INTEGRATING DISASTER RISK ASSESSMENT INTO THE UPGRADE OF WASTE WATER TREATMENT WORKS (WWTW) IN LEPELLE-NKUMPI LOCAL MUNICIPALITY, LIMPOPO PROVINCE

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DEDICATION

I dedicate this work to my two children (Lehumo M and Letlotlo M Mosotho), my mother (Lillian M Mosotho), my siblings (Phuti and Mpho Mosotho), my best friend Gladwin Segage, not forgetting my father (the late Daniel O Chiloane), my grandmother (the late Elizabeth DM Mabe), and grandfather (Klass M Motswene (Mosotho)). Without their inspirational support, unconditional love and perseverance I would not have managed to complete my studies the way I did.

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DISCLAIMER

This thesis is submitted in partial fulfilment of the requirements for the Degree of Masters in Disaster Management for consideration by the Disaster Risk Management Training and Education Centre for Africa, Faculty of Natural and Agricultural Sciences, at the University of the Free State.

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(1 Thessalonians 5:18, New American Standard Bible).

ABSTRACT

The intensifying nature and extent of the conditions of the wastewater treatment works in South Africa together with costs required to manage the effects of wastewater treatment works requires a strong focus on disaster risk reduction. The ever evolving and complex dynamics of risk posed by the wastewater treatment works as the contributor to anthropogenic disasters has sharped the urgency to pursue effective disaster risk assessment as a prerequisite to inform disaster risk management planning and the disaster risk reduction intervention process. The continued negative trend in terms of the functionality and operations of Lebowakgomo wastewater treatment works, posed by the overloading and the non-functionality of the plant, modelled a high risk to the nearby environment and community. The aim of the study was to evaluate the impact non-integration of DRA into the WWTW on the environment and community in order to make recommendations to improve on future upgrades of WWTW. In achieving the afore-mentioned aim, the following objectives were envisaged determining the impact of not integrating disaster risk assessment on the upgrade of wastewater treatment works, determining the effect of the wastewater treatment works on the environment and community and further making recommendations about the importance of integration of disaster risk assessment in the proposed upgrade of the wastewater treatment works. The study focused on the case of Lebowakgomo Wastewater Treatment Works, in the Limpopo Province, the descriptive method of the qualitative approach was employed with reference to this research, it involved the systematic collection of data through descriptive survey questions to examine the prevailing conceptualisation of disaster risk assessment in order to build theory that is grounded in the empirical realities of stakeholders involved in the disaster risk reduction. The results obtained indicated lack of policy compliance, gaps and shortcomings in the likely impact of not integrating disaster risk assessment and the effects of wastewater treatment works to environment and community were also identified, from the findings recommendations were made for better inclusion in the proposed upgrade. Those recommendations indicated the imperativeness of integrating disaster risk assessment in the proposed upgrade by the municipality to further avoid violation of Section 24(a) (b) of the Constitution.

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ACRONYMS AND ABBREVIATIONS

CSIR	Council for Scientific and Industrial Research
CDM	Capricorn District Municipality
CEIMP	Consolidated Environmental Implementation and Management Plan
DEA	Department of Environmental Affairs
DRA	Disaster Risk Assessment
DRR	Disaster Risk Reduction
DRMP	Disaster Risk Management Plan
DPEMS	Development, Planning and Environmental Management Services
DWAS	Department of Water and Sanitation
ECA	Environmental Conservation Act
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMF	Environmental Management Framework
HFA	Hyogo Framework of Action
IDP	Integrated Development Plan
IGR	Intergovernmental Relation Forum
HIV	Human Immunodeficiency Virus
KPA	Key Performance Area
NEM	National Environmental Management

NEMA	National Environmental Management Act
NDMF	National Disaster Management Framework
NWA	National Water Act
NGO	Non-Governmental Organisation
LEDET	Department of Local Economic Development, Environment and Tourism
ROD	Record of Decision
SFDR	Sendai Framework for Disaster Risk Reduction
SONA	State of the Nation Address
SOPA	State of the Provincial Address
SOER	State of Environment Report
WWTW	Wastewater Treatment Works
W_2RAP	Wastewater Risk Abatement Plan
UNDP	United Nations Development Programme
UNISDR	United Nations International Strategy for Disaster Reduction

DEFINITIONS

Capacity – the Combination of all the strengths, attributes and resources available within a community, society or organisation that can be used to achieve agreed goals (UNISDR, 2009).

Disaster risk reduction (disaster reduction) –The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disaster including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (UNISDR, 2009).

Development – is what we do in an attempt to improve our lives (International Federation of Red Cross and Red Crescent Societies IFRCRCS, 2002).

Disaster Management Plan–strategic mechanisms through which disaster risk management actions are coordinated and integrated across all sphere of government (NDMF, 2005).

Effluent – human excreta, domestic sludge, domestic wastewater, grey water or wastewater resulting from the commercial or industrial use of water (DWAF, 2001).

Environmental Impact Assessment –process by which the environmental consequences of a proposed project or programme are evaluated, undertaken as an integral part of the planning and decision making processes with a view to limiting or reducing the adverse impacts of the project or programme (UNISDR, 2009).

Environmental Management Plan – an environmental management tool used to ensure that undue or reasonably avoidable adverse impacts of the construction, operation and decommissioning of a project are prevented; and that the positive benefits of the projects are enhanced (as adapted from DEAT, 2004b).

Green Drop Certification –the Green Drop is a programme used by Department of Water Affairs to assess and compare the quality of the municipalities' wastewater collection and treatment as a percentage score and also rates the municipalities on the quality of wastewater per the total volume treated. Green Drop Certification is awarded to wastewater systems that obtain scores of 90% when compared against the criteria set for wastewater management (DWA, 2014).

Hazard – A dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption or environmental damage (UNISDR, 2009).

Integrated Development Plan – a legislated plan for an area that gives an overall framework for development. It aims to co-ordinate the work of local and other spheres of government in a coherent plan to improve the quality of life for all the people living in an area. All municipalities have to produce and review an IDP annually, as per Section 26 of the Municipal Systems Act 32 of 2000 (a-i)

Risk – the combination of probability of an event and its negative consequences, the probability of harmful consequences or expected loss resulting from interactions between natural or human induced hazards and vulnerable/capable conditions. Conventionally risk is expressed by the equation Risk= Vulnerability /Capacity (UNISDR, 2009).

Risk Assessment – methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability/ capacity that could pose a potential threat or harm to people, property, livelihoods and the environment on which they depend (UNISDR,2009)

Risk Management – the systematic management of administrative decisions, organisation, operational skills and responsibilities to apply policies, strategies and practices for disaster risk reduction (UNISDR, 2009).

Project development cycle – is the framework that helps with development of projects it has a starting and ending point, which consist of the following, **Identification**: stage where one project-idea out of several alternatives is chosen and defined. **Preparation**: idea is carefully developed to the appraisal stage. **Appraisal**: every aspect of the project idea is subjected to systematic and comprehensive evaluation and a project plan is prepared. **Presentation**: detailed plan is submitted for approval and financing to the appropriate entities. **Implementation**: with necessary approvals and financing in place, the project plan is implemented. **Monitoring:** at every stage the progress of the project is assessed against the plan. **Evaluation**: upon completion the project is reassessed in terms of its efficiency and performance (World Bank, 2005).

Pollution – the National Environmental Management Waste Act. Act no 59 of 2008 defines pollution means any change in the environment caused by— (i) substances; (ii) radioactive or other waves; or (iii) noise, odours, dust or heat, emitted from any activity, including the storage

or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or well-being or on the composition. Resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future.

Sludge – solids separated during the treatment of municipal wastewater (Environmental Protection Agency, 2014).

Sustainability – recognising and making best use of the interconnection between social, economic and environmental goals to reduce significant hazard risks. This entails the ability to reduce one's exposure to, and recover from, infrequent large-scale, but also frequent smaller scale, natural and human driven events (UNISDR, 2009).

Sustainable Development – the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations (National Environmental Management Act, no 107 of 1998).

Vulnerability – a set of conditions and processes resulting from physical, social economic and environmental factors, which increases the susceptibility of a community to the impact hazards (UNISDR, 2009).

Wastewater – wastewater is defined as "a combination of one or more of domestic effluent consisting of black water (excreta, urine and faecal sludge) and greywater (kitchen and bathing wastewater); water from commercial establishments and institutions, including hospitals; industrial effluent, storm water and other urban run-off; agricultural, horticultural and aquaculture effluent, either dissolved or as suspended matter" (Corcoran *et al.,* 2010).

Wastewater Treatment Works / Wastewater Treatment Plant – the National Environmental Management Waste Act. Act no 59 of 2008 defines a waste treatment facility as any site that is used to accumulate waste for the purpose of storage, recovery treatment reprocessing, recycling, or sorting that waste.

Wastewater Risk Abatement Plan – A Wastewater Risk Abatement Plan offers a systematic and methodical approach whereby high risk areas are identified, rated and mitigation measures implemented to abate the risk over time (W_2RAP Guideline, 2011).

Water Use License –- water licence used for any activity that occurs in the vicinity of or within watercourses or water bodies, it is required for all activities which could pollute a water resource, the disposal of waste water, stream diversions, abstraction, storing water, and using water for recreational purposes (NWA, 1998).

CHAPTER 1: INTRODUCTION

1.1. Introduction

Less than half of South Africa's 821 sewage works are treating the billions of litres of effluent they receive each day to safe and acceptable standards according to the Green Drop Report (2009). The report – a measure of the state of wastewater treatment plants in all nine provinces cautions that 460 plants (56 percent) are either in a "critical state" or delivering a "very poor performance". In 2009, the Department of Water Affairs conducted a wastewater treatment works risk assessment and the purpose of this assessment was to provide a priority list of WWTWs with potentially high-risk profiles in the provinces and districts. Amongst many the Lebowakgomo wastewater treatment works was highlighted as one of the priority areas.

Capricorn District Municipality is one of the Water Services Authorities (WSA) within the Limpopo Province, meaning it is responsible for ensuring access to water services both drinking and waste in the municipality or rural council as defined in the Local Government Transition Act (1993) to the four local municipalities Aganang, Blouberg, Lepelle-Nkumpi, and Molemole falling within its jurisdiction, excluding Polokwane local municipality. Capricorn District Municipality is responsible for the management and operations of 13 of the 18 wastewater treatment works within the district, of which Nine (9) are stabilisation ponds situated at Lebowakgomo, Alldays, Aganang and Mogwadi and four (4) are wastewater treatment works situated at Alldays, Mogwadi and Lebowakgomo.

The Green Drop Report (2012) highlighted that the WWTW at Alldays is situated in a low risk space, mainly due to the fact that there is no effluent discharged, as a number of the ponds are still empty and further highlighted that the high-risk categories have been assigned to Lebowakgomo Plant, Mogwadi, Lebowakgomo Ponds and Senwabarwana. The activated sludge plants are on the border of high to medium risk; with the primary risk being that the WWTW was hydraulically overloaded. The main focus of this study was on the Lebowakgomo wastewater treatment works falling within the Lepelle-Nkumpi Local Municipality.

According to the sections 20, 33 and 47 of the Disaster Management Act, requirements for priority settings with respect to disasters likely to affect South Africa must be set out by each organ of state. These sections highlight the importance of disaster risk assessment to guide national, provincial and municipal disaster risk in order to avoid any disaster risks. KPA2 of the National Disaster Management Framework Disaster Risk Assessment:

"Outlines the requirements for implementing disaster risk assessment and monitoring by organs of state within all spheres of Government. Furthermore, it shows that the outcomes of disaster risk assessments should directly inform the development of disaster risk management plans" (National Disaster Management Framework, 2005:25)

Coetzee (2013) states that the process of disaster risk assessment outlines the vital part of the legal requirements by the South African Disaster Management legislations. The Disaster Management legislations have a distinct disaster risk reduction focus and it places significant emphasis on the development of planning and integrated, adequate structures and coordinated disaster risk management activities in all spheres of Government. With a broad understanding of the concept of disaster risk assessment in place it will be easier to comprehend the threat of not integrating DRA in the proposed upgrade of the WWTW. Therefore, the study sought to determine the likely impact of not integrating disaster risk assessment in the proposed upgrade of the WWTW and the effects of the wastewater treatment works on the environment and community. The study was done guided by the disaster risk assessment process which provide that disaster risk assessment must be done using a staged approached to enable synchronisation with the requirements of the planning process (NDMF, 2005), and furthermore the study took into account the international, national and local policies on disaster risk management that encourage the inclusion of risk reduction measures to promote sustainable development.

The chapter provides for the description of the study area, research problem of the study under investigation, it furthermore describes the key research questions, the aims and objectives of the research, the methodology, delimitations and limitations of the study, as well as the ethical consideration and an outline of the study were also given.

1.2. Description of the study Area

Capricorn District Municipality (DC35) is situated in the centre of the Limpopo Province, sharing its borders with four district municipalities namely; Mopani (east), Sekhukhune (south), Vhembe (north) and Waterberg (west); it covers an area of about 2 180 530 ha which constitutes 12% of the total surface area of the Limpopo Province. The Capricorn District Municipality (CDM) comprises of four Local Municipalities, after the disestablishment of Aganang LM IDP (2016-2021) see Figure1.1.

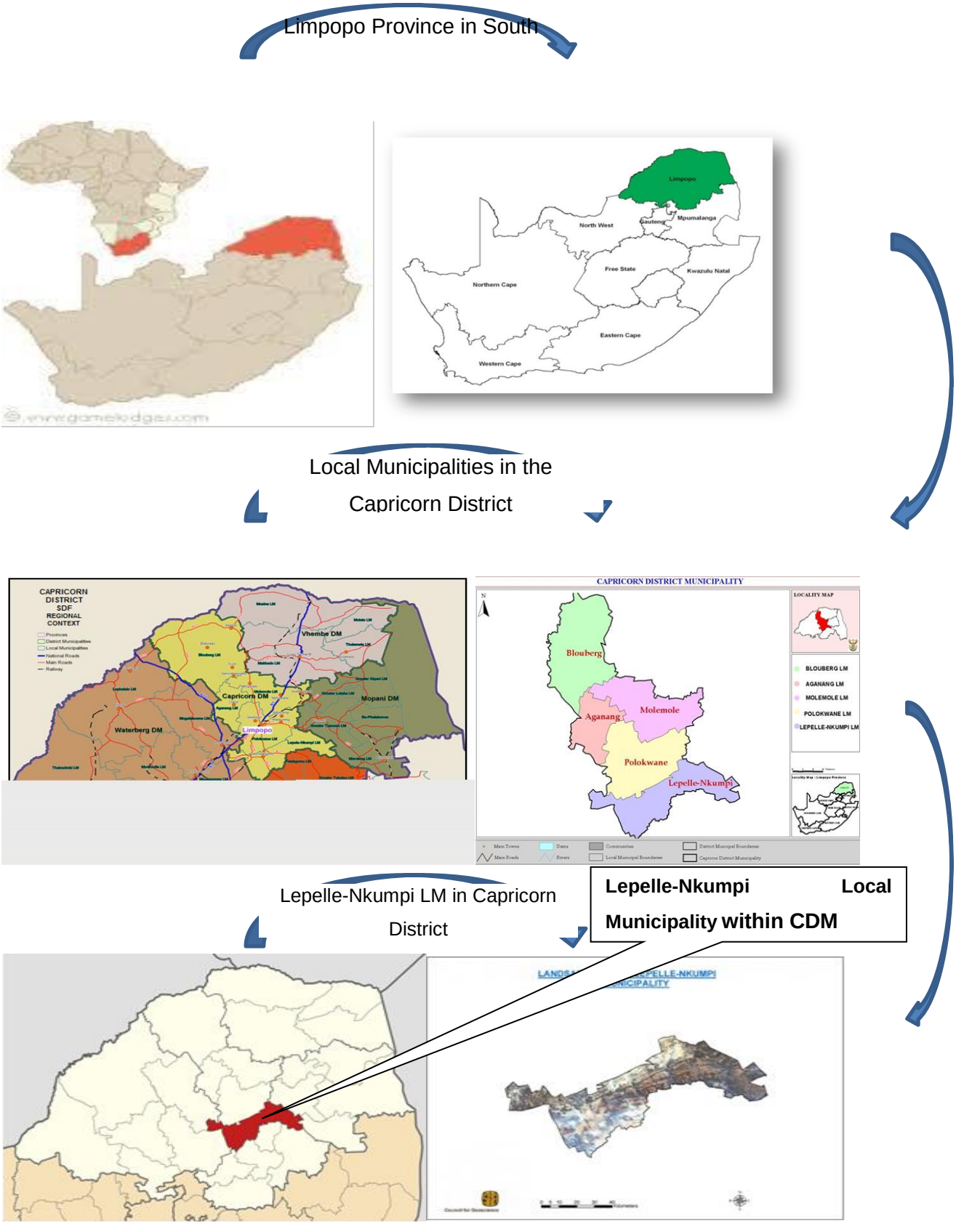

Figure 1. 1: Maps for Africa, South Africa, Capricorn District and its Local Municipality and Lepelle-Nkumpi Local Municipality:

Source: Nationsonline, Capricorn District Municipality IDP (2011/12), and Griplimpopo (2017)

According to the Census (2011), the total population for the district is 1 261 463 with population density of 58.1/km² and a total area of 21.705 km², of which 18% of the population of CDM resides in the Lepelle-Nkumpi as indicated in Figure 1.2.

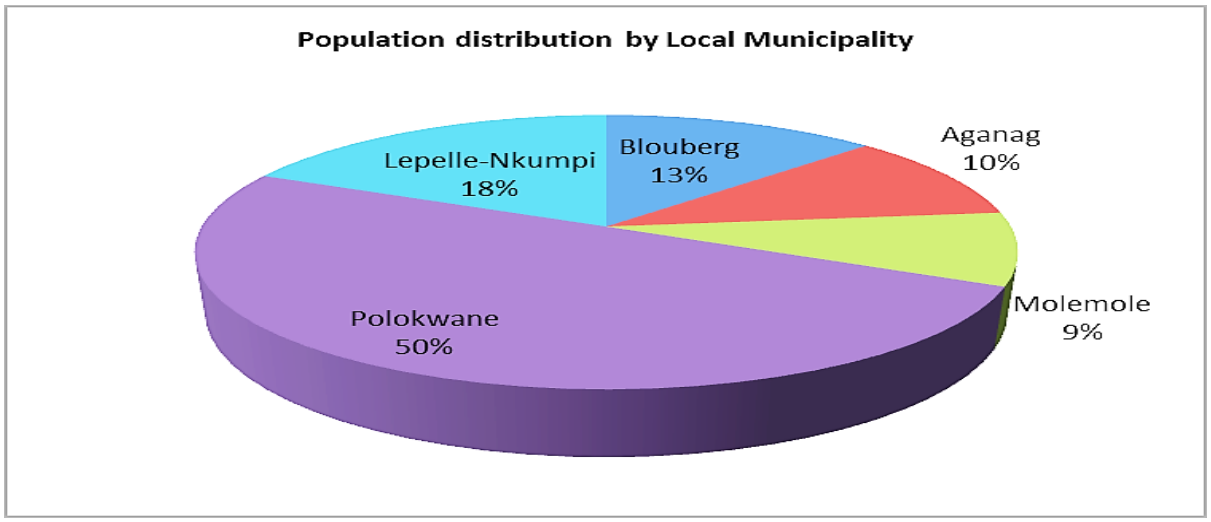

Figure 1. 2: Population per Local Municipality

Source CDM IDP (2016-2021)

Lepelle-Nkumpi Local Municipality

Lepelle-Nkumpi Local Municipality is one of the four local municipality located in the Capricorn District Municipality, it comprises of 18.2% of the district's total population with a population density of 66.5/km². The municipal area stretches for about 3.463 km which represents 16% of the District's total land area and is divided into 29 wards which comprise a total of 94 settlements and it is pre-dominantly rural with a population of approximately 230 350 people and total of 59 682 households; about 95% of its land falls under the jurisdiction of Traditional Authorities while Lebowakgomo, is a district growth point IDP (2016-2021).

- The municipality is faced with the following key challenges, most of which are not a peculiarity:
- High infrastructure development backlog
- Land un-availability due to tribal ownership and spatial reconstruction
- Infrastructure management and maintenance systems
- Environmental management
- By-laws enforcement
- Low Revenue Base

The prominent settlements in the Lepelle-Nkumpi Local Municipality include Lebowakgomo, Magatle, Mamaolo, Moletlane and Mogoto, with Lebowakgomo being the major node of economic activity, also providing the widest range of community facilities and social services. The township of Lebowakgomo was established in 1974 and was enlarged and developed in the early 1980s. Over the years the township has seen major development and population growth by 0.1% during the last ten years (Stats SA, 2011) and this is due to urbanisation.

Lebowakgomo Wastewater Treatment Works (WWTW) is located north-east of Lebowakgomo and is about 25 km from the Lepelle- Nkumpi Municipal Offices; the plant is situated between Lebowakgomo Zone A and Makurung village see Table 1.1., for demographic information, a communal area under the jurisdiction of Bakgaga Traditional Authority area which is part of Ga-Mphahlele (generally referring to the land area within Bakgaga Traditional Authority's jurisdiction).

Table 1. 1: Makurung Demographic

Demographics Municipality	Population	No. of Households	Average Household Size	Working Age
Makurung	4 911	1 126	4.3	81.3 %

Source: Statics SA (2011)

1.3. Situational analysis of Lebowakgomo Waste Water Treatment Works (WWTW)

Wastewater treatment works and stabilisation ponds were strategically constructed in the semi-urban area of Lepelle-Nkumpi Local Municipality. The local municipality has one medium size Wastewater Treatment Works (WWTW) and stabilisation ponds which have been in existence for over 20 years. The treatment works receives domestic, commercial and industrial wastes from the Lebowakgomo Township Zone (A, J, Q, R and S) and the stabilisation ponds receive wastewater from Lebowakgomo Zone (B, P, F Central Business Development, and

Figure 1. 3: Lebowakgomo Map

Source: MapStudio (2017)

Parliamentary site) area as indicated in Figure 1.5.Over the years the municipality has seen a significant growth in development, for example the new development of Lebowakgomo Mall, Lebowakgomo Zone R, P, Q, S and F (RDP) housing, but the same cannot be said of the infrastructure such as wastewater treatment works. All the new and existing development connections to the sewage system has to be done and these connections into the existing system which is already operating above its capacity. In the risk based assessment conducted by DWA (2009) the findings of the report highlight the high risk of the design capacity indicating the problem being the inflow exceeding the design capacity and also the final effluent being discharged onto pastureland and streams, hence a pollution risk to the groundwater, livestock and the surrounding communities, see Figure 1.4 below.

