystevenson.com/Articles/SOCIAL_IMPACT_ASSESSMENT_A_CONTRIBUTION_TO_THE_STATE_OF_THE_ART_SERIES.pdf
- Burdge, R. J., & Vanclay, F. (1996). Social Impact Assessment: A Contribution to the State of the Art Series. *Social Impact Assessment*. <https://doi.org/10.1080/07349165.1996.9725886>
- Cairncross, S., & Feachem, R. (1994). Environmental health engineering in the tropics: An introductory text (2nd edition). *Transactions of the Royal Society of Tropical Medicine and Hygiene*, 88(1), 112. [https://doi.org/10.1016/0035-9203\(94\)90526-6](https://doi.org/10.1016/0035-9203(94)90526-6)
- Centre for Good Governance. (2006). *A comprehensive guide for Social Impact Assessment*. Hyderabad. Retrieved from <http://unpan1.un.org/intradoc/groups/public/documents/cgg/unpan026197.pdf>
- Chapman, A. R. (1996). A Violations Approach for Monitoring the International Covenant on Economic, Social and Cultural Rights. *Human Rights Quarterly*, 18. Retrieved from <https://heinonline.org/HOL/Page?handle=hein.journals/hurq18&id=33&div=&collection=>
- City of Cape Town. (2013). Informal settlements development matrix. City of Cape Town.
- City of Johannesburg. (2004). Kliptown. Retrieved from http://www.joburg.org.za/2004april/apr2_kliptown.stm
- City of Tshwane Metropolitan Municipality. (2016). *City of Tshwane Metropolitan Municipality, 2016. Land Use Management By-law*. Tshwane. Retrieved from http://www.tshwane.gov.za/sites/Departments/City-Planning-and-Development/Land_Use_Management_ByLaw_2016/City_of_Tshwane_Land_Use_Management_By-law,_2016.pdf
- Climate-Data.org. (2015). Climate data for cities worldwide - Climate-Data.org. Retrieved June 22, 2015, from <https://en.climate-data.org/>
- Cooperation for Peace and Unity. (2011). *Water Use in Informal Settlements: Case Study from Kabul*. Kabul. Retrieved from <http://cpau.org.af/manimages/publications/CPAU-WUINFORMAL-FINAL.pdf>
- Corbin, J., & Strauss, A. (2008). *Basics of Qualitative Research (3rd ed.): Techniques and Procedures for Developing Grounded Theory*. *Basics of Qualitative Research Grounded Theory Procedures and Techniques*. <https://doi.org/10.4135/9781452230153>
- Cumming, O. (2008). *Tackling the silent killer. The case for sanitation*. Water Aid. London. Retrieved from <http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Tackling+the+silent+killer:+The+case+for+sanitation#0>
- Cunningham, W. P., Cunningham, M., & Woodworth Saigo, B. (2009). *Environmental science : A global concern* (9th ed.). New York: McGraw-Hill Higher Education; Retrieved from https://trove.nla.gov.au/work/5606627?q&sort=holdings+desc&_id=1538687409058&versionId=16325919+41688638
- Dagdeviren, H., & Robertson, S. A. (2009). Access to Water in the Slums of the Developing World.

- Working Papers*. Retrieved from <https://ideas.repec.org/p/ipc/wpaper/57.html>
- Dallas, H. F., & Day, L. (2004). *The Effect of Water Quality Variables on Aquatic Ecosystems Review*. Cape Town. <https://doi.org/1-77005-131-7>
- De Villiers, B. (1992). Socio- economic Rights in a New Constitution: Critical Evaluation of the Recommendations of the South African Law Commission. *Journal on Human Rights*, 67(13).
- De Wet, T., Mathee, A., & Barnes, B. (2001). Anthropological and Epidemiological: A Case of Health and Environment in Alexander, Johannesburg. *Africanus*, 31(1), 75–106. Retrieved from <https://journals.co.za/content/canus/31/1/EJC21753>
- Debo, T. N., & Reese, A. J. (2003). *Municipal Stormwater Management*. Boca Raton, Florida: Lewis Publishers.
- Department of Water Affairs - Sanitation Services. (2012). *Sanitation Services-Quality of Sanitation in South Africa: Report on the Status of sanitation services in South Africa - Report on the Status of Sanitation Services in South Africa*. Pretoria. Retrieved from [https://www.sahrc.org.za/home/21/files/Quality of sanitation Main report April 2012 final Aug 2012.pdf](https://www.sahrc.org.za/home/21/files/Quality%20of%20sanitation%20Main%20report%20April%202012%20final%20Aug%202012.pdf)
- Esrey, S. A., Habicht, J. P., Latham, M. C., Sisler, D. G., & Casella, G. (1988). Drinking water source, diarrheal morbidity, and child growth in villages with both traditional and improved water supplies in rural Lesotho, Southern Africa. *American Journal of Public Health*. <https://doi.org/10.2105/AJPH.78.11.1451>
- Fatoki, O. S., Muyima, N. Y. O., & Lujiza, N. (2001). Situation analysis of water quality in the Umtata River catchment. *Water SA*. <https://doi.org/10.4314/wsa.v27i4.4959>
- Fogden, J. (2009). *Access to Safe Drinking Water and Its Impact on Global Economic Growth*. Bothell, USA. Retrieved from <https://faculty.washington.edu/categ/healthanddevgbf/wordpress/wp-content/uploads/2010/03/Access-to-Safe-Drinking-Water.pdf>
- Galiani, S., González-Rozada, M., & Schargrotsky, E. (2009). Water expansions in shantytowns: Health and savings. *Economica*. <https://doi.org/10.1111/j.1468-0335.2008.00719.x>
- Gauteng Tourism Authority. (2014). Kliptown Soweto. Retrieved February 16, 2015, from http://www.gauteng.net/attractions/entry/kliptown_soweto
- Glasson, J. (2009). *Socio-economic Impacts 1: Overview and Economic Impacts*. (O. Morris & R. Therive, Eds.). London and New York: Routledge. <https://doi.org/10.4324/9780203892909-8>
- González, L. L. (2008). Cholera in Soweto. Retrieved September 16, 2016, from <http://www.irinnews.org/news/2008/04/22/cholera-soweto>
- Gray, D. E. (2004). *Doing research in the real world*. Sage. London. Thousands Oaks. New Delhi. <https://doi.org/10.1016/j.neulet.2004.06.080>
- Greater Johannesburg Metropolitan Council. (2000). *Report on Interactive Planning Workshop for Johannesburg*. Johannesburg.
- Grinning Planet. (2006). Water pollution effects. Retrieved from www.grinningplanet.com/2006/12-05/water-pollution-effects.htm
- Gwimbi, P., & Dirwai, E. (2003). *Research Methods in Geography and Environmental Studies*. Harare.
- Himlin, R., Engel, H., & Mothoho, M. (2008). *Landuse management and democratic governance in the city of Johannesburg. Case study Kliptown and Diepsloot*. Johannesburg. Retrieved from <http://www.planact.org.za/wp-content/uploads/2014/08/6.-Case-Study-Kliptown-and-Diepsloot.pdf>
- Hodgkinson, C., & Wilson, L. (2007). *Exam Success Geography - Gr 12: Study Guide*. Cape Town: Oxford University Press Southern Africa. Retrieved from <https://www.loot.co.za/product/christopher-hodgkinson-exam-success-geography/xgkh-98->