Figure 1. 4: Pictures of Sewage discharged on pasture land

According to the CDM Wastewater Risk Abatement Plan (2012), the design of the Lebowakgomo WWTW is an activated sludge system with a treatment capacity of 3.0 Ml/d which discharges into the Olifants River catchment. Table1.2. below gives an overview of the existing treatment processes.

Table 1. 2: Position, type and sewerage type of WWTW

WWTW	Longitude	Latitude	Type of Plant	Type of Sewerage
Lebowakgomo Activated Sludge	E 29°33' 08.34"	S 24°19' 29.11"	Activated Sludge	Residential, Commercial and Industrial

Source: CSIR (2016)

The recommendations of the WWTW risk based assessment marked an urgent need of expansion of WWTW to redress management of the inflow and outflow in order to reduce environmental risks. As a way of meeting the recommendations of the risk based assessment, the Capricorn District Municipality and Department of Water and Sanitation considered to upgrade the Lebowakgomo WWTW and stabilisation ponds and also developed a Wastewater Risk Abatement Plan to try to address most of the challenges faced.

In most instances challenges arise during or after project implementation. There is a great concern that projects are implemented without the integration of disaster risk assessment and development of disaster management plans and this has a significant increase in the vulnerability of the people living where development is taking place. The process of disaster risk assessment forms part of the legal requirement set by the Disaster Management Act 57 of 2002. The Disaster Management Act has a distinct disaster risk reduction focus and places considerable emphasis on the development of adequate structures, planning, and integrated and coordinated disaster risk management activities on all tiers of Government (Coetzee, 2006). If nothing is done to improve the current situation such as employment of appropriate application of DRA principles, the problem will remain unresolved and may even increase which will leave communities and the environment vulnerable in a compromised state. Although measures to upgrade the plant are underway, the question of sustainability and promotion of risk reduction measures still remains. Therefore, it is important to conduct the study and develop recommendations to address the problems.

1.4. Research Problem.

According to National Disaster Management Framework (NDMF) 2005, disaster risk assessment is conducted to establish a uniform approach to assessing and monitoring disaster risks that will inform disaster risk management planning and disaster risk reduction undertaken by organs of state and other role players. The importance of disaster risk assessment is to exam the probability and result of the disaster events and that each organ of state must execute a systematic disaster risk assessment prior to the implementation of any projects. Mema (2004) indicate that pollution as a result of poor wastewater and sewage treatment infrastructure has a direct impact on humans and the environment. Further to that the findings by Department of Water Affairs' (2009) report indicate huge challenges with the

wastewater treatment works in South Africa, particularly the Lebowakgomo wastewater treatment works in the Lepelle-Nkumpi Local Municipality.

The problem with the WWTW is that the current measured inflow into the WWTW is ±5.2 Ml/d with a future flow envisaged of 7.5 Ml/d, which indicates a substantial exceed over the design capacity (173%) to the projected flow. The GAP analysis conducted by CSIR (2016), highlighted measured challenges with the operations and maintenance of the WWTW; it indicates that the WWTW is not meeting the minimum standard requirement by the Green Drop Standard, and also data collected by Capricorn District Infrastructure Unit (Assessment of Lebowakgomo WWTW, 2009) indicate the following challenges, some of the challenges highlighted include:

- The WWTW is working above its design capacity, very high inflow at the inlet.
- No proper disposal of screenings, grit and sludge on site.
- The outflow meter not available at the effluent discharge point which results in the final effluent being discharged without being tested.
- Due to overflow of the WWTW most of the effluent is released into the nearby pasture land and streams, Presence of solid and foam on the treat effluent would pollute the receiving water i.e. Chuenie River,
- It further stated that some of the challenges could be addressed by the outcome of the pending Environmental Impact Assessment study (EIA). The flooding incidents at the WWTW resulting in process challenges.
- Incidences of flooding at the nearby roads, houses and schools and have been reported during the rainy season.
- High risk of pollution of the ground water;
- Environmental pollution (Air and Waste); and
- Animal (livestock) drinking the final effluent.

Table 1. 3: Sewage Treatment Facilities Status Report Capricorn District 2014-15

Name of Facility	Ownership	Local municipality	Status	Action required
Lebowakgomo Zone A Sewage Works	Capricorn District Municipality	Lepelle-Nkumpi Local Municipality	• No License • No Operational Plan • Adequate equipment • Personnel available • Effluent analysis not done	• Application for License • Operational Plan • Effluent analysis •

Source: LEDET (2016)

Table 1.3. Above indicated the facility status report which showed some of the challenges that add to the problems. The negative trend in terms of the functionality and operations of the Lebowakgomo treatment works pose a high risk to the nearby environment and community. The study evaluated the legislative requirements on the integration of disaster risk assessment, likely impact of non-integration of disaster risk assessment in the proposed upgrade of the Lebowakgomo Wastewater Treatment Works in Lepelle-Nkumpi Local Municipality, and the effects of wastewater treatment works on the environment and community and an alternative was derived to assist the municipality to improve.

1.5. Research Aim and Objectives

1.5.1. Research Aim

The aim of the study was to evaluate the impact non-integration of DRA into the WWTW on the environment and community in order to make to recommendations improve on future upgrades of WWTW.

1.5.2. Objectives

In achieving the afore-mentioned aim, the following objectives were envisaged:

- To determine the impact of not integrating disaster risk assessment on the upgrade of wastewater treatment works, and
- To determine the effect the wastewater treatment works will have on the environment and community,

1.5.3. Secondary sub-objective

- To make recommendations about the importance of integration of disaster risk assessment in the proposed upgrade of the wastewater treatment works.

1.6. Research Questions

The proposal for the upgrade of the Lebowakgomo WWTW is currently underway and the main question remains what is the likely impact of not integrating disaster risk assessment in the proposed upgrade of the wastewater treatment works and what effect will it have on the environment and nearby community. In order to adequately address the problems raised above the following specific research questions were pursued:

- What are the national and municipal policy requirements on integration of disaster risk assessment in the establishment of wastewater treatment works?
- What are the impacts of not integrating disaster risk assessment in establishment of wastewater treatment works?
- What effect will wastewater treatment works have on the environment and community?
- What recommendations can be made to highlight the importance of integration of disaster risk assessment in the proposed upgrade of the WWTW?

1.7. Significance of Study

The challenge confronting municipalities in South Africa is that of proper and safe operations of the wastewater treatment works and also that of organs of state failing to implement and comply with the stipulations of the Disaster Management Act 57 of 2002, the National Disaster Management Framework of 2005 and the respective national and provincial Frameworks with regards to disaster prevention and disaster risk reduction explained Reddy (2010). Therefore, this study will serve as a valuable instrument to municipalities considering the upgrade or establishment of wastewater treatment plant to consider the integration of disaster risk assessment before the inception of the project for the facilitation and the promotion of effective disaster risk reduction strategies.

According to Hamid, Narendran and Malaysian Water Association (cited by Magonywa, 2014) WWTW has two significant roles, firstly, to protect the public health and secondly, to protect the environment**.** The integration of disaster risk assessment in the proposed upgrade or establishment of wastewater treatment works will offer an appropriate and relevant model for the facilitation and promotion of disaster risk reduction, implementation of practical disaster

risk reduction strategies and promotion of disaster risk management as diverse team of relevant stakeholders will be involved during the conduct of disaster risk assessment for wastewater treatment works. As such, the purpose of a hazard identification, vulnerability-driven, community-based, bottom-up system is stated justifying the advantages of the partnership concept in disaster risk assessment. Reddy (2010)

An added value of the study is that apart from the WRAP developed for WWTW the integration of DRA will contribute towards assisting policy makers to strengthen their policies. Having established the basic significant of the study, it is important to examine the research methodology used to achieve the various research outcomes.

1.8. Research Methodology

Disaster Risk Assessment is the first step in planning an effective disaster risk reduction programme. It examines the likelihood and outcomes of expected hazard events, including the vulnerability conditions that increase the chances of loss. According to Polit and Hungler (2004), methodology refers to ways of obtaining, organising and analysing data, whereas Mouton and Marais (1996) consider methodology in research to be the theory of correct scientific decisions.

The scope of the research will be using a qualitative approach. The study and will make use of the exploratory method, Collins Cobuild English Dictionary for advanced learners (2001) explains exploratory methods as "*exploratory actions are done in order to discover something or to learn the truth about something*". On the other hand Burns and Grove (2003) explain that the exploratory method allows for the researcher to gain new insights, discover new ideas and increase knowledge of the phenomenon. This exploratory method will assist in guiding the research, attention will be to conceptualise the framework of DRA, its process and how it can be employed for the upgrade of Lebowakgomo Wastewater Treatment works.

1.8.1. Research designs

Mouton (2001) defines research design as a strategy of how the researcher intend conducting the research, he further states that research design focuses on the need product, formulates a research problem as a point of departure and focuses on the logic of research. The case study is generally a very illustrious category used by researchers. Its focus is to dig out the characteristics of a particular entity and its key distinguishable attributes including focus on a single unit, in depth description of a phenomenon, anchored on real live scenarios and using multiple data collection methods. Yin (2003) defines Case study as "an empirical

inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident". Zainal (2007) describes Case study as a "method that enables a researcher to closely examine the data within a specific context; a case study method selects a small geographical area or a very limited number of individuals as the subjects of study". This study's case method was used for the Lebowakgomo wastewater treatment works and questionnaires were distributed to the community affected at Makurung Village to gather data on understanding the impact of the WWTW on them and their environment.

Described by Fox & Bayat, 2007; Weiman *et al*., 2005; and Brynard *et al*., 1997, the descriptive method of the qualitative approach was employed with reference to this research, it involved the systematic collection of data through descriptive survey questions to examine the prevailing conceptualisation of disaster risk assessment. On the other hand, since the qualitative approach allows for more diversity in responses as well as the capacity to adapt to new developments and issues during the research process (Flick, 2009; Woods, 1999; Silverman, 2000), it formed the thrust of the research methodology in this study.

1.8.2. Sampling

Oslen (2012) states that sampling is a cost saving way to create sets of cases whereas De Vos (2005) indicates that sampling is the only technique available to ensure an optimal chance of drawing a sample. Kumar (2014) points out that sampling is a process of selecting a few (sample) from a bigger group as the basis for estimating or predicting the prevalence of an unknown piece of information, situation, or outcome regarding the bigger group. In keeping with applicable methods, a smaller but focused sample was selected rather than large random sampling. The non-probability sampling technique (Welman *et al*., 2005) through the purposive sampling style was used to identify the sample to best represent the relevant population. Sarantakos (2005) indicates that in purposive sampling the researcher purposely chooses subjects that are relevant to the project. The already known population alluded to in the study was the local government (Capricorn District Municipality) and the community of the affected area. Out of the 13 WWTW in the Capricorn District only one WWTW was being considered for the study, and out of the population of 4 612 with 1 129 households from Makurung area, 111 people took part in the study. Meaning, 111 people from the area of Makurung living close by the Lebowakgomo Wastewater Treatment works took part in the study.

1.8.3. Data collection

According to Denzin & Lincoln (2000), various data collection methods can be used for example open-ended narrative, checklists, field guides and interviewing. For the study three main focus groups are identified for the data collection process. The research instruments employed for this purpose ranged from questionnaires, interviews and field observation.

Data was collected through:

- Reviewing of documents, reports, plans and publications;
- Interviews with unit managers and officials;
- Semi-structured questionnaires for community was used to guide the discussions; and
- Field observation by the researcher complemented these data collection tools.

Data triangulation was done, as explained by Vos *et al.* (2005). The method is regarded as using more than one data source (interviews, archival materials, observation data etc.), further defined by Guion *et al*. (2014) as a method used by researchers to check and establish validity in their studies by analysing a research question from multiple perspectives and data triangulation as using different sources of information in order to increase the validity of a study.

1.8.4. Data analysis

Sarantakos (2000) describes data analysis as a stage that the researcher will effect, data reduction, presentation and interpretation. For this study thematic analyses were used to synthesise the main outcomes extracted from the relevant studies such as categorising what is stated in the policy, checking the processes and tools used in order to understand the practices applied at the end. Thematic analysis is defined as a qualitative analytic method for "Identifying, analysing and reporting patterns (themes) within data, it minimally organises and describes your data set in detail, however frequently it goes further than this, and interprets various aspects of the research topic"(Braun and Clarke, 2006).

Information collected through interviews and questionnaires was analysed by inductive reasoning and presented in words and narratives. The methodology applied in the data collection, analyses and deductive stages was essential to maintain and enhance the equality and validity of the research. The data analyses advocated by Holliday (2007) were pursued within these five prominent steps:

- Data coding process;
- Division of data into suitable categories;
- Process of tracking;
- Clustering of data into relevant research themes ;and
- Final interpretation process.

In pursuit of the application of the above process the coherent, reliable, complete and quality focused approach proceeding towards constructive research findings and deductions were envisaged and achieved.

1.9. Delimitations and Limitations of the study

There are possible shortcomings that may influence the results of the research or that cannot be controlled. Further to that a researcher can also impose delimitations and limitations in his/her research by choice in order to establish a workable research problem.

1.9.1. Delimitations

According to Simon (2011), delimitations are those characteristics that limit the scope and define the boundaries of the study. The delimiting factors include the choice of objectives, the research questions, variables of interest, theoretical perspectives that the researcher adopted (as opposed to what could have been adopted) and the population chosen to investigate. Therefore, the study is undertaken in the Lepelle-Nkumpi Local Municipality, focusing on the Lebowakgomo WWTW which is situated in the Makurung village. The reason for selecting this community is that the community resides nearby the sewage works and also that the main treatment works is being considered for upgrade and the study can advise on the importance of considering integration of disaster risk assessment on the upgrade of Wastewater Treatment Works and the impact it can have on the community and the environment.

1.9.2. Limitation

According to Simon (2011), limitations are potential weaknesses in the study and are out of the researcher's control, whereas Thomas & Nelson (2001) assert that each and every research or study has limitations. Some of the limitations of the study were total honesty by participants which could not be guaranteed during the answering of the questionnaire as some of the participants did not answer all questions and others gave socially influenced incorrect answers. Conducting disaster risk assessment for both the plant and community is not the purpose of the study and also determining the operational status of the WWTW is not within

the scope of the study. Out of the 13 WWTWs in the Capricorn District only one WWTW was considered for the study.

1.10. Ethical considerations

In every research conducted the researcher should anticipate any ethical issues that may arise, according to Babbie (cited in *De* Vos *et al*., 2004), anyone involved in research need to be aware of the general agreement about what is proper and improper in scientific research. According to Creswell (2003), researchers need to guide and protect their research, safeguarding against misconduct and any impropriety that might reflect on their organisation or institutions and cope with the new challenging problems.

The researcher has the responsibility to respect the rights, needs, values and desires of the participants and also to ensure that the reputation and position of the participant's privacy, especially if the findings of the study could be shared with other people and organisation. It should also be consider that participating in the research project is voluntary, that nobody should ever be coerced to participate in research without their knowledge. Babbie (2001) describes informed consent as "voluntary participation".

The following safeguards were used to protect the rights of the participants:

- The research objective was clearly outlined in writing and articulated to the participants.
- Participants were advised in writing of the voluntary mature of their participation and that they could withdraw from the study any time without penalty and also they will be advised that they can decline to answer any question at any time.
- Participants were informed in writing that the evaluation during research is done only for professional and study purposes and will be done with people directly and professionally involved.
- Information obtained from participants was treated confidentially.
- Credit was given to the work of others by referencing the source of the information to avoid plagiarism.

1.11 Outline of chapters

The study with have the following layout of chapters:

Chapter 1: Introduction: the section provides the background of the study, justification and the focus of the study. It describes the research objectives, research questions and methodology which guide the procedure of the study, **Chapter 2:** focuses on the legislative and theoretical framework with the purpose of giving an insight into the theoretical background**, Chapter 3: Literature Review:** delivers the reviewed literature, and related studies. It also gives insights on key emerging findings and gaps existing from previous studies and related assessments. **Chapter 4: Research Design and Methodology:** documents the design and methodology followed during the research fieldwork. It discusses the instruments used in the measurement of the key variables of the study and explains the sample design, techniques used in data collection and analysis. **Chapter 5: Data Analysis and Discussion:** presents the findings and results of the information collected to determine the level of integration of DRA in the upgrade of the Wastewater treatment plant**, Chapter 6: Summary, Conclusions and Recommendations:** which discusses findings of the study and draws conclusions and recommendations and also provides a summary of the research project in view of the broader research focus.

CHAPTER 2: LEGISLATIVE AND THEORETICAL FRAMEWORK

2.1. INTRODUCTION

Turton (2008) state that the complex world of human settlement is the manner in which hazards are daunting and also the manner in which they develop. The security provided to communities is made even more complex through urban influx, problems of strained management capacity and minimal resources for ensuring human security remains a challenge. Municipalities have a responsibility to deliver quality services to communities and these services should not be viewed as increasing risks but rather reducing risks faced by communities. Previously development initiatives took place without any forethought as to the possible human, property, economic or environmental losses that could occur as a result of major anthropogenic hazards. The process of Integrated Development Planning (IDP) is trying to rectify the situation by ensuring that all development plans have input from the relevant disaster management organisation and other role-players.

The chapter is divided into two 2 parts; Part 1 focuses on the legislations aligned to development of Wastewater treatment works and Part 2 focuses on the Disaster Risk Assessment framework and model, its explanation and application pertaining to WWTW.

2.2. PART 1: LEGISLATIVE REQUIREMENTS

This section analyses the policies that inform the integration of disaster risk assessment for disaster risk reduction on establishment and upgrade of wastewater treatment works. The review of these policies endeavours to describe the policy objectives and means being employed to achieve their objectives. On this note, it is critical that policy objectives be linked with outcomes. The section seeks to measure the progress made (concerning the subject of the study) towards the achievement of the policy objectives. A comprehensive measure of the progress is critical in identifying existing gaps and the causes of failures where there have been shortcomings. This is critical for developing an understanding of regulations and plans that have to be complied with in the establishment of wastewater treatment works planning and development.

Natural and anthropogenic hazards affect everyone, as such the International governments have made commitments to take action to reduce disaster risks and have adopted guidelines such as the Hyogo Framework for Action 2005 - 2015 for the vulnerability reduction of hazards, and the Sendai Framework for Disaster Risk Reduction for emphasis in disaster risk management and disaster risk reduction.

The legislative requirements documents discussed hereunder are according to their sequential order of year of promulgation, looking at what the international policies are alluding to the disaster risk management and risk reduction measures:

2.2.1. International Policy Documents

2.2.1.1. Sendai Framework for Disaster Risk Reduction (SFDR) (2015-2030)

The Sendai Framework for Disaster Risk Reduction is the successor instrument to the Hyogo Framework for Action; SFDR was adopted at the Third UN World Conference in Sendai, Japan, on March 18, 2015. The seven global targets of the framework emphasise the reduction of disaster risk as an expected outcome (SFDR, 2015) focusing on the prevention of new risk , reduction of exiting risk and strengthening resilience as well as setting of guiding targets including the primary responsibility of the State to prevent and reduce disaster risk. All of societies' and all of the state's institutions as well as the principles are involved, giving more focus on both natural and man-made hazards and related environmental, technological and biological hazards and risks and furthermore strongly promote health resilience .

2.2.1.2. Hyogo Framework of Action (2005 -2015)

The Hyogo Framework was adopted in 2005 at the World Conference Disaster Reduction which was held in Kobe, Hyogo Japan. The Framework for Action, as it was referred to, was presented for a period of 15 year (2005 -2015) under the theme "Building the Resilience of Nations and Communities to Disasters" (Hyogo Framework, 2005). The Hyogo Framework of Action (HFA) highlights five priority actions which aimed towards the attaining of the three main strategic goals for HFA (2005) which are:

"To integrate disaster risk reduction into sustainable development policies and planning, to develop and strengthen institutions, mechanisms and capacities to build resilience to hazards and to systematically incorporate risk reduction approaches into the implementation of emergency preparedness, response and recovery programmes"

2.2.2. National policy documents

2.2.2.1. The Constitution of the Republic of South Africa, (Act No. 108 of 1996)

The Constitution of the Republic of South Africa (Act No.108 of 1996), which is the cornerstone of the democracy in South Africa, lays the foundation of a more just and equitable society. Section 24(a) (b) of the Constitution guarantees everyone the right to an environment that is

not harmful to their health or wellbeing and guarantees the right to have the environment protected for the benefit of present and future generations, through reasonable legislative and other measures. In terms of Section 41(1)(b) of the Act, it is the responsibility of all spheres of government to secure safety and wellbeing of the people of the South Africa. The constitution also places the responsibility of securing the safety and health of the environment on all spheres of government. It is therefore imperative to realise that disaster risk management is the primary responsibility of government as well, because the DMA puts emphasis on healthy and safe communities and environment.

With the requirements of the Act it is essential for organs of state to consider the integration of disaster risk in all its activities and projects in order to promote the application of Section 24 of the Constitution.

2.2.2.3. Disaster Management Act (DMA), No 57 of 2002

The DMA provides primarily for an integrated and coordinated disaster management policy that focuses on preventing and reducing disaster risks, disaster impacts' mitigation and preparedness, effective disaster response and recovery. When reviewing the objectives and implications of each policy, it is important to note that policies are interdependent. Noted by Khoza (2008) within the context of disaster management, the DMA plays a coordinating role to integrate the other policies into one goal – disaster risk reduction through community capacity building, strengthening household economies and poverty reduction, and overall, ensure active community participation, political will and sustainability in implementing development oriented risk reduction strategies.

DMA offers an integrated and coordinated disaster management policy that gives attention to prevention and reduction of risks as well as disaster impacts mitigation, preparedness, effective response and recovery. As noted in the National Water Resource Strategy (2004), when developing water related projects, water-related disasters must be managed within the broad framework of the national disaster management policy and legislation.

Sections 20, 33, and 47 of the Act emphasise that each organ of state must promote disaster risk prevention and mitigation and this should be done by means of preventing or reducing the risk of disasters. Determining the level of risk, assessing vulnerability of community and households. The Act promotes the conduct of a comprehensive disaster risk management, actively involving stakeholders at all levels of government as well as the private sector, local communities and civil society. It attempts to implement the legislative framework and to provide coordination and monitoring mechanisms and arrangements. Individual disaster risk

reduction actions and programmes need to be located, rather than treated as discreet, individual measures.