- Holahan, C. J., Moos, R. H., Holahan, C. K., Cronkite, R. C., & Randall, P. K. (2001). Drinking to cope, emotional distress and alcohol use and abuse: a ten-year model. *Journal of Studies on Alcohol*. <https://doi.org/10.15288/jsa.2001.62.190>
- Housing Development Agency. (2013). *Research Report: Informal settlements in South Africa. Housing units in the Kliptown Informal Settlem.* Johannesburg.
- Human Rights Watch. (2013). *Zimbabwe: Water and Sanitation Crisis: Government Mismanagement, Corruption Risks Lives of Million.* Harare. Retrieved from <https://www.hrw.org/news/2013/11/19/zimbabwe-water-and-sanitation-crisis>
- Isunju, J. B., Schwartz, K., Schouten, M. A., Johnson, W. P., & van Dijk, M. P. (2011). Socio-economic aspects of improved sanitation in slums: A review. *Public Health*. <https://doi.org/10.1016/j.puhe.2011.03.008>
- Jagals, P., Grabow, W. O. K., & Williams, E. (1997). The effects of supplied water quality on human health in an urban development with limited basic subsistence facilities. *Water SA*.
- Johannesburg Social Housing Company. (2016). Johannesburg Social Housing Company. Retrieved August 16, 2016, from <http://www.joshco.co.za/>
- Joyce, J., Perez, E., & Solo, T. M. (1993). *Constraints in Providing Water and Sanitation Services to the Urban Poor. WASH Technical Report No. 85* (Vol. 355). Washington, DC. Retrieved from https://pdf.usaid.gov/pdf_docs/Pnabn953.pdf
- Kakuru, M. D., & Dauda, W. B. (2010). *Addressing sanitation challenges in poor urban areas through sustainable technologies, gender integration and supportive policy framework.* Nairobi.
- Katukiza, A. Y., Ronteltap, M., Niwagaba, C. B., Foppen, J. W. A., Kansiime, F., & Lens, P. N. L. (2012). Sustainable sanitation technology options for urban slums. *Biotechnology Advances*. <https://doi.org/10.1016/j.biotechadv.2012.02.007>
- Katukiza, A. Y., Ronteltap, M., Oleja, A., Niwagaba, C. B., Kansiime, F., & Lens, P. N. L. (2010). Selection of sustainable sanitation technologies for urban slums — A case of Bwaise III in Kampala, Uganda. *Science of The Total Environment*, 409(1), 52–62. <https://doi.org/10.1016/j.scitotenv.2010.09.032>
- Kimani-Murage, E. W., & Ngindu, A. M. (2007). Quality of Water the Slum Dwellers Use: The Case of a Kenyan Slum. *Journal of Urban Health*, 84(6), 829–838. <https://doi.org/10.1007/s11524-007-9199-x>
- Kitchin, R. A., & Tate, N. J. (2000). *Conducting Research in Human Geography : Theory, Methodology and Practice.* London: Prentice Hall, London. Retrieved from <https://trove.nla.gov.au/work/6702714>
- Kobel, D., & Del Mistro, R. (2012). Evaluation of non-user benefits towards improvement of water and sanitation services in informal settlements. *Urban Water Journal*. <https://doi.org/10.1080/1573062X.2012.682590>
- Kulabako, N. R., Nalubega, M., & Thunvik, R. (2007). Study of the impact of land use and hydrogeological settings on the shallow groundwater quality in a peri-urban area of Kampala, Uganda. *Science of the Total Environment*. <https://doi.org/10.1016/j.scitotenv.2007.03.035>
- Kyalimpa, J. (2009). WATER-UGANDA: Creating a “Safe Water Chain” | Inter Press Service. *Inter Press Service*. Retrieved from <http://www.ipsnews.net/2009/03/water-uganda-creating-a-safe-water-chain/>
- Lagardien, A., & Cousins, D. (2004). *Sanitation Demand and Delivery in Informal Settlements - Planning and Implementation Support: Cape Town.* [https://doi.org/WRC Report No 1280/01/04](https://doi.org/WRC%20Report%20No%201280/01/04)
- Leedy, P. D., & Ormrod, J. E. (2010). *Practical Research: Planning and Design. Practical Research -*