According to the requirements of the Act, it becomes imperative for any water service authority to conduct a risk assessment for the establishment of the wastewater treatment works in order to encourage a risk- avoidance behaviour by organs of state. As outlined in the DWA:DMP (2003), in order to give effects to the fact that Disaster Management is the responsibility of a wide and diverse range of role players and stakeholders, the Act gives emphasis to the need for uniformity in approach and the application of the principle of co-operative governance.

2.2.2.4. Municipal Systems Act (MSA), No 32 of 2002

The provision of the Municipal Systems Act is for the core principles, mechanisms and processes that are necessary to enable municipalities to move progressively towards the social and development. Chapter three of the MSA states the functions and powers of the municipality which are outlined in (Section 11(2) (3) (a-n)). The emphasis on the critical inclusion of DRA is also highlighted in Section 26 of the MSA, which outlines the core components of IDPs as follows in sub-sections (a), (b), (e), and (g):

(a) *The municipal council's vision for the long-term development of the municipality with special emphasis on the municipality's most critical development and internal transformation needs:*

(b) An assessment of the existing level of development in the municipality, which must include an identification of communities which do not have access to basic municipal services;

(e) A spatial development framework which must include the provision of basic guidelines for a land-use management system for the municipality.

(g) An Applicable disaster management plan.

For any project or programme to be considered for implementation it should be included in the municipal IDP and highlighted in the CDM: IDP (2014-2015). The main objective of the IDP is the improvement of coordination and integration of planning, budgeting, and development within the Municipal area. One of the main challenges with WWTWs is that they don't comply with the regulations and also they are established in places near the community. According to Khoza (2008) the IDP is required to establish sustainable safe human settlements, which

merges environmental, economical, land and infrastructural planning, in a multi-stakeholder spatial planning process.2.2.2.5. National Disaster Management Framework (NDMF) of 2005

The objective of the KPA2 of the National Disaster Management Framework (NDMF) (Disaster Risk Assessment, 2005:52)) is to “establish a uniform approach to assessing and monitoring disaster risks that will inform disaster risk management planning and disaster risk reduction undertaken by organs of state and other role players”. When reading Section 2.1 it highlights the idea behind risk assessment which is to examine the likelihood and outcome of expected disaster events and also each organ of state must execute a systematic disaster risk assessments prior to the implementation of any programme.

The upgrade of the wastewater plant should examine the likelihood and outcome of any disaster events that may occur; situations such as contamination of water and health hazards that arise due to the situation should be avoided at all cost.

For the implementation of NDMF to be possible the integrated multidisciplinary approach to disaster risk management is required and this is made possible by the establishing of forums such as the disaster management advisory forums and joint operational committees at all spheres of government to guide and advise on development of any service that the municipality may want to provide. However, the establishment of these bodies alone is not enough, there has to be key indicators against which to measure their progress and/or lack of it when projects are proposed and implemented. Reddy (2010) further states that the importance of considering this section is to improve on the practice of disaster risk assessment through an integrated and co-ordinated approach involving a diverse team of relevant stakeholders.

When projects such as development or upgrade of wastewater plants are proposed by the municipality, an integrated multi-sectoral approach is ideal to allow for environment planning with relevant organs of state to take place. Engineers and other decision-makers within a Water Services Authority, and those working for and on behalf of the Water Services Authority, should be aware of the social and organisational constraints in the provision of sewage treatment plant. The issues relating to these constraints must be addressed in the objectives of any water supply project, keeping in mind that the sanitation arrangements for a community are inextricably bound to the process.

2.2.2.6. The National Water Act, No 36 of 1998 (NWA)

Although the Act has limited reference to disaster management, section 140 c (iii) state that the*:*

*"Objectives of national information systems are: (c) to provide information to water management institutions, water users and the public - (iii) for public safety and disaster management"***.**

However, the act further states that when planning to construct or erecting any wastewater treatment works in South Africa, a Water license from the Department of Water Affairs (DWA) and a Waste license from the Department of Environmental Affairs (DEA) are necessary. Section 2 (g-k) of NWA outlines the purpose as to:

"*Ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account protection of ecosystems, prevention of water pollution, promoting dam safety and meeting international obligations".*

The other objective of NWA is to contribute to public safety in water matters. Before the establishment of water services, consultation and environmental impact assessment must be conducted, this information must be gazetted as per section 26(b (i-iii)) of the Environment Conservation Act, 1989 (Act No. 73 of 1989) to allow communities an opportunity to raise concerns on matters related to their environment and health.

In case the water service poses a risk to the community Section 144 and 145 of the NWA states that water management institutions must use the most appropriate means to inform the public about anticipated risks posed by water quality, the failure of any dam or any other waterworks or any other related matter and also that the water management institution must, at its own expense, make information available to the public in an appropriate manner, in respect of any risk posed by the quality of any water to life, health or property; and any matter connected with water or water resources, which the public needs to know.

The Lebowakgomo WWTW has lots of challenges which are against everything that both the NWA and DMA promotes. The proposed upgrade of the WWTW it is essential to manage the associated risks for good governance and long-term sustainability of the municipal water resources. When health effects occur as the result of environmental action, risk analysis is used as a valuable tool to identify, quantify and manage the corresponding risks according to

the potential- and probable impact on a receiving resource. This will assist the municipality to work within what the Act requires.

2.2.2.7. The National Environmental Management Act, No. 107 of 1998 (NEMA)

NEMA echoes the provision of section 24 of the Constitution and also contains the internally accepted principles of sustainability. Environment determines how feasible future sustainable growth and development are. The fundamental importance in the integration of environmental concerns in development planning and section 38 of NEMA indicate the principle that demands that negative impacts on the environment and people's environmental rights be anticipated and prevented and where they cannot be altogether prevented be minimised and remedied.

One of the emphases by NEMA is that before certain listed projects can be undertaken, an EIA must be undertaken and the Environmental Authorisation must be obtained in line with Section 24 (4) and (5b)(ii) of NEMA. This written decision is called either an Environmental Authorisation or Environmental Refusal and is listed in an Environmental Authorisation (EA).

The purpose of chapter 5 Section 23(1) of NEMA is to address issues pertaining to Integrated Environmental Management (IEM) to promote the application of appropriate environmental management tools in order to ensure the Integrated Environmental Management of activities. The IEM strives for the identification, predictions and evaluation of the actual and potential impact on the environment, socio-economic conditions and cultural heritage, the risks and consequences and alternatives and options for mitigation of activities, with a view to minimising negative impacts, maximising benefits and promoting compliance with the principles of environmental management. The current situation of the Lebowakgomo WWTW indicates that there is a need for the municipality to acquire the IEM for the proposed WWTW, as the Municipality has a responsibility to grow and develop its community with the aim of improving people's lives, but if the environment is ignored, these improvements will only be short lived. Environmental damage or destruction will result in a lower quality of life over time, particularly in vulnerable communities. Capricorn District Municipality has a responsibility to obtain the IEM for the proposed WWTW which will ensure that the WWTW is in compliance with the requirement of the NEMA.

2.2.2.8. The Development Facilitation Act (DFA), No. 67 of 1995 (DFA)

Measures to facilitate the implementation of reconstruction and development programmes and projects in relation to land, land use and spatial development is to lay down general principles

governing land development throughout South Africa, meaning that all development and implementation at all spheres of government should be guided by this Act.

Capricorn Municipality has seen an increase in disaster related cases over the years and these have had some effect on some of the projects initiated by the municipality. As pointed out in the UN Conference (2014) disasters are increasing in frequency and intensity and those exacerbated by climate change are significantly impeding progress toward sustainable development. Evidence indicates that exposure of people and assets in all countries has increased faster than vulnerability has decreased, thus generating new risk and a steady rise in disasters losses with significant socio-economic impact in the short, medium and long term, especially at the local and community level.

Since developmental planning is geared to achieve sustainable human livelihoods in healthy safe environments, this can be equated to disaster risk reduction. Attaining sustainable human livelihoods is at the centre of vulnerability reduction of any hazard. This justifies the disaster management function to play a coordinating role with regard to the integration of disaster risk assessment in the project development of water services. Sections 3(1)(c)(i, and viii) and 3(h) (i-v) indicate that policies that should promote the efficient and integrated land development including sustainable land development meaning the land used or acquired for the establishment of the WWTW should be used within the borders of this Act. This implies meeting the needs of the communities and protecting the environment as well as taking the geological formations and hazardous undermined areas into considerations.

Recurring challenges at the Lebowakgomo WWTW and ignorance of hazards posted by WWTW is badly affecting the communities, households and small and medium enterprises and constitute a percentage of economic losses in the Makurung village. There has to be a broader and a more people-centred preventive approach to risks posed by the wastewater treatment works. Enhanced work to address exposure and vulnerability and ensure accountability for risk creation is required at all levels. More dedicated action needs to be focused on tackling underlying risk drivers and compounding factors, such as demographic change, the consequences of poverty and inequality, weak governance, inadequate and non-risk-informed policies, limited capacity especially at the local level, poorly managed urban and rural development, declining ecosystems, climate change and variability, and conflict situations. Such risk drivers condition the resilience of households, communities, businesses and the public sector. Moreover, it is necessary to continue increasing preparedness for response and reconstruction and use post-disaster reconstruction and recovery to reduce future disaster risk.

2.2.2.9. The Environment Conservation Act, No. 73 of 1989 (ECA)

The Environmental Conversation Act is meant for the effective protection and controlled utilisation of the environment and for matters incidental thereto, for the purpose of sustainable use of the natural environment. Section 23 of ECA, in particular, gives the authorities in this case, the municipalities, the right to declare an area free of developmental activities. A limited development area can only be declared once the local authority or municipality concerned has consulted each Minister charged with the administration of any law, which in the opinion of the municipality, relates to the matter affecting the environment in that area.

Regulations promulgated in terms of section 26 of ECA aim to control activities (including land use, and transformation; water use and disposal, waste and sewage disposal, among others) that may have detrimental effects on the environmental subjected to an Environmental Impact Assessment (EIA) process. The EIA report must be submitted in order to obtain authorisation for the continuation of the development. It is essential for the municipality to consider the requirements of this Act when upgrading the WWTW in order to avoid the reoccurring challenges faced currently.

2.2.3. Local Policy Documents

2.2.3.1. Environmental Management Policy (EMP)

The Environmental Management Plan (EMP) is the document that provides a description of the methods and procedures for mitigating and monitoring impacts or risks, it is recognised as the tool that can provide the assurance that the project initiator has made suitable provisions for mitigation. The EMP contains the environmental objectives and targets which the project initiator needs to achieve in order to reduce or eliminate negative impacts or rather risks. EMPs provide a link between the impacts predicted and mitigation measures specified within the Environmental Impact Assessment (EIA) report and the implementation and operational activities of the project. The objectives of the EMP highlights the important elements of risk reduction measures that should be considered when developing projects within the district municipality, these objectives are aligned to disaster risk assessment and are considered the first step in planning an effective disaster risk reduction programme.

The environmental analysis as stipulated in section 2.4.1 of the CDM IDP (2013-2014) highlights the water challenges amongst which is the overloaded wastewater works with poor effluent quality discharged into the environment. As a way to address the challenges, EMP encourages that each section within the municipality should develop detailed implementation

strategies to address sectorial approaches which takes the form of commitment on issues identified in the State of Environment Report (SOER) together with other issues identified through the IDP process. This means before the upgrade of WWTW the EIA should be conducted and an EMP plan be developed as well.

2.2.3.2. Policy analysis

This analysis is motivated by the need to determine the likely impact of integration of disaster risk assessment in the proposed upgrade of the wastewater treatment plant based on the analysis of the existing national and municipal documents. An in-depth investigation into the requirements as stated in different Disaster Risk Management policies was analysed by the researcher to bring forth the importance of integration of Disaster Risk Assessment.

The analysis, through the application of disaster risk assessment steps helps to display how integration can be achieved. The analysis does not define the operations of the plant as such the purpose was not to conduct risk assessment but rather to understand the likely impact of integration of disaster risk assessment.

This part is meant to provide an assessment of the policies reviewed under Sections 2.2.1, 2.2.2 and 2.2.3. According to Patton & Sawicki (1993), policy analysis is the process that requires a systematic evaluation approach that analysis relevant information at a depth sufficient to give a good idea of the dimensions of the problem. Morse and Skruy (2006) explain it as an analytical approach to solving complex societal problems.

The policy requirements were discussed and enough data and information have been gathered and relevant policy documents were identified and reviewed to warrant this analysis. The analysis aims to share the success of executing the policies identified to address the research questions.

2.2.3.3. Relevance of the identified policy documents

Birkland (2011) states that the interest in public policies is the policies are intended to address problems such as those dealing with the environment, civil rights, economic freedom, or the promotion of personal morality. The subject of integration of disaster risk assessment is a multi- disciplinary one; hence the analyses of multi-policies. Disaster risk assessment requires a holistic approach and so a range of policies have been formulated to guide how it can be done. The identified policies and documents, at both national and local level, are appropriate to address the problem statement of the study. They guide what is required by law and how

to apply the integration using models that are applicable in the South African context. The conclusions reached are discussed hereunder. With regard to upgrade of wastewater treatment works, the national policies and norms are sufficient to guide the implementation.

2.3. Part 2: Theoretical Framework

2.3.1. Introduction

The primary purpose of this part is to present the theoretical underpinning of disaster risk assessment as a tool towards promoting effective disaster risk reduction. Secondly, is to illustrate and examine the key components of disaster risk assessment and lastly, look at a DRA model that can be beneficial for application for the upgrading of the WWTW. Close analysis of hazard, risk and vulnerability will assist in understating the application of the DRA model.

2.3.2. Risk Assessment

Risk Assessment as explained by UNISDR (2004) is a management activity that involves problem definition, analysis and decision-making, research and analysis involving the generation of information on aspects of risk, such as frequency, occurrence, probabilities and effects. According to the ISDR (2009), risk assessment (and associated risk mapping) include: a review of the technical characteristics of hazards such as their location, intensity, frequency and probability; the analysis of exposure and vulnerability including the physical social, health, economic and environmental dimensions; and the evaluation of the effectiveness of prevailing and alternative coping capacities in respect of likely risk scenarios.

The UNISDR (2004) cite that risk assessment can be done as a rapid judgement for simple risk concerns or as a complex process for major risk issues. Hence, the objectives of risk management determine the type, orientation, scope and approach to risk assessment. Depending on the circumstances, risk evaluators can choose from many methods of risk assessment. However, most available approaches are not directly applicable to assessing disaster risks or are limited due to several reasons. These could be due to the narrow scope of disaster losses covered, non-coverage of cumulative vulnerability, inadequate incorporation of subjective risk perception and limited attention to the decision-making phase of risk assessment. Their five points that should be considered when conducting risk assessment:

- Understanding the **Scope** to be able to capture the full range of losses. This should include covering all types of major hazards or threats, whether natural or man-made.

With the infrastructure such as WWTW it may trigger new hazards and multiply exposures, so an all-hazards approach can facilitate the development of a comprehensive financial strategy for disasters that consider the full portfolio of risks.

- Know the **objectives** as risk assessment is conducted for various purposes in the disaster risk management cycle. It is imperative for the project leaders of the proposed upgrade of WWTW to outline the objective of conducting risk assessment for the WWTW, because such an objective may determine a points determining the type and quality of data required, the most suitable methodology to use and appropriate risk communication tools to be developed. The objectives of risk assessment can also vary among institutions in terms of the assets they want to protect, for instance, population, public infrastructure, private dwellings, small and medium-sized enterprises, and farmers.
- It is advisable that the risk assessment process incorporates **Transparency and accountability** and also
- Disaster risk assessment should also involve **Multi-level governance** and **multi-actor participation.** This facilitates the development of an integrated view on the most significant risks facing the institution and enhances the accountability of the whole DRM system.

2.3.3. Conceptual framework for Disaster Risk Assessment

The conceptual framework is aimed at describing the theoretical factors for logical discussions around disaster risk assessments, whereby key components of DRA which are hazard, risk and vulnerability are closely analysed, as explained by Thinda (2009).

2.3.3.1. Hazard

In the UNISDR (2009) hazard is defined as a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage. Hazards caused by WWTW are categorised as technological or man-made hazards which are events that are caused by humans and occur in or close to human settlements and these can include environmental degradation, pollution and accidents.

Smith (as cited in Reddy, 2010) views hazards as a naturally occurring or human-induced process or event with the potential to create loss, that is, a general source of future danger. The other view comprises a more subtle environmental approach in which the limits of human

rationality and the consequent misconception of nature lead to negative outcomes in human interaction with the environment.

As explained in the WRAP (Guideline, 2011), the source of hazards can be found in each step of the wastewater collection and treatment system, so it is important to conduct hazards' identification for wastewater treatment works in order to ensure that adequate protection measures are applied and to identify treatment requirements. The Risks associated with hazards found in the WWTW are described by identifying the likelihood of occurrence and evaluating the severity of consequences. Emphasis by Palm (1990) is that no matter what or where, humans are always subjected to hazards and risk embedded in the environment. Some hazards are caused by human activities that can cause long-term and irreversible damage to the environment.

2.3.3.2. Disaster Risk

Defined as "the potential disaster actual exposure losses, in lives, health status, livelihoods, assets and services, which could occur in a particular community or a society over some specified future time period." (UNISDR, 2009). Whereas UNISDR (cited by Coetzee *et al.*, 2013) disaster risk is explained as the probability of harmful consequences (deaths, injuries, property, livelihoods, economic and activity disrupted or environment damaged) resulting from interactions between natural or human-made induced hazards and vulnerable conditions.

As Wisner *et al.* (2004) stated, in order to understand disaster there is a need to know not only the hazards that may affect the community but also the vulnerability is important. Lindell *et al.* (2006) express that the impact of disaster is determined by three pre-impact hazards, exposure, physical vulnerability and social vulnerability as adapted from the model proposed by Cutter (1996) and Lindell *et al.* (2006) shown below in figure 2.1. This method can assist in integrating of DRA in the upgrade of the Lebowakgomo WWTW.

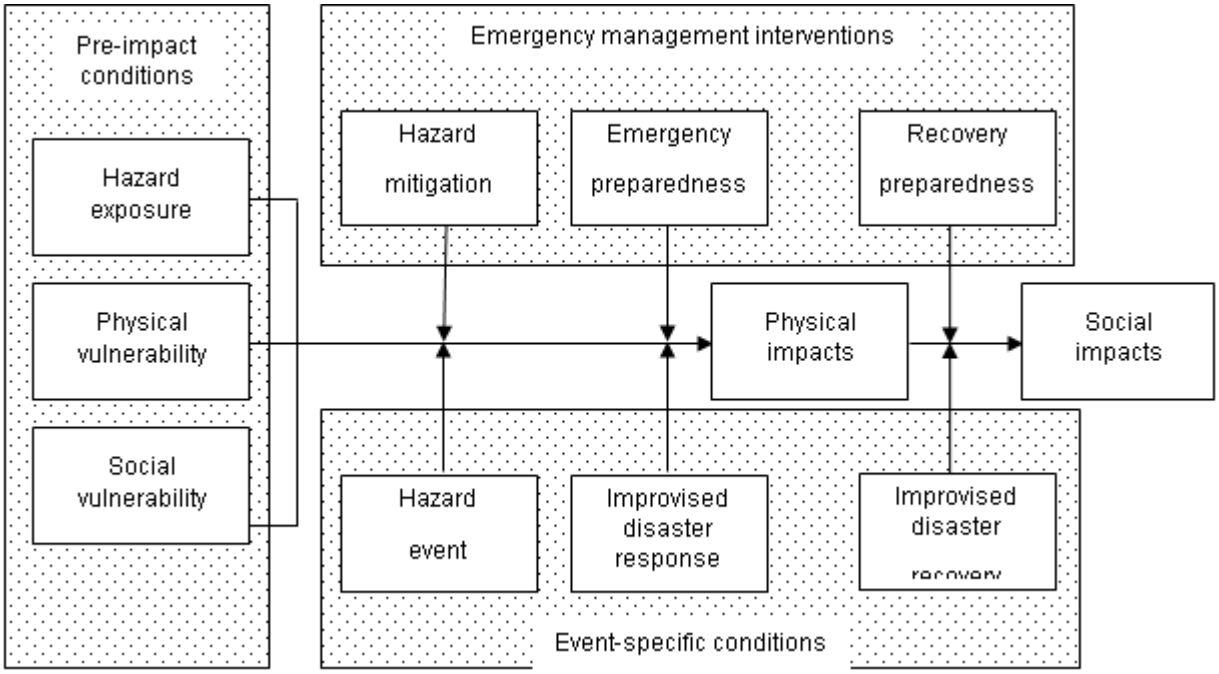

Figure 2. 1: Disaster Impact Model

Source: Adapted from Lindell et al. (2006)

Blaike *et al.* (1994) expresses risk "as the probability of a hazard occurring and possibly culminating in a disaster". Risk is normally expressed as: *Risk = Hazards x Vulnerability, (R= H × V), by IFRC (2000) and Chen et al. (2003).*

Hazards is part of the risk that needs to be understood in order to grasp the complexities of hazards. Foster (1980) outlines that although it is difficult to avoid all risks, societies have progressed in a manner that allows them to function within the specific levels of tolerance for natural and human-made events. Reddy (2010) continues to state that there may be great difficulties is deciding what the acceptable level of risk is, especially if influenced by people's perceptions and interpretations of risk. For example, if the community of Makurung discount the probability of loss or illness from infrequently occurring events related to the WWTW there will be little concern with hazards and the level that they may be placed in. What is apparent is that the key matter in understanding risk and completing risk assessment is based on the different views that people hold on the importance and reaction to different risks within their environment.

2.3.3.3. Vulnerability

Defined as being prone to or susceptible to damage or injury whereas Wisner *et al*. (2004) define it as the characteristics of a group and their situation that influence their capacity to anticipate, cope and recover from the impact of a natural hazard. It can be measured in terms

of the damage to future livelihoods not just what happens to life and property at the time of the hazard event. Other definitions state vulnerability as the “characteristics of a person or group in terms of the capacity to anticipate, cope with, resist and recover from the impact of a hazard” Blaikie *et al.* (1994).