- Planning & Design*. <https://doi.org/10.5281/ZENODO.51613>
- Lloyd, P. C. (1979). Shantytowns in Developing Nations. *Current Anthropology*, 20(1), 114–117. <https://doi.org/10.2307/2741869>
- Lucas, A., & Gilles, H. (2002). *Short Textbook of Public Health Medicine for the Tropics, 4th Ed.* Chapman and Hall/CRC.
- Makhetha Development Consultants. (2007). *Final Draft National Sanitation Strategy*. Pretoria. <https://doi.org/10.1002/adem.200600275>
- Manase, G., & Fawcett, B. (2010). *Cost recovery for sanitation services: The case of poor urban areas*. Southampton.
- Masauni, S., Mohammed, M., Leyna, G. H., Mosha, F., Mghamba, J., Omar, K., ... Mmbuji, P. (2010). Controlling persistent cholera outbreaks in Africa: Lessons from the recent Cholera Outbreak, West District Unguja Zanzibar, Tanzania, 2009. *International Journal of Infectious Diseases*. <https://doi.org/10.1016/j.ijid.2010.02.1549>
- McCauley, A. P., Lynch, M., Pounds, M. B., & West, S. (1990). Changing water-use patterns in a water-poor area: Lessons for a trachoma intervention project. *Social Science and Medicine*. [https://doi.org/10.1016/0277-9536\(90\)90129-G](https://doi.org/10.1016/0277-9536(90)90129-G)
- McConville, J. R., Kain, J.-H., Kvarnström, E., & Ulrich, L. (2014). Participation in sanitation planning in Burkina Faso: theory and practice. *Journal of Water, Sanitation and Hygiene for Development*. <https://doi.org/10.2166/washdev.2014.125>
- Meinhardt, P. L. (2006). Recognizing waterborne disease and the health effects of water contamination: a review of the challenges facing the medical community in the United States. *Journal of Water and Health*, 4 Suppl 1, 27–34. Retrieved from <http://www.ncbi.nlm.nih.gov/pubmed/16493897>
- Mintz, E. D., Bartram, J., Lochery, P., & Wegelin, M. (2001). Not just a drop in the bucket: Expanding access to point-of-use water treatment systems. *American Journal of Public Health*. <https://doi.org/10.2105/AJPH.91.10.1565>
- Moe, C. L., & Rheingans, R. D. (2006). Global challenges in water, sanitation and health. *Journal of Water and Health*. <https://doi.org/10.2166/wh.2005.039>
- Momba, M. N., Osode, A. N., & Sibewu, M. (2009). The impact of inadequate wastewater treatment on the receiving water bodies – Case study: Buffalo City and Nkokonbe Municipalities of the Eastern Cape Province. *Water SA*, 32(5). <https://doi.org/10.4314/wsa.v32i5.47854>
- Mompoti S., & Viljoen, M. F. (2003). The Ethics of Informal Settlements in Flood Plains: Insights Gained from a Study Testing the Merits of Palaeoflood and Conventional Flood Hydrology in Flood Control Planning at Soweto-On-Sea. In *Annual Conference of the Agricultural Economic Association of South Africa, October 2-3, 2003*. Pretoria: Agricultural Economic Association of South Africa. Retrieved from <http://www.planning.org/ethics/ethics.html>
- Montgomery, M. A., Desai, M. M., & Elimelech, M. (2010). Assessment of latrine use and quality and association with risk of trachoma in rural Tanzania. *Transactions of the Royal Society of Tropical Medicine and Hygiene*. <https://doi.org/10.1016/j.trstmh.2009.10.009>
- Mouton, J. (2001). *How to Succeed in Your Master's and Doctoral Studies*. Pretoria: Van Schaik Publishers.
- Muhammad, A. A., Muhammad, J. M., Ismael, Y., & Karamat, M. (2010). Effects of Polluted Water Irrigation on Environment and Health of People in Jamber, District Kasur, Pakistan. *International Journal of Basic & Applied Sciences IJBAS-IJENS*, 10(3). Retrieved from <http://ijens.org/104703-4949 IJBAS-IJENS.pdf>
- Mvukla Trust. (2014). The Mvula Trust on Water and Sanitation. Retrieved January 13, 2015, from www.themvulatrust.org.za