Vulnerability comprises of a combination of factors that determines the degree of which a person’s life and livelihood are put at risk. Holloway (2003) interprets vulnerability as the people-centred approach where important shifts from hazards to focus on socio-economic vulnerability.

2.3.3.4. Capacity

Defined as the capability of people, organisations and systems, using existing skills and resources, to face and manage adverse conditions, emergencies or disaster as informed by the UNISDRT (2009). The capacity to cope requires continues awareness, resources and good management during both crises and non-crises conditions, the measures to cope contribute to the reduction of disaster risks. Now that the conceptual framework of disaster risk assessment and its characteristic has been discussed, the author will now discuss the core issues of Disaster Risk Assessment.

2.3.4. Definition of Disaster Risk Assessment

Disaster Risk Assessment is defined as “A methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend” (ISDR, 2009). Blaiker *et al. (*1994) and Cater (1991) state that disaster risk assessment is commonly recognised as the first and most important step towards the attainment of successful risk reduction strategies and programmes.

The Methodological Framework (2014) indicates that risk assessment guides the optimal allocation of scarce resources available to the phases of disaster risk management; it further elucidates that, by identifying and assessing the likelihood and consequences of potentially disastrous events, risk assessment provides governments with the basis for the prioritisation of investments in disaster risk reduction, the improvement of emergency management capabilities and the design of financial protection strategies in a manner tailored to local conditions, needs and preferences.

The Hyogo Framework for Action 2005-2015 (cited by UNISDR, 2005) indicates that "the starting point for reducing disaster risk lies in the knowledge of the hazards and the physical, social, economic and environmental vulnerabilities and of the ways in which hazards and vulnerabilities are changing in the short and long term, followed by action taken on the basis of that knowledge". It is imperative for the disaster risk assessment to be conducted for the proposed or establishment of any wastewater treatment works as this will assist understanding of the risks posted by the WWTW and also how to prevent or mitigate them.

Looking at the number of recent reports on the status of wastewater treatment works in South Africa, an observer is able to see that the status calls for urgent attention as poor communities turn to suffer the consequence of risk that arises from the poorly maintained or development WWTW. Guzman (2003) highlighted the increasing toll on human lives, infrastructure, economy and environment due to disasters and the insufficient resources to respond and cope with system's claims that the disaster potential of natural hazards and the vulnerability of the social system have worsened, so the need to reduce the impact of disasters now and in the future is imperative.

2.3.4.1. Disaster Risk Assessment Process

Understanding the relationship among hazards, exposure and vulnerability is important to effective disaster prevention, therefore, the disaster risk assessment can be viewed as the first step in planning for an effective disaster risk reduction programme. These would include investigating related hazards and conditions of vulnerability that increase the chances of loss. Disaster risk reduction value can only be realised through sustainable development. The main goal for government is to build sustainable communities with social foundations that strive for an environment that is sustainable for everybody.

The inclusion of the six principles of community sustainability as described by UN/ISDR (as cited by Monday, 2002) offer a collective safety net that has potential to protect the development process against those setbacks that wound development. NDMF (2005) highlights that risk assessment must be undertaken to achieve vulnerability reduction. This can either be an increased sustainability of a development project or programme to support vulnerable households or reduction of potentially harmful consequences associated with industrial, commercial or other developments or to manage high-risk periods and conditions to ensure service and /or business continuity.

The Disaster Management Training Programme (UNDP, 1992) also highlights that development projects implemented without taking into account existing environmental hazards

may increase vulnerability to either manmade or natural disasters. According to the UNDP (1992), the comprehensive risk assessment should consist of the following steps:

- *Step 1: Understanding of current situation, needs and gaps: assessing what already exists, to avoid duplication of efforts and build on existing information and capacities. This should be done through a systematic inventory and evaluation of existing risk assessment studies, available data and information and current institutional frameworks and capabilities.*
- *Step 2: Hazard assessment: identifying the nature, location, intensity and likelihood of major hazards prevailing in a community or society.*
- *Step 3: Exposure assessment: identifying population and assets at risk and demarcate disaster prone areas.*
- *Step 4: Vulnerability analysis: determining the capacity (or lack of it) of elements at risk to withstand the given hazard scenarios.*
- *Step 5: Loss/impact analysis: estimating potential losses of exposed population, property, services, livelihoods and environment, and assessing their potential impacts on society.*
- *Step 6: Risk profiling and evaluation: identifying cost-effective risk reduction options in terms of the socio-economic concerns of a society and its capacity for risk reduction; and also*
- *Step 7: Formulation or revision of DRR strategies and action plans: including setting priorities, allocating resources (financial or human) and initiating DRR programmes.*

The importance of disaster risk reduction and the concept of integration in the disaster management cannot be overemphasised. Integrating disaster risk assessment into project development is also emphasised in the National Disaster Management Framework under the heading integration of disaster risk reduction with spatial development planning. It states, *"Disaster risk is driven by both hazards and vulnerability factors reflected in spatial development framework. In addition, disaster risk assessment findings, along with monitoring information on disaster occurrence are directly applicable to spatial development planning. For this reason, the three spheres of government must establish mechanisms in association with spatial planners in both spheres to ensure that relevant spatial information informs disaster risk reduction planning. They must also ensure that verified risk information is incorporated into spatial development plans and maps",* stated in section 39(2) (a):104) of the National Disaster Management Framework (South Africa, 2005)

Disaster Risk Reduction for Sustainable Development in Africa (2004) indicates that development can cause or reduce disaster risks. Failed development contributes to poverty because development objectives are not realised and disaster reduction intervention also fails. The effects of failing to integrate disaster risk assessment in the proposed upgrade of WWTW can be detrimental to municipalities. Lately the government has witnessed a number of protests due to lack of service delivery or due to inferior services delivered. Linking disaster risk assessment with project development will include looking at project planning, design and implementation cycle. Disaster Risk Reduction for Sustainable Development in Africa (2004) indicates that information from the problem identification stage of disaster risk assessment provides input into the preliminary risk identification and determination is linked to the project's formulation phase.

Van Niekerk (2006) indicates that each sphere of government, including sector departments, have the responsibility to engage in disaster risk reduction activities. By doing so each sector of government and municipality should ensure that all hazards, vulnerability and capacity are taken into consideration in project development and execution, and also ensure that all high risk development is identified before projects' implementation so that remedial actions are taken, when projects are developed in areas that are disaster prone or if projects developed are of a low inferior quality the results may be devastating and costly.

Emanating from the discussions above it is important to recognise that disaster risk assessment needs to reflect the dynamic and complex issues of society, economy and demographic make-up of the community and its infrastructure to inform appropriate risk reduction strategies. At the end the DRA model used in creating an enabling the environment and in facilitating the desired outcomes becomes a key instrument towards a structured and pro-active risk reduction intervention.

This calls for the assessment of the South African Risk assessment model and how it can be integrated in the upgrade of the Wastewater Treatment Works.

2.3.4.2. South African Risk Assessment Model

The National Disaster Management Framework (South Africa, 2005) sets out the general guidelines for undertaking disaster risk assessment in South Africa. The core principle of the model is to emphasise the existing disaster risk reduction concerns and practices. The National Disaster Management Framework (2005) highlights the following as essential for disaster risk assessment when conducted with good monitoring systems:

- Effective Disaster Risk Management and Disaster Risk Reduction.
- Sustainable Development planning.
- Identification of potential threats that can undermine a development's success and sustainability making it impossible for appropriate DRR measures to be incorporated into the project design prior to implementation.
- Shaping focused DRR programmes for specific threats.
- Identifying high-risk periods and conditions.
- Activating preparedness and response actions.

2.3.4.3. Key Principles of the model

The DMA's (South Africa, 2005) requirements for priority setting with respect to disasters that are likely to affect South Africa are set out in sections 20, 33 and 47. These sections underscore the importance of disaster risk assessment to guide national, provincial and municipal disaster risk reduction efforts, including disaster risk management planning. KPA2 (disaster risk assessment) of the National Disaster Management Framework (South Africa, 2005) highlights the requirements for implementing disaster risk assessment and monitoring by organs of state within all spheres of Government. Furthermore, Van Niekerk (2006) shows that the outcomes of disaster risk assessments should directly inform the development of disaster risk management plans.

Disaster risk assessment must be executed by an organ of state in the following instances:

- Prior to implementation of any disaster reduction, preparedness or recovery programmes;
- As an integral component of the planning phase for infrastructure development;
- As an integral component of planning phase for significant initiative that affects the natural environment;
- When social, economic, infrastructure, environmental, climatic or other indicators suggest changing patterns of risk that increases the likelihood of significant disaster impacts;
- It forms an integral part of the decision and policy-making process and requires close collaboration among various parts of society.

The idea of conducting disaster risk assessment is to inform effective disaster planning and risk reduction strategies, DRA should be conducted in a systematic and sequential manner (Reddy, 2010). Again indicated in the Disaster Management Act (57 of 2002), DRA should be

successively integrated into the development plans of any sphere of government so as to ensure that it is considered as the strategic planning and resource allocation process.

NDMF (South Africa, 2005) shows that as the means of increasing capacity of communities towards minimising the risk and impact of disaster, community based disaster risk assessment is essential. The active engagement of the communities improves the quality of the DRA findings and increases the likelihood of community ownership. As mentioned by Jeggle (2001, 2007) and De Guzman (2003), DRA requires a driver's team of experts and relevant stakeholders, for example, the upgrade of WWTP requires involvement of community based organisations, various disciplines and expects in the field.

The most important part of the DRA is that it should be reliable and valid in order to inform disaster risk reduction planning as highlighted in NDMF (South Africa, 2005). Quality assurance prior the implementation of the outcome is essential.

2.3.4.4. Characteristics of the model

The Disaster Risk Assessment model used in South Africa reflects the various stages of the disaster risk assessment process DMA (South Africa, 2002) wherein:

- Stage 1: Comprises of identifying the specific disaster risk to be assessed
- Stage 2: focuses on analysing the disaster risk concerned
- Stage 3: requires an evaluation of the disaster risk being assessed, taking more comprehensive assessment of specific thread and establishes priorities for action
- Stage 4: Informs on monitoring of disaster risk assessment, effectiveness of risk reduction and updating information, and disseminating this information to all stakeholders.

Figure 2.2., as adapted from disaster management national framework, (2005) below, displays the basic stages undertaken in the disaster risk assessment process

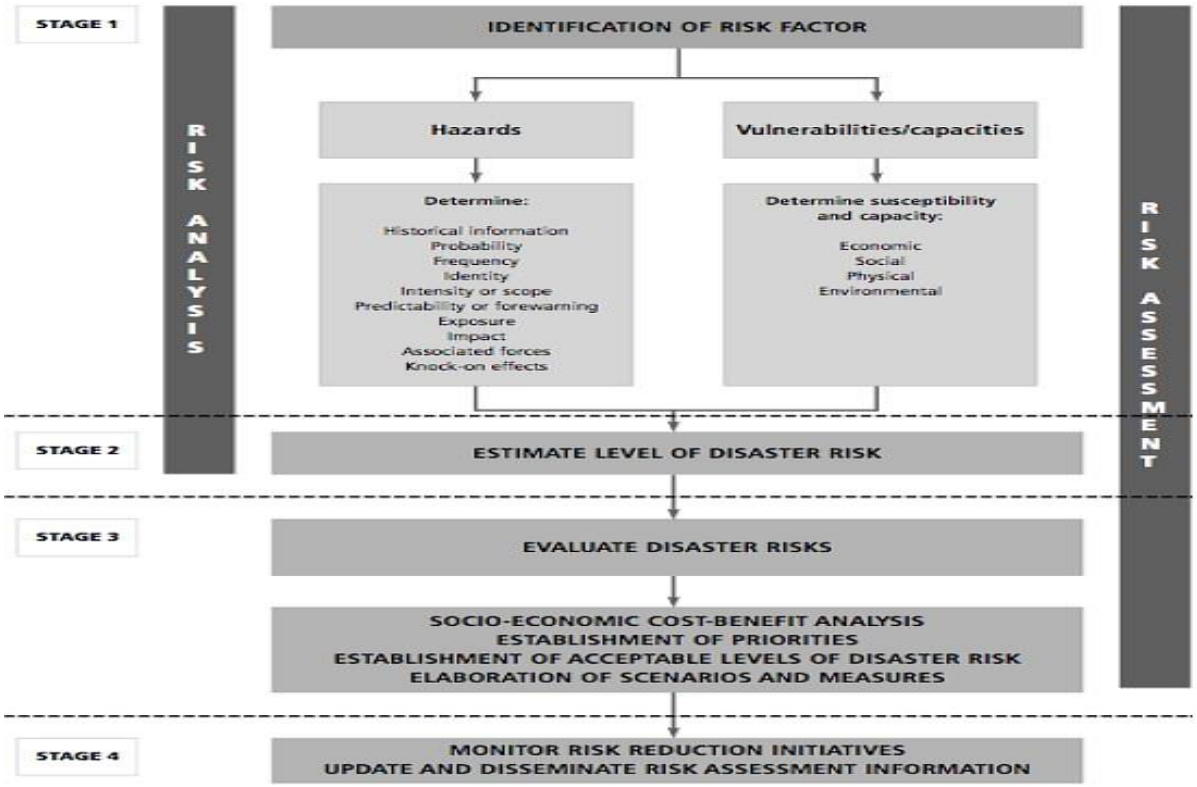

Figure 2. 2: The Stages of a Disaster Risk Assessment Process

Source (Disaster Management National framework, 2005)

To further emphasise the framework above, the requirements of each stage are briefly described below within the context of NDMF (South Africa; 2005)

Stage 1: Identification of specific disaster risk

This stage involves identifying and describing the hazards with respect to frequency, magnitude, speed of onset, affected area and duration. It further outlines the necessity to identify the vulnerability to determine susceptibilities and capacities and this is done by describing the vulnerability of people, infrastructure, services, economic activities and natural resources exposed to the hazard. Also estimating the likely losses that may result from the hazards on those that are vulnerable and to estimate all likely consequences and impacts. Preparing to identify the relevant capacity, methods and resources available to manage the risk. As soon as the identification of hazards, and determination of vulnerability and capacity is done, it is crucial to consider the level of disaster risk.

Before the proposed upgrade of the WWTW a need to apply the first stage of the disaster risk process is essential, determine the hazards associated with the treatment works, the vulnerability of the community and their capacity to cope with the effects of the WWTW.

This is the first phase of disaster risk assessment, the stage identifies the disaster risk problem to be addressed and characterised and the problem placed within the context of the complex factors that constitute the nature and scope of the risk concern. It also involves determining the goal of the risk assessment process. To imitate the development context of the risk problem, the scope of risk assessment should cover relevant development concerns, not just risk issues. This promotes mainstreaming disaster risk assessment in development.

For the risk problem to be addressed, risk assessment requires a conceptual model of risk relationships and the determination of resources and planning needs for the assessment process. In case of the Lebowakgomo WWTW the municipality developed W_2RAP a primary risk management tool used to enhance municipal wastewater service. It is important find a way to infuse the disaster risk assessment tool and wastewater risk assessment abatement. For this to happen contribution, participations and partnerships with a variety of development sectors and disciplines are required for effective problem definition.

According to UNISDR (2004), this will help ensure that disaster risk problems issues are known within the development community and are shaped by the interaction between members of the development and disaster management communities. For the success of Risk assessment planning, steps depend on establishing or maintaining an effective process for stakeholder participation. Such involvement is very important in promoting realistic assessment through incorporation of subjective risk assessments, ensuring that risk assessment is responsive to the circumstances of target groups. These efforts engender ownership of the process and can encourage the utilisation of traditional and local knowledge.

Stage 2: Analysing the disaster risk

Throughout this phase the focus is on the estimating the level of risk associated with specific threat to determine whether the resulting risk is a priority or not. Estimating the level of risk is done by matching the likelihood of hazard with its expected impact or consequences.

Research and analysis involve identifying and determining the parameters of risk, including the location, intensity and likelihood of the hazard and elements at risk. It also comprises of determining the vulnerabilities of the elements at risk and their coping capacities. Cited from UNISDR (2004), the basic issues to address in undertaking hazard and vulnerability assessments include the following checklist:

- major hazards that affect the target group or sector, how they occur and their frequencies;

- extent of losses, damage and injuries arising from the hazard;
- communities most vulnerable to the negative effects of the hazard;
- extent to which communities are vulnerable to hazards and the major factors that underlie or condition this vulnerability;
- how those affected communities cope with disasters.

A key step in mainstreaming disaster risk assessment in development is to link disaster risks directly to development risks by focusing on the relationships between risk characteristics and the development conditions and status of target communities. Doing this effectively requires detailed consideration of the issues and emphasis on vulnerability and capacities of affected people during the risk analysis stage.

Here the analysis of the identified and calculated risk from the WWTW is crucial, matching the likelihood of the identified risks with impact or consequences it will have on the community of Makurung.

Stage 3: Evaluating the disaster risk

This stage necessitates further prioritisation of disaster risks when there are multiple threats to assess against the background that there are limited resources and budgets. A Smith (2004) state that Risk evaluation is essential as it is not possible to address all disaster risks at the same time. Only those that are classified as high priority should be given immediate attention.

At this stage the prioritisation of the analysed risk is important. The municipality need to then evaluate the resources available visas the priority of the disaster risk. The Municipality must align its budget according to the priority list, using the Risk Matrix to prioritise may assist the municipality to know which area to give attention to first.

Decision-making on how to address disaster risks consists of three components: risk evaluation, risk characterisation and risk communication. Cited from UNISDR (2004):

- The risk evaluation component encompasses the following activities:
    - setting criteria for cost-benefit and other decision models,
    - establishing priorities against which decisions would be judged,
    - comparing risk profiles with the decision criteria to determine acceptable and unacceptable risks,
    - elaborating scenarios, options and measures to address unacceptable risks, and

    - evaluating and selecting measures to adopt.
- Risk characterisation presents the technical accuracy of the analysis, while highlighting any uncertainties, conflicts or alternative viewpoints and indicates any additional requirements for data or analysis. Risk characterisation also provides important information for communicating the results of the risk assessment to risk managers and other stakeholders of the process
- Risk communication is an iterative process of constant exchanges among relevant parties with the intention of bringing congruence between actual, perceived and estimated risks. With respect to mainstreaming risk assessment in development, risk communication provides the means for interaction among stakeholders in the risk assessment process as well as between the risk and development communities. The cultivation of a culture of risk prevention in both risk management and development undertakings depends critically on information and communication.

Stage 4: Monitoring of disaster risk reduction initiatives, and update and disseminate disaster risk assessment

This stage comprises of ongoing monitoring to measure the effectiveness of the disaster risk reduction initiatives, identify changing patterns and new developments in risk profiles, and updating and disseminating information for the purpose of disaster risk management. Here the municipality has to draw disaster risk reduction majors; this can be in form of policies, contingency plans.

To emphasise the integration of disaster risk assessment in project development can assist organs of state to reduce costs and waste of energy, as Knipe *et al.* (2002) states "organisations where people, teams, projects and systems are not pointed in the same direction as each other, its turn to strategy creates wasted resources in budget and human energies". The study clearly highlights the importance of conducting disaster risk assessment and integration of the findings in the projects' development cycle, in terms of the disaster risk management "integration is crucial for disaster risk reduction strategies and projects to function successfully" (Hoogstad and Kruger, 2008:10).

Disaster risk assessment is an essential requirement for the full arrangement of DRM plans and policies that contribute to overarching governmental objectives of reducing society's vulnerability and enhancing its resilience. It is used to identify and understand all possible risks and to create the opportunity to apply new thinking and to implement innovation towards controlling and prevention. The results of disaster risk assessment may be used to inform and

educate all relevant stakeholders and units about the most important threats society and the project face and thereby contribute to a culture of risk amongst communities, individuals and project implementers. The municipality needs to identify the broad range of natural and man-made hazards and assess those that could cause significant damage and disruption to the municipal vital interests. Before any upgrade or development of WWTW can be considered a proper disaster risk assessment is required, outlined on the Methodological Framework (2014). A holistic approach is important to uncover complex risks that may arise from vulnerabilities and interdependencies across sectors. Documents such as Risk-based regulations (DWA, 2011) seek to establish a scientific baseline comprising of the highest risk areas within the wastewater services' value chain and to use continuous risk measurement and reporting to ensure that corrective measures be taken to abate these high and critical risk areas.

2.3.4.5. Integration of DRA by other sectors

At local level, the link between sector departments such as town planning, agriculture, land-use management, environmental management, IDP and disaster management is not pleasing. There are no effective communication and integration. The cooperation between the Environmental Management, Disaster Management and Infrastructure Unit is lacking making each unit to work in isolation. Hence monitoring of residential land change is unsuccessful.

The existing prominent discrepancy is that there are clear guidelines for the integration of disaster risk assessment but these guidelines are not considered. The imperative multi-disciplinary nature of roles of line functioning departments is not well defined. The existing structures meant to deal with disaster risk management issues are well thought out, however, there is a need to foster commitment from all sector departments involved.

Having to realise that the wastewater treatment plant is a priority three hazard, the CDM IDP 2006–2011 recommends the leading agency in wastewater management to be the infrastructure water quality unit. The other relevant department in this regard is the infrastructure water design and planning environmental management. These departments bear the responsibility for ensuring effective and well-maintained wastewater treatment plant design structures. From an engineering perspective, the engineers are in a better position to make wastewater management regulatory recommendations to the municipal Organizational and Management Structure.

From the above it is clear that these responsibilities can be referred to the partnerships between government and the private sector. The government should provide institutional and

political mandate and directive, whilst the private sector can bring in technical and possibly managerial skills. The public needs to be involved by being fed the relevant information about the operations of the wastewater treatment works in their area, what can be done to address them and allowed to voice their input on the matter.

Table 2. 1: Broader roles of critical sectors in the integration of DRA in WWTW

SECTOR DEPARTMENT		**FUNCTIONS RESPONSIBLE FOR**
DWA		To ensure protection, use, development, conservation, management and control of all water resources, included is WWTW, within the legal framework of National Water Act 36 of 1998
LEDET		To provide authorisation for the development of the project
CDM	Design and Planning	To develop terms of reference that are clear for establishment of WWTW in line with legal requirements
	Water Quality	To monitor and test the wastewater (effluent) being released into the river to ensure that it meets the national standards.
	Operations and Maintenance	To ensure that all machinery at the WWTW is working order in case of breakdown to respond timely.
	Environmental Management	To manage the environment and natural resources for the benefit of present and future generations
	Disaster Management	To coordinate and advocate for integration of disaster risk reduction within the municipality for development programmes.