- Napier, M. (2000). *Human Settlements and the Environment*. Pretoria. Retrieved from <http://www.environment.gov.za/soer/index.htm>
- Nathanson, J. A., & Scheinder, R. A. (2014). Basic Environmental Technology — Water Supply, Waste Management and Pollution Control. *Medical Journal Armed Forces India*, 60(2), 206. [https://doi.org/10.1016/S0377-1237\(04\)80128-X](https://doi.org/10.1016/S0377-1237(04)80128-X)
- Nhapi, I. (2009). The water situation in Harare, Zimbabwe: A policy and management problem. *Water Policy*. <https://doi.org/10.2166/wp.2009.018>
- Opisa, S., Odiere, M. R., Jura, W. G. Z. O., Karanja, D. M. S., & Mwinzi, P. N. M. (2012). Faecal contamination of public water sources in informal settlements of Kisumu City, western Kenya. *Water Science and Technology*. <https://doi.org/10.2166/wst.2012.503>
- Organisation for Economic, & Cooperation and Development. (2001). Implementing the Water-related MDGs in EECCA. Retrieved May 3, 2016, from <https://www1.oecd.org/ENV/OUTREACH/IMPLEMENTINGTHEWATER-RELATEDMDGSINEECA.HTM>
- Owusu-Asante, Y., & Ndiritu, J. (2009). The simple modelling method for storm- and grey-water quality management applied to alexandra settlement. *Water SA*. <https://doi.org/10.4314/wsa.v35i5.49187>
- Parliament of South Africa. National Environmental Management Act, Act No 107, 1998, No 19519 § (1998). Cape Town, South Africa: South African Parliament.
- Parliamentary Monitoring Group. (2013). *Urban Settlements Development Grant, 3rd Quarter Spending for 2012/2013 by Johannesburg, Tshwane and Ekurhuleni*. Johannesburg. Retrieved from <https://pmg.org.za/committee-meeting/16074/>
- Penrose, K., De Castro, M. C., Werema, J., & Ryan, E. T. (2010). Informal urban settlements and cholera risk in Dar es Salaam, Tanzania. *PLoS Neglected Tropical Diseases*. <https://doi.org/10.1371/journal.pntd.0000631>
- Peters, K., & Oldfield, S. (2005). The paradox of “Free Basic Water” and cost recovery in Grabouw: Increasing household debt and municipal financial loss. *Urban Forum*. <https://doi.org/10.1007/s12132-005-0009-9>
- Pruss-Ustin, A., Boss, R., Gore, F., & Bartram, J. (2008). *Safer water, better health*. WHO. New York: World Health Organization. Retrieved from http://www.who.int/quantifying_ehimpacts/publications/saferwater/en/
- Puling, L., & Van der Merwe, J. H. (2004). *Solid Waste Management in Developing Urban Areas : Case Study of Lwandle Township (MSc Geography and Environmental Studies)*. University of Stellenbosch. Retrieved from <http://scholar.sun.ac.za/handle/10019.1/8255>
- Reeve, R. N. (2002). *Introduction to environmental analysis*. New York: Wiley. Retrieved from <https://www.wiley.com/en-za/Introduction+to+Environmental+Analysis+-p-9780471492955>
- Rubin, M. (2007). *Land Management and Democratic Governance in the City of Johannesburg: Synthesis Report*. Johannesburg. Retrieved from <http://www.planact.org.za/wp-content/uploads/2014/08/1.-Synthesis-Report-Land-Management.pdf>
- SA Cities Network. (2006). *South African State of the Cities Report 2006*. Johannesburg,. Retrieved from www.sacities.net
- Sakijege, T., Lupala, J., & Sheuya, S. (2012). Flooding, flood risks and coping strategies in urban informal residential areas: The case of Keko Machungwa, Dar es Salaam, Tanzania. *Jàmá: Journal of Disaster Risk Studies*, 4(1), 1–10. <https://doi.org/10.4102/jamba.v4i1.46>
- Sano, J. C. (2007). *Urban Environmental Infrastructure in Kigali City Rwanda (Challenges and Opportunities for Modernised Decentralised Sanitation Systems in Poor Neighbourhoods)*. Wageningen University. Retrieved from <http://edepot.wur.nl/55880>

- Satterthwaite, D. (2004). The under-estimation of urban poverty in low- and middle-income nations. *Environment and Urbanization*.
- Scheinberg, A., Spies, S., Simpson, M. H., & Mol, A. P. J. (2011). Assessing urban recycling in low- and middle-income countries: Building on modernised mixtures. *Habitat International*. <https://doi.org/10.1016/j.habitatint.2010.08.004>
- Septien, S. (2015). How do we solve Africa's sanitation problems? | World Economic Forum. In *World Economic Forum*. Davos. Retrieved from <https://www.weforum.org/agenda/2015/08/how-do-we-solve-africas-sanitation-problems/>
- South African Human Rights Commission. (2014). *Report on the Right to Access Sufficient Water and Decent Sanitation in South Africa: 2014*. Braamfontein. Retrieved from https://www.gov.za/sites/default/files/report_right_access_water_sanitation2014_a.pdf
- South African Parliament. (1996). *Constitution of the Republic of South Africa, Act 108 of 1996*. Pretoria: South African Parliament. Retrieved from <http://www.justice.gov.za/legislation/constitution/SACConstitution-web-eng.pdf>
- Stark, J. R., Hanson, P. E., Goldstein, R. M., Fallon, J. D., Fong, A. L., Lee, K. E., ... Andrews, W. J. (2000). *Water quality in upper Mississippi River basin, Minnesota, Wisconsin, South Dakota, Iowa, and North Dakota, 1995-98* (Circular 1211). Reston, VA. <https://doi.org/10.3133/CIR1211>
- Statistics South Africa. (2011). *Census 2011*. Pretoria. Retrieved from www.statssa.gov.za
- Statistics South Africa. (2012). *Census 2011 - Census in brief*. World Wide Web. <https://doi.org/ISBN978-0-621-41388-5>
- Strauss, J., & Myburg, M. (2003). *Research Methodology Study Guide*. Johannesburg: Rand Afrikaans University.
- Susskind, Y. (2008). Why Water Rights Are Women's Rights | Alternet. Retrieved March 15, 2016, from https://www.alternet.org/story/93903/why_water_rights_are_women%27s_rights
- Swinburn, G., Goga, S., & Murphy, F. (2006). *Local Economic Development: A Primer Developing and Implementing Local Economic Development Strategies and Action Plans*. Retrieved from <http://documents.worldbank.org/curated/en/211891468140975725/Local-economic-development-a-primer-developing-and-implementing-local-economic-development-strategies-and-action-plans>
- The National Department of Human Settlements - South Africa. (2009). *The National Housing Code: Part 3 - Updating Informal Settlement*. Pretoria. Retrieved from http://www.dhs.gov.za/sites/default/files/documents/national_housing_2009/4_Incremental_Interventions/5_Volume_4_Upgrading_Infromal_Settlement.pdf
- Tyler-Miller, G. (2003). *Environmental science : working with the Earth*. Ontario.
- Uganda. Ministry of Water and Environment. (2007). *Water and sanitation sector performance report 2007*. Kampala. Retrieved from <https://www.ircwash.org/resources/water-and-sanitation-sector-performance-report-2007>
- UNDP. (2006). *UNDP Annual Report 2006: Global Partnership for Development*. New York. Retrieved from WWW.UNDP.ORG%3EUNDP_IN_ACTION_2006
- UNDP. (2016). *Human Development Report 2016: Briefing note on the Democratic Republic of the Congo*. Retrieved from http://hdr.undp.org/sites/all/themes/hdr_theme/country-notes/COD.pdf
- United Nations. (1977). *United Nations Conference on Water (Mar del Plate 1977)*. New York. Retrieved from <https://www.ircwash.org/sites/default/files/71UN77-161.6.pdf>
- United Nations. (2008). *The Millennium Development Goals Report*. New York. Retrieved from <http://www.un.org/millenniumgoals/2008highlevel/pdf/newsroom/mdg>