The sector departments highlighted above should be involved in wastewater treatment plant operations and management. Their broader roles and responsibilities on the subject are also known, but the efficiency of each sector department in implementing its functions as well as the integration of these functions are a cause for concern.

The effects of the Wastewater treatment works do not have political boundaries. Moreover, activities from the plant can affect stream characteristics in another municipality. These

impacts can be far-reaching. A common case is the effluent growth problem in the Chueniespoort Dam in Lepelle-Nkumpi, which source is claimed by some to be from the sewerage effluent.

2.3.4.6. Some advantages of disaster risk assessment

Institutionalising disaster risk assessment has many advantages because of the efforts involved are important development management tools on its own. Disaster risk assessment is useful for several purposes, including:

- making a risk-responsive physical and economic policy,
- regulatory framework for development,
- promoting participatory development through public education and awareness, private sector and business decision-making, and
- Risk sharing and transfer interventions.

2.3.4.7. Limitations of risk assessment

Risk assessment does not always result in a conclusive or compelling outcome regarding the importance of risks and appropriate corrective measures acceptable to all stakeholders. These difficulties could be due to poor identification of the risk problem or target population, why the problem is a concern and how stakeholders perceive the problem. Other constraints could arise because of insufficient data or resources for adequate assessment, or the difficulty in attributing responsibility for disaster risks emanating from different locations and sources.

The assessment outcomes may also not be politically acceptable since risk management is essentially a political process. These difficulties underscore the fact that risk assessment is only one of many decision tools that should be applied to any given disaster risk situation and that the process must be part of a broader risk management strategy. However, it is essential to minimise these pitfalls in the risk assessment process itself, partly by adopting suitable methods.

2.4. Conclusion

The chapter highlighted the thorough analysis of legal documents pertaining to disaster risk assessment, wastewater and other related matters. This chapter showed how important it is for policies to complement each other and also implemented holistically to include all sectors and stakeholders at all spheres of government. It is imperative for the municipality to consider

this model, as the focus is more on the disaster risk assessment, so that it can avoid overlooking the disaster risk reduction initiatives during planning and budgetary processes. Fortunately this model encourages an integrated planning through multi-disciplinary and multi-sectoral process which can be applied during the upgrade of the Lebowakgomo WWTW.

CHAPTER 3: LITERATURE REVIEW

3.1. Introduction

This section aims to review a body of research and establish how other research has investigated the subject of integration of disaster risk assessment in the upgrade of wastewater treatment works. As noted by Mouton (2001), a literature review is meant to discover the most recent and authoritative theorising about the subject in order to find out the most widely accepted empirical findings in the field of the study and also ascertain the most widely accepted definitions of the key concepts in the field.

3.2. Explanation of Wastewater

Van der Merwe-Botha and Manus (2011) explain Wastewater as the liquid or water-carried waste that is removed from formal and informal residences, institutions, commercial and industrial establishments, together with the groundwater, surface water, storm water and potable water. It is the water that has been adversely affected in quality by anthropogenic influence. Municipal wastewater is usually conveyed in a combined sewer or sanitary sewer, and treated at a wastewater treatment plant.

The main reason for wastewater collection and wastewater treatment is to ensure that the effluent discharged into the environment does not pose unacceptable risks to the human health and natural resources. Wastewater can be divided into two types,

- **Industrial wastewater -** This is discharged by manufacturing processes and commercial enterprises. Processed wastewater can contain rinse waters including such contaminants as residual acids, plating metals and other toxic chemicals.
- **Domestic or sanitary wastewater**- This comes from residential sources including toilets, sinks, bathing and laundry. It can contain body wastes containing intestinal disease organisms.

3.3. Types of Wastewater treatments plants and associated risks

The Green Drop 2009 and 2011 assessments were used to evaluate the various technologies (treatment processes) applied by municipalities across the nine provinces in South Africa (DWA 2009; DWA 2011). A framework was developed to categorise the various technologies, consisting of 16 technology types. Further simplification of the technology types was done by reducing the various technology types into three generic technology groups:

i) Activated sludge processes and variations thereof,
ii) Trickling Bio filters,
iii) Pond and lagoon systems

Ngwenya (2006) highlights that a number of incidents of water pollution due to sewage discharged from municipal wastewater and sewage treatment plants were recorded. The major problem is that municipal raw or treated effluent is discharged and channelled into receiving waters such as streams, rivers and underground water. This raw or treated effluent can introduce a potentially infectious agent into water that may be used by the rural communities, resulting in incidences of water borne diseases.

A number of investigations conducted indicated that wastewater and sewage effluent from treatment plants and deteriorating infrastructure are a major source of pollution, contributing to a number of pollutants found in water resources. Groundwater is also at risk of being polluted by leachate discharging from stationary effluent leaking from treatment plants (Ngwenya, 2006). On the other hand, Turton (2008) highlights that there is an increasing concern regarding the quality of South Africa's water resources and that the contribution of untreated effluent or poorly treated wastewater discharges to the deteriorating water quality.

In most instances municipal raw water or treated effluent is discharged from specific point-sources and channelled into the receiving waters such as streams, rivers, lakes, ponds and ground water. Looking at the situation at Lebowakgomo Wastewater plant the effluent is discharged at Ga-Chuene (Mamaolo) river where the Makurung community and animals are drawing water. The challenge is that communities and animals are exposed to a wide range of potentially infectious agents that they can get from the water which may result in incidences of waterborne diseases with far reaching socio-economic implications.

In 2011 a report by the Star newspaper, picture below, highlighted concerns by the Makurung community. The report highlighted the dangers that the community are exposed too. The article highlighted that some residents of Makurung and neighbouring villages are drinking contaminated water after a sewage discharge into the Mamaolo River, from which some of the community members are drawing water. It further stated that the villagers accused the Capricorn District Municipality of channelling untreated sewage to the river because it fails to treat it at its plant. See Figure 3.1 below:

Figure 3. 1: Animals grazing near a stream formed by wastewater discharged to the river:

S**ource (IOL, 2016)**

In 2005 reports by The Mail and Guardian highlighted the outbreak of cholera in Delmas, Mpumalanga Province, where there were 380 cases of diarrhoea, 30 suspected cases of typhoid fever and 9 confirmed cases. The outbreak originated in the town's water supply, suspected to have been contaminated with human faeces. According to Gathiram *et al*. (1992), a number of outbreaks of typhoid fever in many parts of South Africa were reported, including KwaZulu-Natal and Limpopo. Other cases were reported in the Eastern Cape by the UKhahlamba District Municipality (2008) where 94 patients were treated for diarrhoea symptoms while 18 babies died. These incidents were ascribed to the microbiological water quality attributed to sewage spills from catchment based land activities. Betaman (2009) highlighted that a raw sewage spill from Beit Bridge into the Limpopo River and a total breakdown in that Zimbabwean town's water treatment caused the worst of the recent cholera outbreaks in Southern Africa. The spillage epitomised an infrastructural breakdown in Zimbabwe that cost at least 3 037 lives and infected 65 700 people there and in South Africa over 3 months.

A number of studies investigating the wastewater problems traced the pollution of water resources to design weakness, overloaded capacity and faulty equipment and machinery of the municipality and sewage treatment plants and also non-consideration of disaster risk assessment (Momba *et al.,* 2006). The Capricorn District preliminary wastewater risk abatement plan developed by CSIR outlined a number of challenges and recommendations with the WWTW. It does not reflect the importance of the municipality's and community's engagement.

Failure of the wastewater treatment plant and the impact of the results of such failure has a major impact on the surrounding community as they are the ones at the receiving end. The integration of disaster risk assessment in the development and upgrading of the wastewater treatment plan is essential for the following reasons,

- The designer needs to determine the current population and then estimate the future expected population depending on estimated growth of the population.
- The figure for the existing population should be crosschecked against the size of the sewerage area and the likely population density in the various zones. Particular care is needed in establishing the full number of contributors in all areas.
- Forecasting the future growth of the population and estimating the design by taking all possible factors into consideration.

3.4. Understating disaster risk assessment

UNISDR (2004), state that there is a great need for managers and other stakeholders involved in development to understand how to identify and address risk and for them to do that effectively. They have to understand the actual harm of past disasters and the potential threats posed by pending hazards and this can only be done through risk assessment. Disaster risk assessment is the process of collecting and analysing information about the nature, likelihood and severity of disaster risks. According to the UNDP (2010), risk assessment is a process to define the nature and extent of such risk, by analysing hazards, evaluate existing conditions of vulnerability that collectively could potentially harm people, property, services, livelihoods and the environment on which they depend. On the other hand, UNISDR (2004) states that the process of disaster risks assessment include making decisions on the need to prevent or reduce disaster risks. This looks at what risks to address and the optimal approach to tackling those risks found to be unacceptable to the target groups and communities. As outlined in the Disaster Management Framework (2005), disaster risk assessment stresses proactive management of disaster risk through reduction of both prospective and accumulated risks, hence, it covers assessment of risks from future hazards as well as those that have already occurred.

UNISDR (2004) highlights that development takes place within the context of specific sectors but disaster risk management is not a stand-alone sector or programme. Development is a mechanism to address multi-faceted issues that constitute vulnerability. Thus, disaster management is a multi-sectoral and inter-institutional process. Mainstreaming disaster risk assessment in development therefore involves integrating it in specific development sectors.

Integrating risk assessment in the water management sector, in this case wastewater treatment works, involves considering three generic issues:

- How the activities of the sector impact disaster risks;
- How to apply risk assessment in planning the sector's development;
- Any sector-specific considerations in mainstreaming disaster risk assessment in development strategies and programmes.

Statics show that the majority of the disasters that occur in Africa originate from water–related threats (UNISDR, 2004). It is important for the sector to consider the extent to which risk is considerable and mainstreamed in water resources management in order to institutionalise disaster risk management. Disaster risk assessment is one of the first steps in planning an effective disaster risk reduction programme. Where the risk of disasters exists, the disaster risk must be thoroughly assessed first so that disaster risk management plans can be developed to address the findings of the assessments. Disaster risk assessment scrutinises the likelihood and outcomes of expected hazard events, including the vulnerability conditions that increase the chances of loss. Below the study will look at some of the steps that should be followed when conducting disaster risk assessment.

3.5. Disaster Risk Management

3.5.1. Concept of Disaster Management (DM)

The process of disaster management forms part of the legal mandates that are laid down by the Disaster Management Act 57 of 2002. Van Niekerk (2006) states that the Disaster Management Act has a distinct disaster risk reduction focus and places considerable emphasis on the development of adequate structures, planning and integration and coordinated disaster risk management activities on all spheres of Government.

Van Zyl (2006) stated that the management of risks is one of the greatest challenges of the 21st century. As the population grows, economic and environmental losses due to natural and human–made disasters are also increasing and the need to provide for a systematic approach to the management of risks is essential. Disaster Management has become a focal point for scientific endeavours to achieve a better understanding of the hazards that shape our natural and built environments and to set standards to bring about a safer world.

Disaster Management is defined by the DM Act (2002) as the continuous and integrated multi-sectoral, multi-disciplinary process of planning and implementation of measures aimed at

preventing or reducing the risk of disasters; mitigating the severity or consequences of disasters; emergency preparedness; a rapid and effective response to disasters; and post-disaster recovery and rehabilitation. The main aim of disaster management is to reduce the vulnerability of those communities most at risk through improved access to services, development opportunities, information, education and empowerment and also to involve communities at all levels to uphold the optimal use, conservation and protection of the natural resources of the country (Van Zyl, 2006), the author further explains that disaster risk management aims to express the likelihood that a household, community, city or any area will be able to anticipate, resist or recover from the losses sustained from a hazard or other threat, without external assistance. Whereas Technical Cooperation (cited by Hoffmann, 2002) expresses disaster risk management as a series of actions (programmes, projects and/or measures) and instruments expressly aimed at reducing disaster risk in endangered regions and mitigating the extent of disasters.

- The following are the elements of disaster risk management. These elements are intended to strengthen the management of risks and the consequences of disasters or to reduce losses:Risk assessment is contained in three distinct steps,
    - The identification of hazards likely to result in disasters;
    - The estimation of the risks of such events; and
    - The evaluation of the social and economic consequences of the derived risk.

Hoffmann (2002) indicates that risk assessment is the outcome of the investigation of the cause-effect matrix between hazards and vulnerabilities.

The following Figure 3.2 indicate the disaster continuum and it is further discussed below

***Figure 3. 2**: Disaster Continuum*

Source:** http://www.polity.org.za/polity/govdocs/green_papers/disaster/gpdm2-3.html, **(2017)

- Prevention or reduction of risks

Actions designed to safeguard or reduce the intensity of a hazardous event so it does not become a disaster.

- Mitigation

Actions taken well in advance of a hazard alert to minimise the severity or consequences of disasters and the vulnerability of communities and households to a known or expected threat.

- Preparedness for emergencies

Advance measures taken to predict, respond to and manage a hazard event. Measures that prepare people or institutions to react appropriately before, during and after an emergency

- Response / Relief to disasters

Measures taken to lessen instant adversity and meet basic needs for shelter, water, sanitation, health care as well as search, rescue and protection of those affected.

- Recovery / rehabilitation - post disasters

Process undertaken by a disaster-affected community to fully restore itself to its pre-disaster level of functioning and which enables it to become even more disaster-resistant.

The link between disasters and development is now apparent to everyone, and disaster risk management is gaining increasing currency as an effective form of investment (Hoffmann, 2002). Van Niekerk (2002) describes Sustainable development as – “the ability to meet the needs of the present without compromising the ability for the future generations to meet their need”. For the municipality to build and promote a sustained community the balance between disaster risk management and development should be preached always. Furthermore, for a municipality to build sustainable communities thriving from generation to generation with a social foundation that provides for health, respects cultural diversity, is equitable and considers the needs for future generations the inclusion of disaster reduction strategies is imperative.

3.5.2. Disaster Risk Reduction

Disasters often follow natural hazards. A disaster's severity depends on how much impact a hazard has on society and the environment. The scale of the impact in turn depends on the choices made for the community’s lives and for the environment. These choices relate to how food is grown, where and how houses are build, the kind of government in charge, the financial

system and what is taught at schools. Each decision and action makes communities more vulnerable to hazards - or more resilient to them.

It is helpful to note that Figure 3.2 below promotes the complete continuum of disaster risk management. The different elements of disaster risk management namely risk assessment, awareness, reduction, response and recovery are displayed in a useful manner.

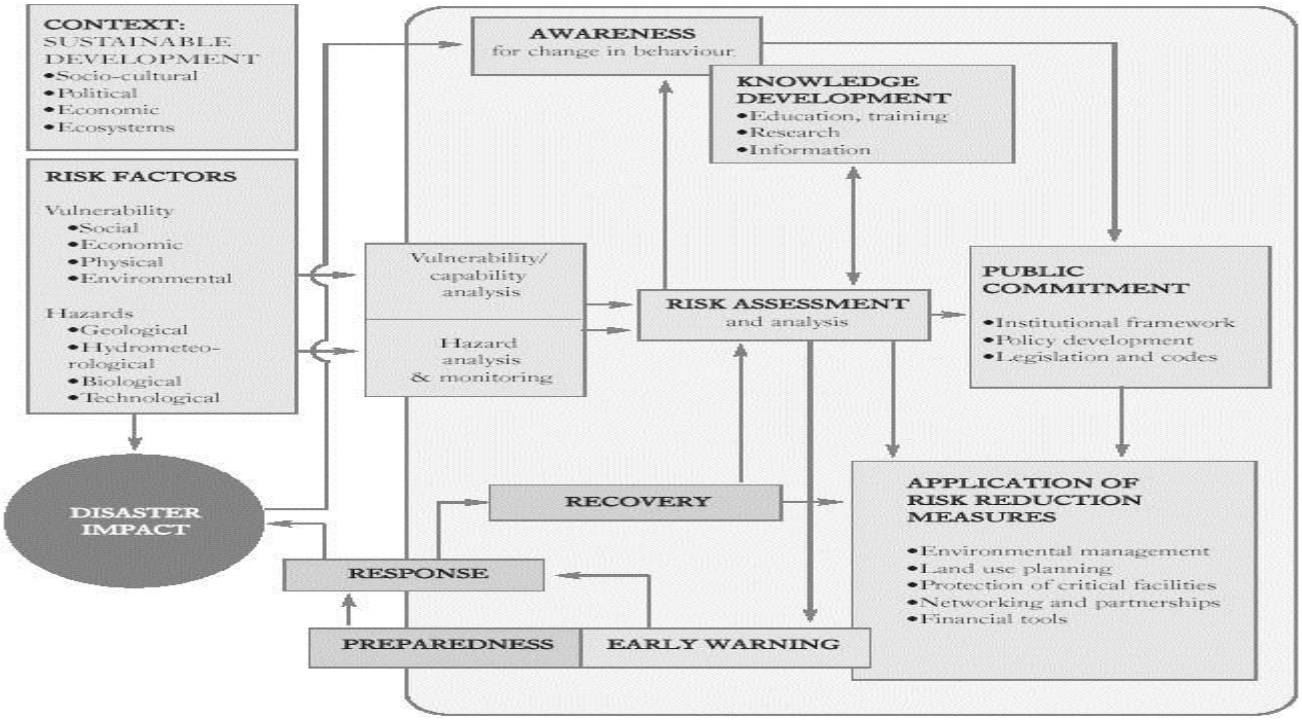

Figure 3. 3: Framework for Disaster Risk Reduction

Source: UN/ISDR, (2004)

3.6. The importance of integrating DRA into Development projects

This section examines the public policies that inform the integration of DRA in the development project, the review of these policies endeavours to describe the policy objectives and means being employed to achieve their objectives. On this note, it is critical that policy objectives be linked with outcomes. The section seeks to measure the progress made (concerning the subject of the study) towards the achievement of the policy objectives.

Disasters arise from the combination of hazard events and human vulnerability. Modern engineering practice has brought significant achievements through such things as seismic building codes and flood management systems, but there remains a general lack of awareness on how humans contribute to the occurrence of disasters and on what can, and should be done, to avoid harm (CCCD Commission, 2008).

The Disaster Management Act (57/2002) and Municipal Systems Act (32/2000) emphasise the importance of integration of Disaster Management into development, meaning disaster reduction, prevention and preparedness should be an integral part of the every development policy within the spheres of government. In order to achieve this disaster risk reduction measures, integration between development plans and disaster risk assessments should be emphasised at all times. All national organs of state must carry out disaster risk assessment to identify priority disaster risks relevant to their functional areas.

A comprehensive measure of the progress is critical in identifying existing gaps and the causes of failures where there have been shortcomings. This is critical for developing an understanding of regulations and plans that have to be complied within water project planning, development and implementation.

3.7. Municipal Plans

3.7.1. Wastewater Risk Abatement Plan (W_2RAP) (2011)

Wastewater Risk Abatement Plan (2011) is explained as a plan used to mitigate potential risks, it is a valuable primary risk management tool used to enhance municipal wastewater service delivery. The W_2RAP encompasses all steps in the wastewater value chain from production to discharge or reuse in a particular catchment. The emphasis of the plan is on wastewater planning and management, not on testing, with documentation and communication being a key component of the process. The Wastewater Risk Abatement Plan is used to equip water management professionals to define controls points and risk management procedures for the operation and maintenance of wastewater treatment plants. When health effects occur as the result of environmental action, risk analysis is used as a valuable tool to identify, quantify and manage the corresponding risks according to the potential and probable impact on a receiving resource. This involves the development of Guidelines; Standards; and Management strategies (Van der Merwe-Botha and Manus, 2011).

The CDM developed the W_2RAP (2012) that looked at all the WWTW under their management, with the primary aims being:

- To prevent contamination during transport of wastewater, storage and disposal of sludge;
- To reduce or remove contamination through the treatment processes; and
- To minimise contamination of the resource to which the treated effluent is returned.

The intention of this objectives is to safeguard public health, protect the ecosystem and to verify the effluent quality to ensure that the W_2RAP is being implemented correctly and is achieving the performance required to meet the relevant national, regional and local waste quality standards or objectives of conducting a risk assessment W_2RAP (2012).

3.7.2. Disaster Management Plan

The disaster management plan was compiled to address the wide range of risk management planning capabilities. The main aim of the plan is to yield indicative information about common vulnerabilities in communities, local areas or provinces and this information should be incorporated into the IDP planning process and projects (NDMF, 2005). According to the Capricorn District Disaster Management plan (2013), the following should be considered:

- *DMP should form an integral part of the District IDP so that disaster risk reduction activities can be incorporated into its developmental initiatives,*
- *DMP should anticipate the likely types of disaster that might occur in the District Municipal area and their possible effects,*
- *DMP should identify the communities at risk,*
- *DMP should provide for appropriate prevention, risk reduction and mitigation strategies,*
- *DMP should identify and address weaknesses in capacity to deal with possible disasters,*
- *DMP should facilitate maximum emergency preparedness,*
- *establish the disaster risk management policy framework and organisation that will be utilised to mitigate any significant emergency or disaster affecting the Capricorn District Municipal Area*
- *Establish the operational concepts and procedures associated with day-to-day operational response to emergencies by District Departments and other entities.*
- *Incorporate all special Hazard / Risk-specific and Departmental DRM Plans and related emergency procedures that are to be used in the event of a disaster. These will provide for,*

  (i) the allocation of responsibilities to the various role players and co-ordination in the carrying out of those responsibilities;

  (ii) prompt disaster response and relief;

  (iii) disaster recovery and rehabilitation focused on risk elimination or mitigation;

(iv) the procurement of essential goods and services;

(v) the establishment of strategic communication links;

(vi) the dissemination of information.

This plan was developed in accordance with the requirements of section 52 and 53 of the Disaster Management Act, no 57 of 2002, and section 26(g) of the Municipal Systems Act, 32 of 2002. The tools highlighted in the DRMP give a holistic approach of hazard management and planning for potential hazards as listed in the CDM disaster risk profile.

The CDM DMP comprehend that it is important that the Capricorn DMC should participate in the planning structure of the CDM IDP. This will help to ensure the continuous incorporation of disaster risk related information into the IDP planning process and projects which will assist inputting in projects such as the upgrade of the wastewater treatment plant.

Section 10 of the CDM DMP indicate that each Department and Service of the Capricorn District, as well as applicable external entities/organisations, are responsible for submitting their respective Entity's Disaster Risk Management Plan to the Capricorn District Disaster Risk Management Centre, as per Section 52 of the Disaster Management Act, 57 of 2002.

Section 10 CDM DRMP further states that disaster risk reduction aspects contained in these Entities / Service DRM Plans should also be incorporated into that entity's submission to the Integrated Development Plan (IDP) to achieve the development targets of the District, meaning that during the upgrade of the WWTP the disaster risk reduction aspects should be forwarded so that they can be incorporated in the CDM IDP.

As prescribed by section 24 of the DMA the municipality must adopt a proactive integrated and coordinating approach to DRM, which describes the specific interlinked responsibilities of each municipal department regarding DRR. Section 52 of NDMF (2005) indicate that all departments within the municipality are supposed to perform their functions in consultation with relevant stakeholders , NGO's, private sector and the community under its jurisdiction of those that can be affected by hazard emanating from the projects developed by the municipality.

In the District DMP, shortcomings were highlighted by the lack of information on the WWTP, also disaster risk assessment was not conducted and these no DMP for the WWTW.

3.7.3. Risk Reduction and Good Governance

Disaster Risk Management (DRM) should be placed as a core element within the structure of governance to mainstream DRR into development policies and operations. As Davis (2014) states, structure and quality of governance need improvement at all levels from national, local government to public involvement by legally defining mandates and status. Davies (cited by Turnball *et al*., 2014) defines governance as an exercise of political, economic and administrative authority in the management of countries' affairs. It further states that governance influences how income and assets are distributed to the people and determines how the people protect themselves from hazards and how they access recovery. Authors such as has Wisner *et al*. (2004), state that Governance is widely regarded as the key to reducing disaster risks.

The link between policy, procedures and practices is important in determining the integration of DRA. Without effective measuring tools of the policy achievements, the guiding principles enshrined in these policies may not be applicable. Tools such as DRA are there to assist with coming up with a process that will enable the application of what the policy require for effective implementation during development. As Khoza (2008) stated, the success of the course of action of all policies must be measured in terms of policy objectives vs. outcomes. Twigg, (2004) points out that "critical importance, more than good policies, is the availability of relevant human capacity (in both public and private sectors) to implement the policy guidelines, after-all, organisations are run by people".

Legislations such as Acts and Policies are meant to guide the responsibilities of public servants concerned. The policy framework provides tools of performance measurement, monitoring and evaluation of public servants. Structures such as advisory forums or intergovernmental relation forum (IGR) are there to assist in ensuring good governance.

Governance is increasingly becoming a key area for success of sustained reduction of risks the municipality should place DRM as core element within the structure of government. The Hyogo Framework for Action (HFA) defines "development and strengthening of institutions, mechanisms and capacities to build resilience to hazards as one of the strategic goals, and it emphasises the action of ensuring the DRM as a national and local priority with a strong institutional basis for implementation (UNISDR, 2005).

The critical importance of good governance is that it creates the favourable environment at international regional, national and local levels that permits the generation of appropriate development plans and strategies that contribute to the achievement of MDGs and disaster

risk reduction. Good governance should achieve increased coordination at all levels; the development of multi-sectoral disaster risk management policies and strategies based on broad involvement of all individuals, government, private sector and civil society institutions, allocation of appropriate resources at local, national and international levels, and effective partnerships.

3.7.4. Enforcement of inclusion of Disaster Risk Assessment in the upgrade of WWTP

Khoza (2008) states that policies themselves do not reduce people's vulnerability unless well applied. The achievement is seen when guiding principles are applied successfully on ground level. He further highlights that government institutions need to be capacitated to plan, implement, develop and manage disaster risk within their jurisdictions in an integrated manner.

It should be remembered that disaster risk assessment should be the basis before projects can be developed. In the considered upgrade of the Lebowakgomo WWTW, the Public Works Report (2011/1) proposed that the following should be done or considered,

- Designing of the WWTW should take the following into consideration:
- determine the current population and then estimate the future expected population depending on estimated growth of the population,
- the figures for the existing population should be cross-checked against the size of the sewage area and the likely population density in the various zones.
- particular care is needed in establishing the full number of contributors in all areas.

This is done to ensure that the sewage treatment plant meets the required criteria. It is also important for the designers to familiarise themselves with DWA's discharge standards, the General and Special standards and also the Supply and Sanitation Policy before attempting the design of the sewage works. They should also determine which effluent quality criteria are required in that specific area.

Section 32(1) of the Constitution gives everyone the right to information. This is complimented by Section 142 of NWA and Chapter 7, Part 2 of NEMA. NWA, Section 145(1) (a), (c), (e) and (g) demand water management institutions to, at their own cost, make available to the public the information at their disposal. The other efficient way of applying of any policy can be in the form of public awareness. Communication is the main key to fostering an integrated uniform approach to integrating disaster risk assessment in the wastewater treatment plant.

As indicated in the CDM IDP (2013-2014) the key performance area and objectives need to be considered for strategic priorities when considering development. The foundations for achieving these policy objectives are programmes, projects and action plans. It should be noted that the diverse nature of the subject of disaster risk reduction means that various CDM units have control over different aspects of disaster risk management. All the relevant departments therefore need to be involved in the development of appropriate policies and strategies. The integration of all "sectoral" plans like the Pronouncements by the President, Premier, MEC and the Executive Mayor; National and Provincial Policy (SONA, SOPA and Budget speeches); LG Strategic Agenda; National Development Plan (Vision 2030); New Growth Path and 12 National Outcomes (in particular outcome 9) should be high on the CDM's agenda in order to give effect to a truly integrated planning.

The CDM DRMP calls for the Head of the DRMC to ensure that copies of the completed plan as well as any amendments to the plan are submitted to the Disaster Management Centre to be incorporated in the municipal disaster risk management plan. The responsibility placed on the Head of the CDM DRMC is to disseminate the DRMP information to all stakeholders such as NGOs, community organisations and other key stakeholder participation to allow for the successful implementation of DRR. Communities affected by the by-products of the wastewater treatment works have the right to be informed of any risks that may arise and explained to them what measures will the municipality take to protect them and their environment.

To ensure that information reaches the community at the right time, the use of a good communication strategy is essential. Risk communication involves reaching different audiences to make risk comprehensible, understandable and respecting audience values, predicting the audience's response to communication and improving awareness and collective and individual decision-making (Renn, 2008).

The municipality should create a relationship with the media so that it can deal effectively with issues that affect people and what people want to address (Aalst et al., 2008).The effective risk communication achieves both informing people at risk about the key determines of the particular risk and of impending disaster risk (early warning), it also engages different stakeholders in the definition of a problem and the identification of respective solutions.

3.7.5. Local capacity and Policy implementation

It is apparent that the CDM has good policies for the development and management of wastewater projects. However, it is one thing to have guiding principles and systems in place

and another to ensure that they operate effectively. The effectiveness of these policies lies in the integration of all aspects of sustainability after all "organizations are run by people" (Twigg, 2004).This includes the integration of DRA in the upgrade or development of wastewater treatment works. There is a need for an integrated guideline to regulate the general application of DRA in project development of WWTW.

The matters of appropriate and qualified capacity (human capital) and resources (fiscal, technology, etc.) in the CDM (Disaster Risk Management Centre and water quality unit) are not satisfying. It should, however, be noted that the CDM does consider the issue of having enough relevant capacity to deal with disaster risk issues. The importance of ensuring that there are sufficient resources and human capacity within the organisation to deal with DRM cannot be overemphasised.

The evaluation of policy is done to determine whether or not there is acceptable progress in the implementation of the policy documents. It is important to note that good policies and action plans are insufficient to reduce disaster risks if they are not translated into practice and implemented. Translating policies into practice requires pertinent capacities and good governance and creating of multidisciplinary and inter-sectoral partnerships, including the expansion of disaster risk management networks. Good governance calls for paramount political commitment and mobilising the political will and defining this institutional and structural mechanism that can generate disaster risk reduction policies and strategies.

According to UNISDR (*cited by* Khoza, 2008), political commitment (at all levels and across the multiple functions of official responsibilities) is widely recognised as being essential for a strategic approach to DRR. The requirement for political commitment is most often identified with government instruments and structures, but the concept applies equally to other organised bodies of interest pertinent to WWTP hazards' identification and management. Appropriate governance for disaster risk management is a fundamental requirement if risk considerations are to be factored into development planning and if existing risks are to be successfully mitigated (UNDP, 2004).

3.8. Wastewater treatment plant designation

In principle, the significance of wastewater treatment works is afforded a clear status in policy, development and spatial planning processes. Pertaining to the Lebowakgomo Wastewater Works some progress has been made regarding the development of the policies guiding the functioning of the wastewater treatment works. Although some policies were developed the proposed upgrade of the wastewater treatment plant has to be take into account – the capacity

of the plant and indicative inflow/ outflow of the plant, disinfecting of raw effluent and the proper discharge of the final effluent. Whilst assessing the level of applicability of the disaster risk assessment policies, it should be noted that the wastewater treatment works at Lebowakgomo is post-development. This makes the calculation of inflow to the plant to be reactive for old developments in Lebowakgomo, hence the proposal to upgrade.

3.9. Wastewater treatment plant design structures

It is indisputable that the treatment plant attenuation structures are effective in their daily operations. All the wastewater treatment plants' weakening structures are registered with DWAS and LEDET. Designs of the wastewater treatment plant are meant to cater for developments and any new development that may come, population growth and densification. These cause problems concerning the carrying capacity of sludge. The maintenance of the structures is problematic at present and this is due to lack of capacity both financially and in human resources.

DWA is responsible for water resource development and management in terms of the NWA, and within the broader framework of other environmental legislation. The Department also strongly reflects the will to make sound decisions which ensure the development of society and the economy whilst maintaining, and where possible enhancing, ecological integrity. The concept of management of the environment has evolved from the exclusivity of protection of plants and animals to balancing the complex interaction of society, the economy, and ecology. "Environmental management is the integration of social, economic and ecological factors into planning, implementation and decision-making so as to ensure that development serves present and future generations" (National Environmental Management Act, Act 107 of 1998).

The key legislative Acts to which DWA is required to refer are the National Environmental Management Act (Act No. 107 of 1998) and the Environment Conservation Act (Act No. 73 of 1989). In accordance with the requirements of the National Environmental Management Act (Act No. 107 of 1998), the Department of Economic Development, Environment and Tourism, Limpopo (LEDET), is to provide authorisation for the development of the project. The authorisation is to be acquired in terms on the Environmental Impact Assessment Regulations (2006), DWA has to prepare a Consolidated Environmental Implementation and Management Plan (CEIMP) as a requirement of NEMA. This describes the Department's functions, policies, plans and programmes and it states how these should comply with environmental legislation. Outlined in the NEMA the Department through the CEIMP has to commit itself to developing and implementing an integrated Environmental Management Framework (EMF) to ensure that

its approach is aligned with the principles prescribed in NEMA and the ECA. The EMF will inform the Department at a strategic decision-making level, bring about environmental legal compliance, and help in achieving environmental sustainability through the promotion of sound environmental management practices as explained in the DEA Guideline (2005). Integrated Environmental Management is a co-operative governance effort with DWS as a full partner in the process. Explained in Public Works Guidelines (2011) the environmental requirements and conditions should be included in the project construction contracts and be enforced during the construction and maintenance phases of the project. The project planning, design and implementation cycle presents an important point in linking risk assessment with development of any wastewater treatment works.

3.10. Conclusion

The literature review and discussion of policy and other documents and disaster management framework in this chapter serve to establish the theoretical background of the study. Emphasis is placed on the notion of integration of disaster risk assessment in the upgrade of the Wastewater Treatment Plant.

The integration of disaster risk assessment in the wastewater treatment plant and the relationship with the community and environment has a greater bearing on the risk of any development that the municipality is likely to incur**.** This chapter seeks to highlight some studies on the subject of integration of DRA in the development and upgrade of a wastewater treatment plant and how it is important for municipal units to collaborate during project development in order to address disaster risk reduction issues before hand.

Although some success has been achieved towards emphasising the inclusion of disaster risk assessment to plan and mitigate any disasters from occurring, lots still have to be done in order to improve the current situation. The CDM has had some progress in addressing the risk reduction issues in the development of Environmental Management Policy, Wastewater Risk Abatement Plan and the Disaster Management Policy but this is not sufficient if collaborations and engagement by unit heads is not done.

CHAPTER 4: RESEARCH DESIGN AND METHODOLOGY

4.1. Introduction

This chapter guides the gathering and compilation of data; it describes the setting of the study area, the research method, data collection procedures, as well as the course of data analysis.

4.2. Research Methodology

4.2.1. Research design

The study made use of qualitative methods explained by Ipsos (2007) as an operational study based on in-depth analysis of interviewee responses (in a group or individually). Described by various authors (Fox & Bayat, 2007; Weiman et al., 2005; Brynard et al., 1997) the descriptive method of the quantitative approach was employed with reference to this research. It involved the systematic collection of data through descriptive survey questions to examine the prevailing conceptualisation of disaster risk assessment. On the other hand, since the qualitative approach allowed for more diversity in responses as well as the capacity to adapt to new developments and issues during the research process (Flick, 2009; Woods, 1999; Silverman, 2000), it formed the thrust of the research methodology in this study.

To summarise and further clarify the direct contrast of qualitative methodology as described by Denzin & Lincoln (2000) the following Table 4.1., is presented.

Table 4. 1: Description of qualitative methodology*, Source: Denzin & Lincoln (2000)*

Qualitative Research
• Deals with subjective data, presented in language (by people) instead of numbers.
• Flexible and exploratory methods are used to enable the researcher to change the data progressively so that a deeper understanding of what is being investigated can be achieved.
• Investigates the day-to-day events and bases results on events and behaviours of people.
• Achieves an insider's view by talking to and observing behaviour (first-hand experience) in a subjective manner
• Occurs within a dynamic and changeable nature of reality.
• Validity is considered more important in representing the research objectives
• Involves small samples of people, cases, and studied by means of in-depth methods

According to Burns & Grove (2001), designing a study aids the researcher to plan and implement the study in a way that will benefit the researcher to obtain intended results, thus increasing the chances of obtaining information that could be associated with the real situation

The case study, is generally a very illustrious category used by researchers. Yin (2003) defined Case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident. Zainal (2007) on the other hand explains Case study as a method that enables a researcher to closely examine the data within a specific context. A case study method selects a small geographical area or a very limited number of individuals as the subjects of study. Lebowakgomo wastewater treatment works was used as a case study for the research, the reason was to get in-depth details as much as possible about an event, person or process in the area of Makurung and the impact the WWTW has on the community and environment so as to inform the need for integration of disaster risk assessment for the proposed upgrade of the WWTW.

4.2.2. Data collection

According to Denzin& Lincoln (2000), various methods of data collection can be used, for example, open-ended narrative, checklists, field guides and interviews. For the study three main focus groups were identified for the data collection process. The research instruments employed for this purpose ranged from questionnaires (refer Appendix A), interviews questions (refer Appendix B-H) and also field observation. As such, the questions applied were open-ended and were accordingly adapted to the practices and experiences portrayed by the participants within the study. This openness enabled a comprehensive approach in the collection of data through qualitative evaluation drawing on both critical thinking as a means of being open to multiple possibilities and scrutinising various possibilities to gain a fresh perspective (Strauss & Corbin, 1998; Denzin & Lincoln, 2000).

For the purpose of easy reference Capricorn District Municipality provided the documents needed for research, this was done after consent was sought from the municipality to engage the relevant Departments and Units involved in the establishment and upgrade of WWTW within the municipality. Departments such as Infrastructure, Environmental Management, and Disaster Management within the district municipality focusing on project identification, project design, implementation, risk assessment and environmental management issues were approached for interviews. Sector departments were also consulted to collect secondary information. Further to that the developed questionnaire assisted in collecting data from the community, Kumar (2014) explains a questionnaire as a written list of questions, the answer to which are recorded by a respondent.

According to Crowther and Lancaster (2009), there are two types of data collection methods namely, Primary and Secondary Data. They stated that Primary Data is often collected through techniques such as experimentation, interviewing, observation and survey, while Secondary information, on the other hand, and is information which already exists in some form or other but which was not primarily collected at the initial phase. These two types of information collecting methods were used:

Primary data Collection – which was applied through questionnaires, interviews and observation

Secondary data collection – obtained from various sources such as books, internet and journals.

Municipal policies relating to disaster risk management and wastewater management (e.g. IDP, DMRP and W_2RAP) were read to familiarise the researcher with the setting of the study area and also establish the extent to which disaster risk assessment concerns were integrated in the establishment of WWTW; engagements with appropriate officials from CDM (Infrastructure Unit), Environmental Management and Disaster Risk Management were pursued. The method followed by the study to gather information from Unit managers was more of an unstructured interviewing method of information collection. Strydom, Fouche & Delport (cited by Khoza, 2008) stated that this type of method is referred to as purpose-driven, in-depth interviews. The main questions asked to aid the objective and sub-objectives of the study were prepared by the researcher to kick-start and guide the conversations. If responses were seen to be lacking enough detail or not understood by the respondents, the main questions were substantiated by follow-up questions and engagements.

4.2.3. Interviews

The face-to-face and a telephone interviews were conducted with the participants listed in Table 4.2. , below.

Table 4. 2: Number of participants interviewed

Type of respondent	Workplace	Tools	Number of participants	Total
Units within the Municipality				
Coordinators : Disaster Risk Management Officers	Disaster risk management	Unstructured interview	2	2
Technician: Water Quality	Infrastructure	Unstructured interview	1	1
Senior Supervisor: Process Controller	Infrastructure	Unstructured interview	1	1
Plant Operators.	Infrastructure	Unstructured interview	3	3
Manager :Planning and design Manager	Infrastructure	Unstructured interview	1	1
Manager: Environmental Management	DPEMS	Unstructured interview	1	1
Officers: Environmental Management	DPEMS	Unstructured interview	3	3
Sector Departments				
Sister Nurse	Primary Health Care (clinic) and Mobile Clinic	Unstructured interview	2	2
Manager	Primary Health Care	Unstructured interview	2	2
Principals	Depart of Education: Schools	Unstructured interview	4	4
Manager : Hazardous and Chemical Waste Management	LEDET	Unstructured interview	1	1
Environmental Officer: Hazardous and Chemical Waste Management	LEDET	Telephone interview	1	1
Manager : Water & Sanitation Services	DWS	Unstructured interview	1	1
Doctor: Veterinary	Department of Agriculture (Vet)	Unstructured interview	1	1

4.2.4. Questionnaires

Questionnaires were developed and distributed to the Makurung community, and 111 people participated. The following people were amongst those that took part in the study, members from the traditional authority, cattle farmers, ward councillor, ward committee member, community health workers and community in general.

4.2.5. Observation

During site inspection, a walkabout was done at the Lebowakgomo Wastewater Works to try to observe the daily operations of the plant. This included understating the actual design capacity, daily operations, treatment which includes management of screens and sludge and discharge of effluent from the plant to the last end, the Chuene River. Further to that an observation was made on how badly the WWTW is affecting the environment as most of the animals from the surrounding areas were drinking the effluent discharged from the WWTW.

4.3. Sampling and Population

Sampling is the process of selecting units (e.g. people, organisations, data etc.) from a population of interest so that by studying the sample the researcher may fairly generalise the results back to the population from which they were chosen, that is according to Research Method Knowledge Base (2014). The Capricorn District Municipality has about 13 WWTWs; of the 13 only one, the Lebowakgomo WWTW located outside Makurung village, was sampled for the study. The affected population was estimated at 4 612 with 1 129 households from Makurung area (Stat SA, 2011). In this study the population was Makurung's women and men who are affected by the WWTW, and further to that 5 sector departments including the district municipality were sampled for the study.

4.4. Data Capturing

In this study the Microsoft Word and Microsoft's Excel (spreadsheet) were used to capture and analyse the data that was gathered by means of questionnaires and interviews. This method was selected because after collecting the data, information was tabulated into Microsoft's Excel, therefore, data was analysed using charts and graphs.

4.5. Data analysis

Sarantakos (2000) describes data analysis as a stage in which the researcher will do data reduction, presentation and interpretation. Information collected through interviews and

questionnaires from all the participants, was classified into themes and reduced to sizable groups. Collected data was then transferred onto a spreadsheet and then graphs and tables were created from there. The goal of this was to integrate the themes and concepts into a theory in order to offer an accurate, detailed interpretation of the data and review of documents. Thematic analysis was used to analyse data in this study. Maps, data tables and column charts that describe the information that conforms to the goal of this study were used to present the analysis.

Presentation of the results of the study, a writing technique with an inductive narrative analysis was employed from the literature review, collected data and analysis made.

4.6. Ethical Consideration

Throughout the study the researcher pledged adherence to ethical conduct as it applies to participants. Those values included voluntary and informed consent by the interviewees and the values of honesty with professional bodies, right to privacy, anonymity, causing no harm to participants, seeking permission from participants, confidentiality and internal and external validity of the study. The researcher objective was clearly outlined in writing and articulated to the participants and also a written consent to gather information was written to the municipality and further to that participants

Were advised in writing of the voluntary nature of their participation and that they could withdraw from the study any time without penalty and also that they can decline to answer any question at any time.

Were informed in writing that the evaluation during research is done only for professional and study purposes and will be done with people directly and professionally involved.

Information obtained from participants will be treated confidentially.

Credit will be given to the work of others by referencing the source of the information to avoid plagiarism.

The researcher had the responsibility to respect the rights, needs, values and desires of the participants and also to ensure that the reputation and position of the participant's privacy be ensured, especially if the findings of the study could be shared with other people and organisation

4.7. Conclusion

The chapter outlined the research methodology and the design used in the study, including procedures, participants, data collection and analyses methods, including and ethical issues. The next chapter provides data analyses and the results of the study that will help to translate the viewpoint into actual practice.

CHAPTER 5: DATA PRESENTATION AND ANALYSIS

5.1. Introduction

The aim of this chapter is to analyse, interpret and discuss data in the way that it addresses the objective of the study and also answers the research questions. This chapter outlines the findings of the data collected from the community of Makurung, as well as different departments that were interviewed including the employees at the Capricorn District Municipality. The distributed questionnaires, interviews and observations during site inspections were used as methods to collect information from different communities.

One hundred and eleven questionnaires were distributed to the community of Makurung village. Face-to-face interviews were held with different staff members from CDM and other sector departments. Questionnaires were self-administered by the researcher.