reports/MDG_Report_2008_ENGLISH.pdf

- United Nations Children's Fund. (2010). *Water, Sanitation and Hygiene*. New York.
- US Department of Health and Human Services - Office on Women's Health. (2008). *US Department of Health and Human Services Office on Women's Health Strategic Plan FY2010-FY2015*. Washington, D.C. Retrieved from <https://www.womenshealth.gov/files/documents/owhstrategicplan.pdf>
- Van Vliet, B., Spaargaren, G., & Oosterveer, P. (2010). *Social perspectives on the sanitation challenge*. *Social Perspectives on the Sanitation Challenge*. <https://doi.org/10.1007/978-90-481-3721-3>
- Vanclay, F. (2002). Conceptualising social impacts. *Environmental Impact Assessment Review*. [https://doi.org/10.1016/S0195-9255\(01\)00105-6](https://doi.org/10.1016/S0195-9255(01)00105-6)
- Vanclay, F. (2003). Conceptual and methodological advances in social impact assessment. In H. A. Becker (Ed.), *In The International Handbook of Social Impact Assessment*. Edward Elgar Publishing Limited.
- Watkins, K. (2006). *Human Development Report 2006 - Beyond scarcity: Power, poverty and the global water crisis*. *Journal of Government Information*. New York. [https://doi.org/10.1016/S1352-0237\(02\)00387-8](https://doi.org/10.1016/S1352-0237(02)00387-8)
- Watson, D. M. (2007). Local Diveristy Paterns. *Frontiers of Ecology and the Environment*, 5(5). Retrieved from <https://esajournals.onlinelibrary.wiley.com/toc/15409309/5/5>
- Willems, S. (2011). *Improving Water and Sanitation Conditions for Slum Dwellers in Kenya*. European Union. Retrieved from <https://europa.eu/capacity4dev/article/improving-water-and-sanitation-conditions-slum-dwellers-kenya>
- World Bank. (2007). *Making the Most of Scarcity Accountability for Better Water Management in the Middle East and North Africa*. *The World Bank*. <https://doi.org/10.1596/978-0-8213-6925-8>
- World Health Organisation. (1992). *Our Planet, Our Health: Report on the WHO Commission on Health and Environment*. *World Health Organisation*. Geneva. <https://doi.org/10.1177/095624789200400107>
- World Health Organisation. (2002). *The world health report 2002 - Reducing Risks, Promoting Healthy Life*. *World health report*. New York: World Health Organization. Retrieved from <http://www.who.int/whr/2002/en/>
- World Health Organisation. (2015). *World Malaria Report 2015*. New York: World Health Organization.
- World Health Organisation, & United Nations Children's Fund. (2010). *Progress on Sanitation and Drinking Water: 2010 Update*. (2010 Updat). New York: WHO/UNICEF,. Retrieved from <https://www.unicef.org/eapro/JMP-2010Final.pdf>
- World Health Organisation, & United Nations Children's Fund. (2014). *Progress on Sanitation and Drinking Water - 2014 Update. ... Monitoring Programme for Water Supply and Sanitation* <https://doi.org/978 92 4 150724 0>
- World Health Organisation, & United Nations Children's Fund. (2015). *Schistosomiasis Report*. New York. Retrieved from www.who.int/schistosomiasis
- Zanzibar Sustainable Programme. (2000a). *Water supply, Wastewater, Flooding and Drainage*. *Zanzibar Town*. Zanzibar.
- Zanzibar Sustainable Programme. (2000b). *Working Group Report Jang'ombe/Urusi. Infrastructure Improvement*. *Zanzibar Town*. Zanzibar.
- Zawahri, N., Sowers, J., & Weinthal, E. (2011). The politics of assessment: Water and Sanitation MDGs in the Middle East. *Development and Change*. <https://doi.org/10.1111/j.1467-7660.2011.01730.x>

8 APPENDICES

8.1 APPENDIX 1: QUESTIONNAIRE FOR PARENTS IN KLIPTOWN INFORMAL SETTLEMENT



QUESTIONNAIRE FOR PARENTS OR GUARDIANS OF KLIPTOWN INFORMAL SETTLEMENT

TICK THE APPROPRIATE BOX

SECTION A: DEMOGRAPHIC DETAILS OF PARENTS

1. WHAT IS YOUR GENDER? MALE FEMALE
2. WHAT IS YOUR SOURCE OF INCOME? GOVERNMENT GRANT PIECE WORK INFORMAL ACTIVITIES

SECTION B: SOCIAL IMPACTS OF WATER POLLUTION

3. WHAT AGES OF CHILDREN ARE MOST AFFECTED MOST BY PHYSIOLOGICAL IMPACTS OF WATER POLLUTION AND WHY? 0-4 5-8 9-12 13 AND ABOVE EXPLAIN