5.2. Section A: Analysis of the Makurung Community administered questionnaire

5.2.1. Socio- demographic information

The following section contains statistical analyses pertaining to personal details of the respondents relating to age, gender, marital status, employment status, supplementary income, and household size, number of children and duration of stay. Thereafter, each of the biographical variables of the sample is graphically depicted and discussed.

Table 5.1: Socio-demographic information

Variables	**Frequency**	**Percentage**
Age		
18-25	1	1.8%
26-30	2	9.90%
31-35	11	6.30%
36-40	7	20.70%
41-45	23	60.40%
46+	67	60.4%
	111	**100%**
Gender		
Female	77	69.4%
Male	34	30.6%
	111	**100%**
Employment Status		
Employed	6	5.4%
Unemployed	105	94.6%
	111	**100%**

Supplementary Income		
Stipend	4	3.60%
Pension	59	53.10%
Illness grant	12	10.80%
Children's grants	36	32.40%
	111	**100%**
Household Size		
0-2	8	7.21%
3-6	51	45.90%
6+	52	46.80%
	111	**100%**
Number of Children		
0-3	52	46.80%
3-6	42	37.80%
6+	17	15.30%
	111	**100%**
Duration of Stay		
>4	0	0%
4-7	2	2%
8-11	10	11.1%
12+	99	99%
	111	**100%**
Source of Water		
Rivers	0	**0%**
Well/ Boreholes	8	8%
Catchment, tanks, drums	0	0
Piped water	4	4%
Others, please specify (buy water)	99	89%
	111	**100%**

5.2.1.1. Age

Table 5.1. Indicates the age distribution of the respondents, this clearly indicate that people over the age of 46 may not be able to deal with any risky effects that may arise from the WWTW.

5.2.1.2. Gender

The analyses in Table 5.1. , indicate that in the total sample, 69.4 % were female and 30.6% were male. This illustrations a huge number of women residing in Makurung and in case of incidents women would suffer more compared to the male counterparts.

5.2.1.3. Employment status

According to the research analyses, Table 5.1. Indicates 94.6% of the participants were unemployed while 5.4 % were employed. This indicates a very high level of unemployment which could increase the vulnerability of the community, as most of the community members have to buy clean water for survival. The increase number of unemployment will lead to most community members sourcing alternative unclean water for survival.

5.2.1.4. Supplementary Income

Table5.1. indicates that, 3.6% indicated that they were receiving a stipend, 10.8% % were receiving Illness grants, 32.4 were receiving a Child grant, and 53.1% were receiving pension grants. The high number of Makurung people depends on grants for survival suggesting that the only source of income is government dependent, increasing their vulnerability.

5.2.1.5. Household size

Table 5.1. presents the research analysis of the participants, 6.30% people indicate that between 0-2 reside in their household, 46.8% between 3 -6 and other 46.8% more than 6. This indicates that the average size household can accommodate between 3 and more people increasing the dependency rate, demanding that there be an alternative source of income to sustain the household.

5.2.1.6 Number of Children

According to the research analyses, Table 5.1., 45.8% people indicated that between 0-3 children resided in their house, 37.8% between 3-6 children and 16.2% more than 6 children. This indicates that a large number of families with small children increase the vulnerability of being exposed to risks associated with wastewater treatment works.

5.2.1.7. Duration of stay in the area

According to the research analyses on Table 5.1. 0% stayed less than 4 years,1.8 % stayed between 4-7 years, 9% stayed between 8 -11years and 89 % of the participants have being staying in the community for more than 12 years. This indicate that most of the home owners are aware of the development in their area and also it indicates that they can give a better perspective of what has transpired over the years in their area, further to that give a clear picture of the impacts of the WWTW on their community and the environment.

5.2.1.8. Source of drinking water

Table 5.1. The research sampled number indicated that, 3.9% receives from piped water, 7.2% uses well/boreholes, and 89.1% of the participants indicated that they were souring water by buying from the neighbours. This information indicates a large number of people could be at risk if the water is contaminated by the untreated effluent released from the WWTW.

5.2.2 Knowledge of Wastewater Treatment Works

It is clear that most of the sampled participants knew what a WWTW was, as they highlighted an understating between toilet systems used at their village and the ones used at Lebowakgomo Township. Further to that, most of the participants knew where the WWTW was situated and which community it was servicing. Figure 5.1. Indicate the research analyses of the sampled participants, of which 82 % indicate that the WWTW was established more than 12yrs ago, whereas 1.8% participants answered between 4 -7 years, 8.1% said between 8 - 11 years and 7.2% participants did not answer. This indicates that the community and environment has been exposed to the wastewater treatment works for a number of years increasing the vulnerability to risks associated with treatment works.

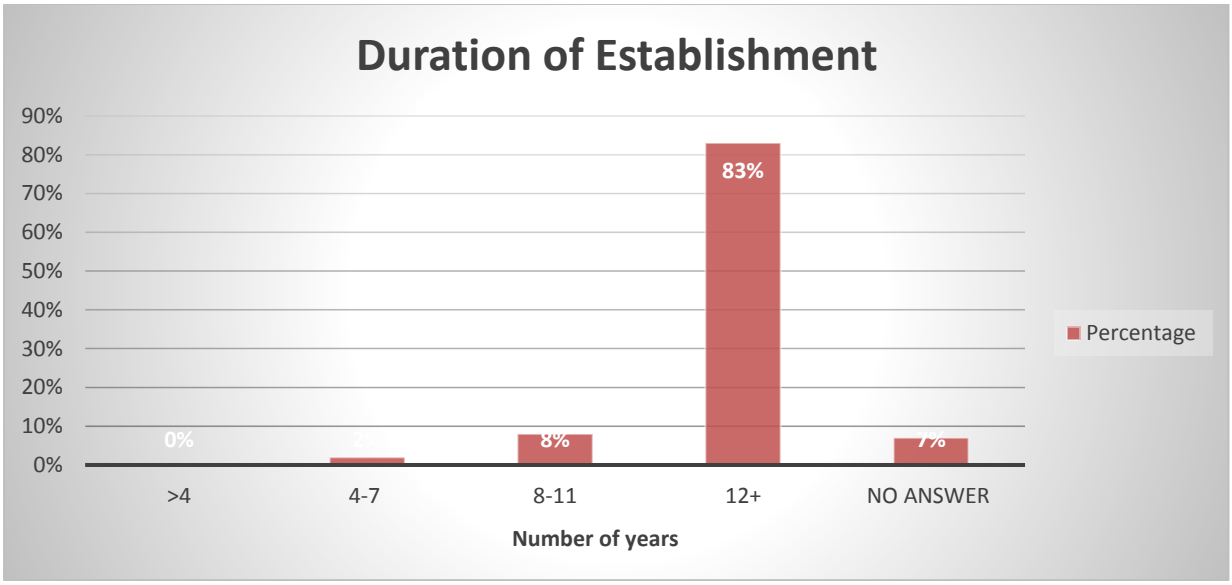

Figure 5. 1: Number of years WWTW established

5.2.2.1. The performance and management of the wastewater treatment works

Based on the first question as shown in the Table 5.2, 100 participants strongly disagree that the plant is operating well while 11 of them disagree as well. None of the participants agreed or strongly agreed that the plant is operating well. 70 participants strongly disagree that the plant has enough capacity to carry wastewater and the other 41 also support them. In terms

of knowing the problems associated with the plant, 111 participants strongly agreed to knowing the problems, while 98 participants strongly agreed to experience the problems associated with the plant, the other 13 who took part in the study did support them as well.

Table 5. 2: Performance and Management of WWTW

Questions	Agree	Strongly agree	Strongly disagree	Disagree
Do you think the plant is operating well?	-	-	100	11
Do you think plant has enough capacity to carry wastewater?	-	-	70	41
Do you know the problems associated with the plant?	-	111	-	-
Have you ever experienced any problems with plant?	13	98	-	-

5.2.2.2. Duration of existence of problems in the area

Figure 5.2. According to the research analyses of the 111 participants, 72.1% indicated to having experienced problems for more than 10yrs, whereas 18.9% said between 3 and 10 years and 11.1% for less than 5years. This indicates that the community of Makurung have been exposed to the risks associated with the treatment works and experiencing the same problems since the establishment of the WWTW without assistance from Municipality.

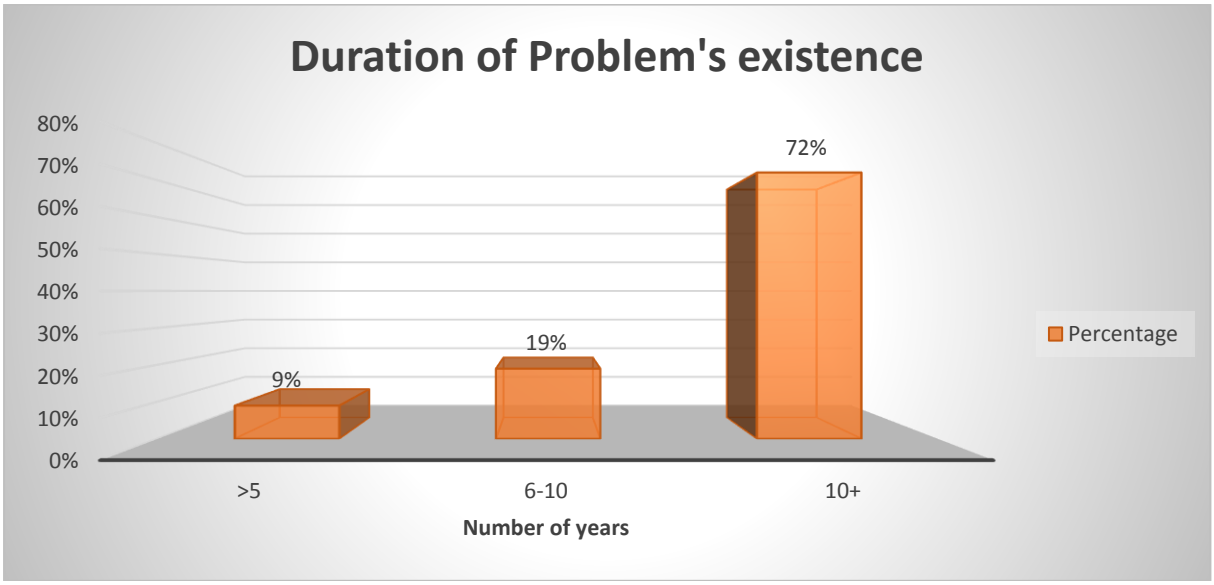

Figure 5. 2: Duration of problems with WWTW

5.2.2.3. Functionality of Wastewater treatment works

According to the research analyses as per Table 5.3.of the sampled participants there is clear indication that the WWTW is not functioning well, most of the participants indicated a serious challenge with wastewater treatment works as some participants indicated that the infrastructure was not in good working order and this warranted intervention from the municipality to avoid their animals drinking wastewater from the treatment works.

Table 5.3: Functionality of WWTW

Questions	Agree	Strongly agree	Strongly disagree	Disagree
Functionality of WWTW	-	-	-	111

5.2.2.4. Effects of Wastewater treatment works the area

The sampled participants indicated on Figure 5.3. The areas listed below as likely to be affected by the effects of WWTW and which could have the potential to cause harm. It is clear that the community aware of the problems that poses threats in their area and what they can affect. This clearly indicate that agencies responsible for promoting disaster risk reduction should be involved to intervene.

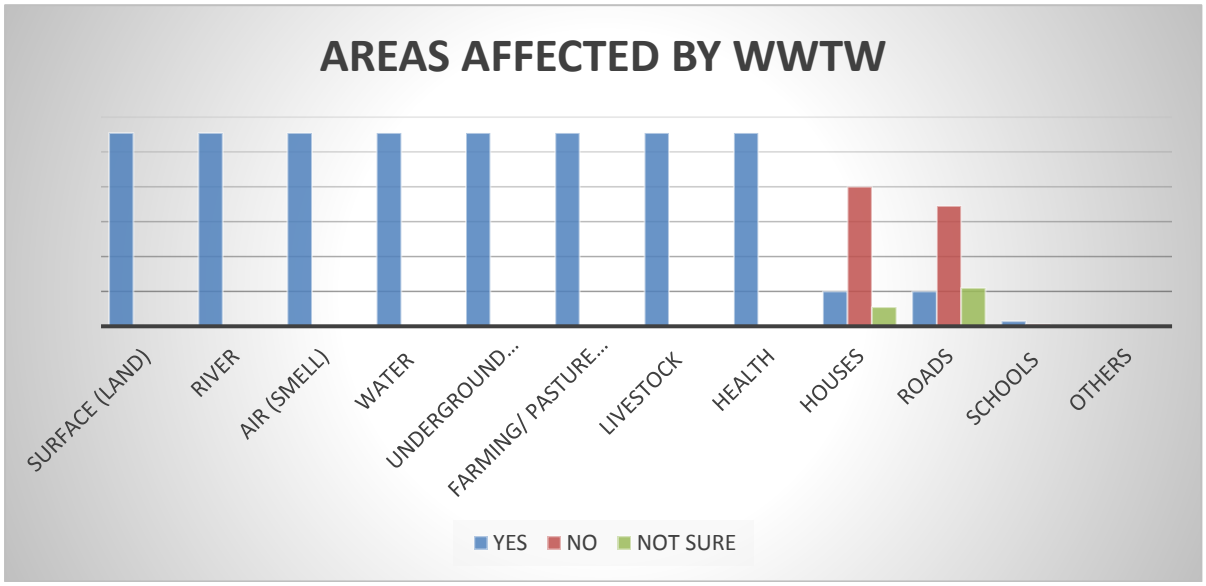

Figure 5. 3: Areas affected by WWTW

5.2.3. Municipality Engagement with Community

5.2.3.1 Community Involvement

From the collected data, Figure 5.4 indicates, 95% of the sampled participants were not consulted nor participate in the public participation meetings while only 5% agreed being consulted or participated in the public participation meetings held by the municipality during the establishment and the proposed upgrade of the WWTW. This indicated lack of community involvement on a project which has a major impact on them.

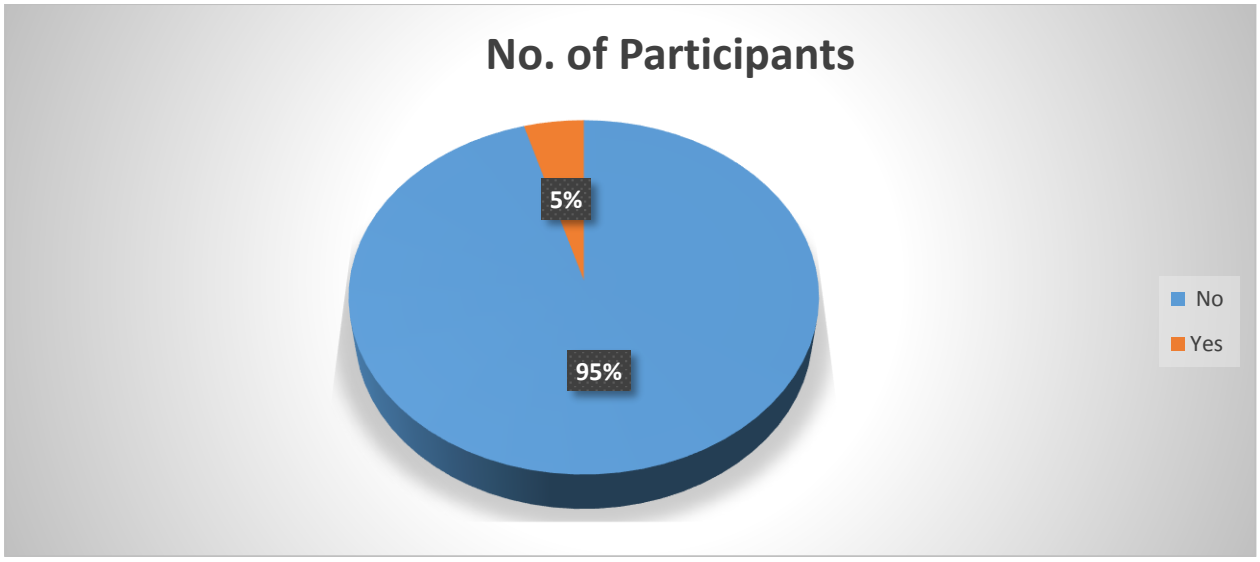

Figure 5. 4: Number of participants on the establishment of WWTW

5.2.3.2. Awareness campaigns conducted

According to the research analyses 98% of the sampled participants, indicated that the Municipality never conducted awareness campaigns on the risk associated with the WWTW. This indicates the lack of awareness on challenges arising from the wastewater treatment works exposing community at the risks from the WWTW.

5.2.3.3. View on the Upgrade of the WWTW

According to the research analyses of the sampled participants, Figure 5.5 indicate that, 41.4% of the participants strongly agreed that the WWTW should be upgraded and 58.5% disagreed to upgrading of the WWTW. They think the upgrade will improve the situation and reduce the currently faced challenges.

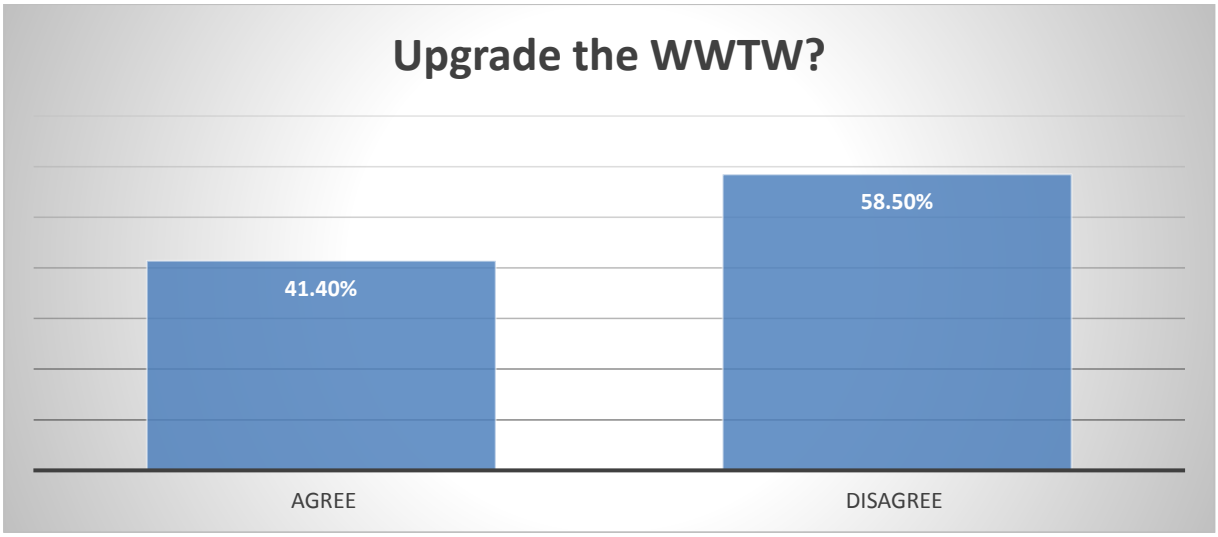

Figure 5. 5: Number of participants on Upgrade of WWTW

5.2.3.4. View on relocation of the WWTW

Figure 5.6 indicate the sampled research analyses of the participants, 85.6 % participants agreed to relocation of the WWTW and 14.4% disagreed to relocation, indicating that there is a strong view from that community that challenges can be avoided if the treatment works was moved from their area, as they are not benefiting anything from the treatment works except risks that are affecting their health, animals and environment.

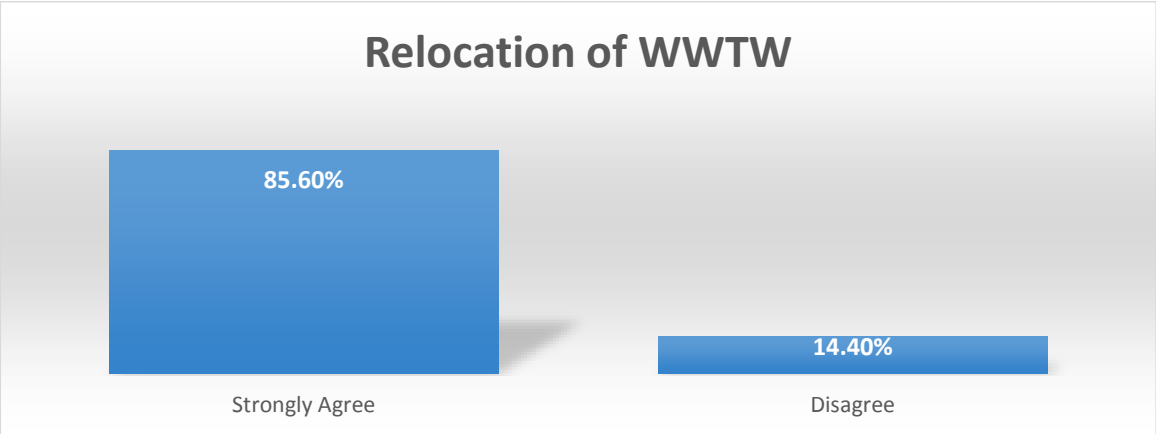

Figure 5. 6: Number of participants on relocation of WWTW

5.2.3.5. Other suggestions about the Wastewater Treatment works in this area

Indicated below are the research analyses from the sampled number of participants the following views where outlined for consideration?

- Municipality should rebuild the wall to avoid cattle entering the treatment works to drink wastewater
- Municipality should cover the wastewater channel to avoid exposure;

- Municipality should ensure that the treatment works reduces the odour released form the treatment works;
- Municipality should engage them as the community not only with Moshate;
- All risks associated with WWTW be communicate to them; and also
- Awareness campaigns be conducted so that they can plan in case of disaster.

Most of the participants, especially those who are farming with cattle, indicated that the sewage is affecting their selling price whenever they want to sell their stock and this has a major impact on their finances as they mostly depend on cattle farming for a living.

5.3. Section B: Interview analyses with key Sector departments

The data collected from the key sector departments captured and presented in a table forms indicate a clear picture of the common trends and different views. The analysis of the findings indicate clear need for integration.

5.3.1 Presentation of the Interview results from all key sector department

5.3.1.1. Number of participants from Sector Dept.

Figure 5.7, below indicate the number and gender of people participants from different key sector departments. The results shows that these more males' counterpart employed in the field of work visa-vi the number of female employees.