4. DO YOUR CHILDREN QUEUE TO FETCH WATER FROM THE COMMUNAL WATER TAPS? YES
NO NOT SURE SOMETIMES

5. HAVE YOUR CHILDREN BEEN ABSENT FROM SCHOOL DUE TO WATERBORNE DISEASES? YES
NO NOT SURE SOMETIMES IF YES EXPLAIN

6. DID MISSING SCHOOL DUE TO BEING TREATED FOR WATERBORNE DISEASES AFFECT YOUR CHILD'S ACADEMIC PERFORMANCE?

YES NO NOT SURE SOMETIMES IF YES EXPLAIN

7. WHICH GENDER QUEUES MORE FOR WATER? BOYS GIRLS EXPLAIN

8. WHICH GENDER IS AFFECTED MORE BY LACK OF SANITATION AND WATER SUPPLY?

BOYS GIRLS EXPLAIN

9. ARE CHILDREN EXPOSED TO BAD ODOUR FROM TOILETS IN KLIPTOWN INFORMAL SETTLEMENT? YES NO NOT SURE SOMETIMES ALWAYS

IF YES EXPLAIN HOW

10. ARE CHILDREN EXPOSED TO ROTTING GARBAGE FROM ROTTING REFUSE AND DOMESTIC WASTE DUE TO ERRATIC WASTE REMOVAL IN THEIR PLAYING AND LIVING ENVIRONMENT KLIPTOWN INFORMAL SETTLEMENT? YES NO NOT SURE SOMETIMES IF YES EXPLAIN HOW

11. IS REFUSE COLLECTED REGULARLY BY RESPONSIBLE AUTHORITIES? YES NO NOT SURE SOMETIMES

IF NO EXPLAIN

12. HAVE YOU EVER HAD CASES OF YOUR CHILDREN DRINKING CONTAMINATED WATER AND EATING CONTAMINATED FOOD? YES NO NOT SURE SOMETIMES IF YES EXPLAIN HOW

13. WHEN YOUR CHILDREN SUFFER FROM WATER-RELATED ILLNESSES, DO YOU TAKE THEM TO THE CLINIC, SPIRITUAL HEALERS OR TRADITIONAL HERBALISTS?

CLINIC SPIRITUAL HEALERS TRADITIONAL HERBALISTS FOR ANY OF THE OPTIONS CHOSEN, GIVE REASON/S WHY

14. HAVE YOU EVER HAD CASES OF DIARRHOEA IN CHILDREN IN 2015? YES NO NOT SURE SOMETIMES IF YES EXPLAIN

15. HAVE YOUR CHILDREN SUFFERED FROM CHOLERA IN 2015? YES NO NOT SURE SOMETIMES IF YES EXPLAIN

16. DID TAKING YOUR CHILD TO THE HOSPITAL OR CLINIC, SPIRITUAL HEALERS OR TRADITIONAL HERBALISTS FOR WATERBORNE DISEASES AFFECT YOUR FAMILY INCOME? YES NO NOT SURE SOMETIMES IF YES EXPLAIN HOW

SECTION C: FACTORS CONTRIBUTING TO WATER POLLUTION

17. WHICH PART OF KLIPTOWN INFORMAL SETTLEMENT DO YOU LIVE AND HAVE YOUR CHILDREN AT ANY POINT SUFFERED FROM WATERBORNE DISEASES IN 2015?

TAMATIEVLEI YES NO

MANDELAVIEW YES NO

VALENTINE VILLAGE YES NO IF YES ON ANY EXPLAIN

18. WHICH TYPE OF TOILET DO YOU AND YOUR CHILDREN USE?

MOBILE TOILET BUCKET SYSTEM TOILET PIT LATRINE

19. ARE MOBILE TOILETS ADEQUATE AND IN GOOD CONDITION? YES NO IF YES EXPLAIN IF NO EXPLAIN WHY

20. ARE BUCKET SYSTEM EMPTIED REGULARLY AND WELL MAINTAINED ADEQUATE AND IN GOOD CONDITION? YES NO NOT SURE SOMETIMES IF YES EXPLAIN HOW

IF NO EXPLAIN WHY _____

21. WHICH WATER FACILITIES DO YOU AND YOUR CHILDREN USE?

COMMUNAL TAPS HOUSEHOLD TAPS OTHER

22. ARE THE WATER SUPPLY FACILITIES ADEQUATE? YES NO NOT SURE SOMETIMES

23. DO YOUR CHILDREN SOMETIMES USE WATER FROM THE KLIPSPRUIT RIVER FOR BATHING AND WASHING BLANKETS? YES NO NOT SURE SOMETIMES

24. WHERE DO YOU DISPOSE YOUR GREY WATER? IN THE ROAD BACK OF SHACKS IN THE GARDEN OTHER AREAS

25. WHAT DO YOU THINK SHOULD BE DONE TO IMPROVE WATER SUPPLY AND SANITATION IN YOUR AREA? _____

THANK YOU FOR YOUR COOPERATION

8.2 APPENDIX 2: INFORMED CONSENT FORM FOR PARENTS



Informed Consent Form for parents for Conducting Research in Kliptown informal settlement

Please fill in the reply slip below if you agree to participate in the research

An assessment of the social impacts of water pollution on children in informal settlements: The case of Kliptown informal settlement, Soweto, Johannesburg.

Parents' Informed Consent

I _____ the parent/guardian of _____

Hereby confirm that I have been informed by Jennifer Tadzei Kamusono about the nature of the study. Yes/No

Have also received, read and understood the Information and Consent sheets regarding the educational study. Yes/No

I am aware that my responses in the questionnaire will be processed without mentioning my real name. Yes/No

In view of the requirements of the research, I agree that the data collected during this study can be processed in a computerised system by the researcher. Yes/No

I can at any stage, without prejudice, withdraw my participation in the study. Yes/No

I have had sufficient time to ask questions and (of my free will) join the study. Yes/No

Signature of Parent: _____ Date: _____

8.3 APPENDIX 3: INTERVIEW SCHEDULE FOR THE MATRON AT KLIPTOWN CLINIC



STRUCTURED INTERVIEW SCHEDULE FOR THE MATRON AT KLIPTOWN CLINIC

1. WHAT IS YOUR GENDER? MALE FEMALE
 2. WHAT IS YOUR RANK? NURSE SISTER IN CHARGE MATRON
 3. DO YOU GET CASES OF DIARRHOEA FROM CHILDREN IN KLIPTOWN INFORMAL SETTLEMENT? YES NO . IF YES HOW MANY CASES ROUGHLY PER MONTH?
 4. DURING THE COURSE OF THIS YEAR, DID YOU HAVE ANY CASES OF CHOLERA IN CHILDREN FROM KLIPTOWN INFORMAL SETTLEMENT? YES NO NOT SURE SOMETIMES IF YES HOW MANY IN A PARTICULAR YEAR?
 5. BESIDES DIARRHOEA AND CHOLERA, DO YOU GET CASES OF OTHER WATERBORNE DISEASES FROM KLIPTOWN INFORMAL SETTLEMENT? YES NO IF YES WHICH ONES AND ROUGHLY HOW MANY CASES PER MONTH?
 6. DO YOU GET CASES OF MALARIA AND BILHARZIA(SCHISTOSOMIASIS) FROM KLIPTOWN INFORMAL SETTLEMENT. YES NO NOT SURE SOMETIMES IF YES ROUGHLY HOW MANY PER MONTH
 7. DO YOU GET CASES OF SKIN RASHES, SCABIES AND EYE INFECTIONS FROM KLIPTOWN INFORMAL SETTLEMENT? YES NO NOT SURE SOMETIMES IF YES ROUGHLY HOW MANY PER MONTH

 8. HAVE YOU HAD TO REFER OTHER CASES TO CHRIS HANI BARAGWANATH HOSPITAL? YES NO NOT SURE SOMETIMES. IF YES WHICH ONES?
 9. WHAT COULD BE THE CAUSES OF DIARRHOEA IN CHILDREN FROM KLIPTOWN INFORMAL SETTLEMENT? _____

 10. WHAT DO YOU THINK ARE CAUSES OF THE WATERBORNE DISEASES FROM KLIPTOWN INFORMAL SETTLEMENT BESIDES DIARRHOEA AND CHOLERA? _____

 11. WHAT CAN BE DONE TO REDUCE THE FREQUENCY OF WATERBORNE DISEASES IN CHILDREN IN KLIPTOWN INFORMAL SETTLEMENT? _____

- THANK YOU FOR YOUR COOPERATION

8.4 APPENDIX 4: INFORMED CONSENT FORM FOR THE MATRON



Please fill in the reply slip below if you agree to participate in the research

An assessment of the social impacts of water pollution on children in informal settlements: The case of Kliptown informal settlement, Soweto, Johannesburg.

Matron's Informed Consent

I _____ the Matron of Kliptown Clinic

Hereby confirm that I have been informed by Jennifer Tadzei Kamusono about the nature of the study.
Yes/No

Have also received, read and understood the Information and Consent sheets regarding the educational study. Yes/No

I am aware that my responses in the interview will be processed without mentioning my real name.
Yes/No

In view of the requirements of the research, I agree that the data collected during this study can be processed in a computerised system by the researcher. Yes/No

I can at any stage, without prejudice, withdraw my participation in the study. Yes/No

I have had sufficient time to ask questions and (of my free will) join the study. Yes/No

Signature of Matron: _____ Date: _____

8.5 APPENDIX 5: ETHICAL APPROVAL FROM UNIVERSITY OF SOUTH AFRICA

CAES RESEARCH ETHICS REVIEW COMMITTEE

Date: 05/03/2015

Ref #: 2015/CAES/029

Name of applicant: Ms JT Kamusono

Student #: 46566570

Dear Ms Kamusono,

Decision: Ethics Approval

Proposal: An assessment of the social impacts of water pollution on children in informal settlements: The case of the Kliptown informal settlement, Soweto, Johannesburg

Supervisor: Dr DJP De Waal

Qualification: Postgraduate degree

Thank you for the application for research ethics clearance by the CAES Research Ethics Review Committee for the above mentioned research. Final approval is granted for the duration of the project, **subject to submission of the permission letters from the Kliptown local authority and the Kliptown clinic.**

Please consider points 4 and 5 below for further action.

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the CAES Research Ethics Review Committee on 05 March 2015.

The proposed research may now commence with the proviso that:

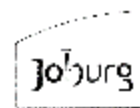
- 1) The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*
- 2) Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the CAES Research Ethics Review Committee. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*



8.6 APPENDIX 6: AUTHORISATION LETTER FROM THE CITY OF JOHANNESBURG



GAUTENG PROVINCE
REPUBLIC OF SOUTH AFRICA



• **JOHANNESBURG** •
METRO LOCAL GOVERNMENT

JOHANNESBURG HEALTH DISTRICT

Enquiries:
johannesburg@research@gauteng.gov.za
011 462 2000 ext 2200

27 March 2015

Jennifer Tadzei Kamusono
Unisa
E-mail: jekam586@yahoo.com

Reference no: 2014-18/064

Dear Ms Jennifer Tadzei Kamusono,

Re: Study protocol: An assessment of social impact of water pollution on children in informal settlements: The case of Kliptown informal settlement, Soweto, Johannesburg.

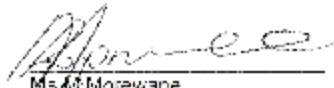
Your application dated for the above approval project refers. The District Research Committee has reviewed your application. This letter serves as an in-principle approval to access the Districts Health facilities (mentioned below) for the above project, subject to following conditions:

- The facilities to be visited: Sub-district/ Region G: Kliptown Clinic
- This facility will be visited from 01 April to 31 December 2015.
- You will report to the Facility managers of the Clinic before initiating the study
- Participants' rights and confidentiality will be maintained all the time.
- No resources (Financial, material and human resources) from the above facilities will be used for the study. Neither the District nor the facility will incur any additional cost for this study.
- The study will comply with Publicly Financed Research and Development Act, 2008 (Act 51 of 2008) and its related Regulations.
- You will submit a copy (electronic and hard copy) of your final report. In addition, you will submit a six-monthly progress report to the District Research Committee. Your supervisor and University of the Witwatersrand will ensure that these reports are being submitted timously to the District Research Committee.
- The District must be acknowledged in all the reports/publications generated from the research and a copy of these reports/publications must be submitted to the District Research Committee.

We reserve our right to withdraw our approval, if you breach any of the conditions mentioned above.

Please feel free to contact us, if you have any further queries. On behalf of the District Research Committee, we would like to thank you for choosing our District to conduct such an important study.

Regards,



Ms. M. Morewana
Chief Director
Johannesburg Health District

20/02/2013

8.7 APPENDIX 7: LETTER OF INTRODUCTION FROM THE UNIVERSITY OF SOUTH AFRICA



23 March 2015

TO WHOM IT MAY CONCERN

Dear Sir/Madam

LETTER OF INTRODUCTION

This is to confirm that Ms Kamusono, JT (student number: 46566570) is a registered student in the Department of Environmental Science, College of Agriculture and Environmental Sciences of the University of South Africa.

She is studying towards a Masters degree in Environmental Management with the research title "An assessment of the social impacts of water pollution on children in informal settlements: The case of Kliptown informal settlement, Soweto, Johannesburg".

Will you kindly recognize her in this regard.

If you have any queries or reservations, please do not hesitate to contact the undersigned people:

- Student: jekam56@yahoo.com
- Supervisor: Dr D De Waal, ddw@lantic.net

Thank you very much in advance for your assistance.

Sincerely Yours


Prof W. M. Nel
COD: Environmental Sciences

Request to do research from the Ward Counselor in Kliptown informal settlement

The Ward Counselor
Kliptown Informal settlement
Kliptown
Johannesburg

16 December, 2014

REF: Request for Permission to do research in Kilptown informal settlement

Dear Madam

My name is Jennifer Kamusono. I am studying for MSc Degree in Environmental Management in the College of Agriculture and Environmental Science at the University of South Africa. I write this letter to seek your permission to do research in Kliptown informal settlement.

I am carrying out a study on the **assessment of the social impacts of water pollution on children in informal settlements: The case of the Kliptown informal settlement, Soweto, Johannesburg.**

I am mainly looking at the social impacts of water pollution in children. I also intend to determine the factors that contribute to the social impacts of water pollution. This research is on children because I noticed that children are a vulnerable group who need to be protected from the dangers of drinking and playing with contaminated water. I strongly believe that diagnosing the social impacts of water pollution can only help us to devise strategies to look after our children better. My research will not only benefit the informal settlement where it is conducted, but also other South African informal settlements in handling the social impacts of water pollution.

The research will involve:

- Parents responding to questions on social impacts of water pollution in children in Kliptown informal settlement over a period of 2 hours. The questionnaire will be completed during the weekend on a Saturday when most parents are present.

100 parents (Both males and females) will be given questionnaires to complete. The parents will respond to questions on social impacts of water pollution as well as the factors that contribute to water pollution and the extent of the water pollution in the informal settlement. 2 nurses will be interviewed also to assess the level of water pollution and the social impacts of water pollution in the informal settlement.

To accurately capture what nurses say about the social impacts of water pollution, the interviews will be audio-recorded. The interviews will take at most 40 minutes per nurse.

I would like to make it clear that participation in this study is entirely voluntary, no harm is envisaged, and all information will be treated as confidential and names not known. Participants can choose to accept or decline to answer any questions, and can withdraw from the study at any given time. I hope to publish part or all the results of this study in academic journals. In order to maintain anonymity and confidentiality, all names I use will be pseudonyms.

I will provide participants with a summary of my research results on completion if they would like me to.

Name: Jennifer Kamusono

Signature:  Date: 16/03/15

Research Supervisor: Dr David de Waal Phone: 011 421 3500
Mobile: 083 227 8681
Email: david.dewaal@aecom.com

OFFICE OF THE SPEAKER
Ward 17
Region G

Date: 16/03/15
Signature: 



CITY OF JOHANNESBURG
Councillor Valentine
Ward 17

Date: 16 March 2015

To whom it may concern

Dear Sir/Madam

This serve to confirm that Jennifer Kamusono has spoken to me about the social assessment of the social impact of water pollution in the informal settlement For more information please do not hesitate to contact me.

Kind Regards

Councillor M.Valentine
Region G: Ward 17
Cell: 083 719 2042

OFFICE OF THE SPEAKER
Ward 17
Region G
Date: 16/03/15
Signature: 