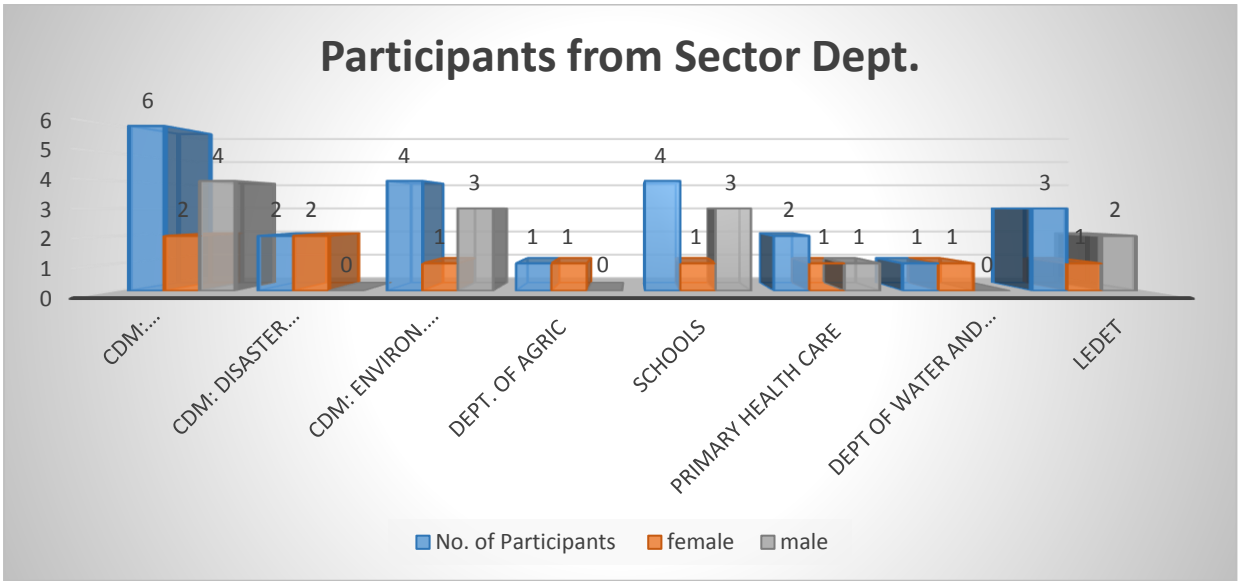

Figure 5. 7: Participants from Sector Departments.

5.3.1.2. Level of Education

All participants indicated having either a University or Technicon Degrees. Which show an advantage because participants are knowledgeable in the field their employed for. The need for municipality to employ qualified personnel is essential.

5.3.1.3. Interview questions for CDM Infrastructure

Table 5. 4: Understanding of DRA

Question	Yes	No	Not sure	Don't know
Was Disaster risk assessment conducted for the proposed upgrade of the WWTW?		1	5	
Do you have a disaster risk assessment plan for the proposed upgrade of the WWTW?			5	
Was public consultation conducted for the proposed upgrade of the WWTW?	6			
Do you think it is important to conduct disaster risk assessment for the proposed upgrade	6			

Five (5) of the participants were not sure if disaster risk assessment was conducted for the WWTW, but reflected that risk assessment for wastewater treatment plant was done, they further referred the researcher to engage with the Manager: Planning and Design who indicated that DRA was not conducted but EIA was conducted by an appointed consultant. Participants were not sure of the availability of a DRA plan but indicated that Wastewater Risk Assessment Plan was conducted and drawn up for the WWTW. The information of community engagement, Six (6) of the participants indicated that previously public consultation was done, but also reflected that with the current proposed upgrade they are not sure as they are not involved.

All participants indicated that the plant's main challenges are that it's overloaded and operating above its maximum capacity, all systems are malfunctioning and also that the quality of the effluent leaving the plant is of poor standard which has a high potential of causing health hazards to both the operators and community members. They further indicated that the current challenges cannot be fixed or addressed due to municipality's financial constraints. All the participants indicated that it very important to conduct DRA for the WWTW, reason being, it is too able to coordinate planning of activities and mitigation of any disaster that may arise from the WWTW.

5.3.1.4. Role player involved in the proposed upgrade of the WWTW

Just like disaster risk management, the management of wastewater is not a one-man business. The development of wastewater treatment works involves a number of sectors. The following sectors were identified by the participants from the CDM infrastructure unit as role players who may take part in the proposed upgrade:

- Department of Water and Sanitation.
- Department of Local Economic Development, Environment and Tourism.
- Department of Agriculture.
- Department of Health.
- District and Local Municipality (Infrastructure, Disaster Management, Environmental Management etc.).
- Traditional Authority.
- Cooperative Governance, Human Settlement and Traditional Affairs.
- Communities residing up and down stream
- Mining industry nearby.

5.3.1.5. Which role players should be involved in ensuring integration of DRA in the proposed upgrade of WWTW?

The following sectors were identified by the participants from CDM infrastructure unit as role players who can to take part in the proposed upgrade:

- District municipality as Water services authority.
- Local municipality.
- Mining Industry.
- Department of Agriculture.
- Department of Health.
- LEDET.

5.3.1.6. What internal challenges could hinder implementation of the proposed upgrade of WWTW?

Three participants indicated that budget could hinder the process as upgrading requires lots of funds and also skills shortages and the other 3 indicated that exclusion of operational people during planning, appointment of incompetent services providers, lack of funds for operations and maintenance and poor communications could hinder the process.

5.3.1.7. What external challenges could hinder implementation of the proposed upgrade of WWTW?

All Six of participants indicate by listing the following on Table 5.4 as some of the challenges that could hinder the proposed upgrading of the Wastewater treatment works.

Table 5. 5: External Challenges to hinder implementation of upgrade of WWTW

Listed hinders
Exclusion of traditional Authority from the area
Exclusion of community members
Late response of application of licence by DWAS
Service Provider not being able to meeting contractual obligations
Political interference

5.3.2. Presentation of interview results from Department of Agriculture

5.3.2.1 Impact of wastewater on animals?

The participant indicated that the wastewater treatment works has a great impact on the animals exposed to drinking sewage water and feeding off sludge. They indicated that most animals may become exposed to different viruses, bacteria or other parasites during grazing and water drinking.

5.3.2.2. Animal diseases associated with drinking wastewater

The following were identified as the animal diseases associated with drinking wastewater, Table 5.7., below.

Table 5. 6: Animals diseases associated with drinking wastewater

Animal Infections	**Diseases**	**Transmission**
Diseases caused by a Virus	Food and Mouth	Contact with urine, faeces etc.
Diseases caused by Bacteria	Johne's Diseases (Bovine Para-tuberculosis)	Ingestion of faeces, agent is persistent in soil, pasture, manure and stagnant water for a prolonged period
	Blackquarter (black leg)	Soil during grazing

5.3.2.3. Impact on humans after consumption contaminated meat

The participant indicated that the viruses and bacteria can have a major impact on the health of the animals and persons consuming the contaminated meat (carcass). In most cases it is prohibited to slaughter and dress an animal diagnosed with some of the diseases.

5.3.2.4. Impact of wastewater on agriculture

The participant indicated that the impact of wastewater on agriculture can be both beneficial and not beneficial especially if the water is not treated according to the national standards. Therefore, is important for the municipality to discharge a fully treated effluent to avoid any risk that can arise from contact with the effluent.

5.3.2.5. Knowledge of challenges at Makurung relating to the WWTW

The participant indicated that they are aware of the challenges, Lebowakgamo wastewater treatment works and the outcry of the Makurung community regarding their animals drinking sewage water. The participant further indicated that although the community is complaining regarding the consumption of the meat they have never forwarded a carcass or the animal's intestines to be inspected for any animal diseases.

5.3.2.6. Awareness campaigns conducted

The participant indicated that they do conduct awareness studies and animal vaccination on the persistent animal diseases prevalent in the research area.

5.3.3. Presentation of interview results from the Department Water and Sanitation and LEDET

5.3.3.1 Management of Lebowakgomo WWTW

The participants from LEDET highlight that they are responsible for the monitoring of compliance with wastewater treatment works and to provide authorisation for the development of the wastewater project within the legal framework of NEMA. The DWA respondent indicated that the responsibility of development and maintenance lies with the water services authority. The participant indicated that the department is responsible for issuing of licences and developing guidelines about types of WWTW to be considered for development and also to ensure protection, use, development, conservation, management and control of all water resources, including the WWTW, within the legal framework of the National Water Act 36 of 1998.

5.3.3.2. Departmental mandate

Both LEDET and DWA participants indicated that the mandates of establishment and upgrade are a constitutional right as highlighted in the Bill of Rights. They indicated that both

departments have to work together to assist the water service authority in ensuring that they meet their legal obligations as per Section 24 of the Constitution of the Republic of South Africa, Act 108 of 1996) that everyone has the right to an environment that is not harmful to their health or well-being.

5.3.3.3 Knowledge of the problems associated with the Lebowakgomo WWTW

Both LEDET and DWS participants indicated that they are aware of the problems at the Lebowakgomo WWTW. LEDET indicated that every quarter inspections are done and reports are forward to the municipality for implementation of the recommendations. Whereas DWS indicated that the department was aware of the situation currently and measures are being employed to try assist the municipality this measures include the proposed upgrade of the treatment works.

5.3.3.4. Legislative enforcement

Both institutions indicate that they conduct regular monitoring of the treatment works and the municipality and also provincial structures have been activated to assist with recommendations to water authorities to implement while awaiting long term solutions.

5.3.4. Presentation of interview results from Department of Education (Schools)

5.3.4.1. Effects of the Lebowakgomo WWTW to schools

All the four participants responded that that they are partially affected, they indicated that the odour from the treatment works tend to be very strong at times, also that during the rainy season wastewater is spread and also that all schools use borehole water and they think the wastewater could contaminate the underground water.

5.3.4.2. Awareness of the challenges posed by WWTW

All four participants indicated that the schools are aware of the challenges and stated that those challenges are, the strong smell (odour) from the plant, animals being exposed to drinking wastewater and insects such flies transporting infections from the source to the people, health issues such as outbreak of cholera that may affect the schools and learners.

5.3.4.3. Effects of the challenges (risks) to schools

Three of the participant's identified challenges they were not sure how this challenges can affect schooling, beside health issues that may warrant learners failing to come to school and

maybe contamination of underground water as all schools are using boreholes as source of drinking water. One of the school principals indicated that the school was just adjacent to the river. He indicated that during the raining season the exposure of children to contaminated water can post a challenge to the school although no such cases where recorded previously.

5.3.4.4. School programmes to give awareness on the identified challenges (risks)

All participants indicated that schools are not conducting awareness on the challenges for the specific problem area, but that they at times, through their normal school curriculum, highlight issues on health and talk about life-orientation information that they share with the learners.

5.3.4.5. Importance of municipality to conduct awareness on risks

All the participants indicated that it is important for the municipality to conduct awareness campaigns to highlight to the learners problems that are associated with the WWTW, inform them on what to do and how to avoid exposure. They further indicated that this will create a relationship between the municipality, community and schools.

5.3.4.6. Four factors to improve Lebowakgomo wastewater treatment and benefit the school

Participants indicated the following factors as the ones the municipality should consider,

- Upgrading the WWTW
- Manage the plant and the wastewater discharged from the treatment works
- Conducting awareness
- Cleaning and clearing of the wastewater channel for free flowing of wastewater.

5.3.5. Presentation of interview results from Disaster Management

5.3.5.1. DRA practices within the municipality

Both participants indicated that, according to the Disaster Management Act and Framework, DRA is conducted by the DRM centre within a particular municipality, and further to that each sphere of state should develop its own Disaster Management Plan. The participants indicated DRA was conducted for the municipality although the current DRA does not indicate the WWTW and its challenges.

5.3.5.2. DRA identified as one of the strategic goals of the organisation

Both participants indicated that within the organisation it does seem like DRA is not considered a strategic goal, it is more done for compliance sake. Both participants indicated that this is informed by the lack of a disaster risk management plan for projects.

5.3.5.3. Conduct of DRA for the Lebowakgomo WWTW and involvement of DRM

Both participants indicated that they are not sure if DRA was conducted for the WWTW, as it doesn't reflect on the current DMP. Further to that they indicated that they are not sure if the user department could have conducted a risk assessment before or not as they don't have information. Both participants indicated that they were not involved.

5.3.5.4. Availability of disaster risk management plan

Both participants indicated that the municipality does have a DMP, although the plan does not reflect any of the wastewater treatment plants within the district.

5.3.5.5. Integration of disaster risk assessment into the municipal disaster management plan

Both participants indicated that DRA is an integral part of DMP, so disaster risk assessment for the district is integrated but the plan does not have the plans for established wastewater treatment plants, which could be due to exclusion of the WWTW during the previous assessment.

5.3.5.6. Responded to disaster incident related to the WWTW.

Both participates indicate that they have never responded to a disaster incident in the area or related to the WWTW.

The importance of disaster management to conduct and integrate disaster risk assessment for the planned project (upgrade)

Both participants indicated that it is important to conduct and integrate disaster risk assessment for the planned upgrade. That by having the DRA it will enable the municipality to plan better and take the community into consideration during their planning. They further indicated that moving forth the WWTW will be included when conducting disaster risk assessment of the area.

5.3.6. Presentation of interview results from Environmental Management

5.3.6.1. Responsibilities of the office of Environmental Management in the Municipality

All participants indicated that the responsibility of Environmental Management is “to manage the environment and natural resources for the benefit of present and future generations”

Their activities are focussed on;

- Awareness and training
- Promoting concepts of sustainability and green economy within CDM / district
- Environmental Impact Assessments
- Waste Management
- Support to local municipalities in the district on environmental matters
- Air quality management and issuing of atmospheric emission licences
- Development of strategies and policy (where applicable) e.g. Strategic Environmental Assessments, Environmental Management Plans, etc.
- Compliance monitoring and enforcement
- Alien plant eradication projects
- Greening initiatives
- Climate change initiatives

5.3.6.2. Availability of plans and policies that govern the implementation of Environmental Management within the district

All participants answered “Yes” to the question of availability of plans and policies and also listed the legislations as follows in the next paragraph. They further indicated that the most important of all these however is the National legislation available to them, known by the abbreviation of SEMAs, Specific Environmental Management Acts, which are adequate. They are:

- National Environmental Management Act (107 of 1998)
- National Environmental Management: Biodiversity Act (10 of 2004), known as the NEM: BA.
- National Environmental Management: Waste Act (59 of 2008), known as the NEM: WA

5.3.6.3. Involvement on establishment of the Lebowakgomo WWTW

All participants indicated that they were not involved in the establishment of the WWTW, as it was established by DWA and transferred to the municipality.

5.3.6.4. Knowledge of proposed upgrade of WWTW

Two of the participants indicated not being involved in the proposed upgrade, one participant indicated that he was only involved to establish the issuing of Record of Decision (ROD) issued by LEDET and the other indicated that his involvement was to provide comments on the possible environmental impacts and recommending mitigation measures.

5.3.6.5. EIA conducted for the proposed upgrade of WWTW and availability of report

Two of the participants indicated not knowing if EIA was conducted and one participant indicated that it was conducted and that the report is available, whereas the other participant indicated that it was said that it was done to cater for the increased flow, but no records were submitted to their office.

5.3.6.6. Environmental problems associated with the current WWTW

All participants indicated as follows, that pollution as in untreated effluent is passing through the plant being released into surrounding communities and into the Olifants River ultimately through a channel that has been dug to divert the raw sewage, sewage sludge is not treated but dumped unto the surrounding veld, odour is released from the plant, and also the overflow of raw sewage into the open environment.

5.3.6.7. Problems associated with the establishment of WWTW

Participants indicated that problems associated with WWTW have been report to all structures with the municipality both politically and administratively. The relevant hazardous waste and pollution officials at LEDET were aware of the ongoing problem, but nothing has been done to date.

5.3.6.8. Monitoring inspections for the Lebowakgomo WWTW and around the Makurung area.

Two of the participant indicated not knowing if monitoring inspections were conducted, one participant indicated to conducting at least two compliance monitoring inspections annually

and the other participant indicated that they were not conducting compliance monitoring as they cannot police their own employer and further stated that compliance should be done by relevant personnel from LEDET and DWS.

5.3.6.9. Number of environmental awareness campaigns conducted

All four participants indicated that they do conduct environmental awareness campaigns, although is not only for a related specific area but for all environmental issues. The participants also indicated that the solution to the Lebowakgomo WWTW cannot be solved by awareness campaigns, the solution should be sourced to prevent the pollution.

5.3.6.10. WWTW adherence to environmental management policies (either nationally or locally)

All participants indicated that the WWTW does not comply with any of the Specific Environmental Management Acts, and that majors to raise the matter with all affected parties have be exhorted as such they await the upgrade of the WWTW.

5.3.6.11. Additional points for consideration

Communities should force the authorities to attend to the problem by reporting the matter to national hotlines / Ministers within DEA and DWA directly. It is the only way pressure will be placed on the municipality to resolve the matter as it has been dragging its feet for quite some time. Alternatively, communities should approach Legal Aid Centres to assist them in taking legal action against the municipality forcing it to adhere to national policy / legislation.

5.3.7. Findings from the Sector Departments

5.3.7.1. Capricorn District Infrastructure

The drawn terms of reference for the past upgrade didn't include the element of disaster risk assessment. The units within the department are work in isolation planning and design, water quality and operations and maintenance are not doing things together, meaning each unit is only concerned with its functions which can create problems on operational issues. It seems like this lack of support and poor communication from strategic level to operational level are creating a frustrating working environment for staff.

5.3.7.2. Department of Agriculture

Whether the Department is conducting awareness campaigns on everyday animals' health issues, the matter of the impact on animals drinking the untreated effluent are not well outlined. No research on the impact has been done for the affected research study area, thus making it hard for the department to produce any evidence to the claims made by the community.

5.3.7.3. Department of Economic, Development, Environment and Tourism and Department of Water and Sanitation

The LEDET is addressing what is expected, and to an extent not addressing, some of the environmental challenges when giving reports to the municipality. The report generated by the department aims to address the status report (Annexure I) of the treatment works rather than the environmental impact and its consequence on the community. Further to that the municipality is failing to implement the outcomes of the reports and recommendations. Numerous meetings are held but nothing is being done to address the condition.

The report from the Department of Water Affairs (2014) indicated on their Green Drop report that Lebowakgomo WWTW is not in a good state and as it is not on par with the national standards, the report state that the treatment works has moved into a high an critical risk state which requires strategies and intervention of an unusual nature, with resources to back up any plans. The establishment of wastewater treatment works was done by the department and afterwards they were handed over to municipality to take over without proper financial support.

5.3.7.4. Schools from the area

The impact of the wastewater treatment on learners is not clearly, although there is a need for continues awareness campaigns, for water and food monitoring by health inspectors to dictate any risk that may arise due to the effects of the WWTW.

5.3.7.5. Capricorn District Disaster Management

The Disaster Risk Management office is overlooked, the importance of risk reduction is only considered at operational level rather than the strategical level. The unit has minimum staff affecting their involvement in the strategical activities. The unit should continue advocating for disaster risk management within the municipality.

5.3.7.5. Capricorn District Environmental Management

Environmental management issues are not taken into consideration by the other departments. Developed policies and environmental guidelines are being ignored, making the unit to operate in a difficult setting. The unit indicated that the solution for Lebowakgomo WWTW cannot be solved by awareness campaigns, the solution should be sourced to prevent the pollution and this can be done by upgrading the wastewater treatment works.

5.4. Section C: Field Observation

The following observations were made through the inspection in the facility based on the findings done by the Department of Water Affairs and Forestry (2012) and the LEDET 2016 Provincial Report and also the researcher's own observation:

5.4.1. Wastewater treatment works

The WWTW is working above its design capacity, very high inflow at the inlet, no proper disposal of screenings, grit and sludge on site. The outflow meter is not available at the effluent discharge point, which results in the final effluent being discharged without being tested. Due to overflow of the WWTW, most of the effluent is released into the nearby pastureland and into streams and the presence of solids and foam in the treated effluent would pollute the receiving water i.e. Chueniespoort River. Also, a strong odour is released from the plant, screens are under repairs, flows recorded but some of the meters are dysfunctional, bio filters receive uneven flow, blockages and pooling evident, clarification not effective – solids carry-over, scum formation, overload possible, disinfection taking place, efficiency uncertain as result of high solids and ammonia content of final effluent. As stated by Lim *et al.* (2014) untreated or partially treated sewage discharged into surface waters (rivers and drains) or allowed to seep into the ground with minimal treatment may contaminate water leading to an outbreak of waterborne diseases. Lebowakgomo Township is growing at a rapid pace and the same cannot be said of the WWTW, meaning development and activities are not growing at the same pace. If the two development and activities are not done concurrently then as Roma and Jeffry (2010) stated the results in the widespread possibility of health problems related to malaria, cholera and diarrhoea because of contamination of the underground. The initiating factor is recognising disaster risk assessment as a crucial process towards the development of WWTW and also acknowledging that the process is driven by the need to comply with national and legislative framework.

5.4.2. Community

Most of the participants feel frustrated by the situation. The Community members feel that the Municipality is not considering their outcries on the WWTW issues. They complain that their domestic animals are grazing at the treatment works and the nearby pastureland and also drinking the untreated effluent released from the wastewater treatment works. The impact of the situation is badly affecting the cattle farmers as most are dependent on financial wellbeing generated from selling of livestock. Most indicated that they are unable to sell their stock at a market price value due to the stigma associated with their animals drinking contaminated water and also that during community gatherings there are specific parts of the meat that can be consumed, such as the insides (tripe) of the cows (e.g. intestines), but have to be discarded due to what they say because of thickened and corrugated intestinal mucosa/ or rather toxic inflamed intestines.

Figure 5. 8: Pictures of Pastureland and animals drinking from the sewage channel

5.5. Summary

This chapter entails analyses of data collected form the study area, the staff members from the municipality and other related departments, as well as the collected documents, plans and policies assisted in giving a broader perspective on the study area. The chosen methods of analysing data made it simpler to capture and to discuss the necessary information for the study in an organised manner, making the process of doing analyses work easier for the research to interpret.

The results obtained indicated that there is a need for the municipality to consider integrating Disaster Risk Assessment in the proposed upgrade in order to take into consideration the factors raised by the different sectors.

CHAPTER 6: RECOMMENDATIONS AND CONCLUSION

6.1. Introduction

This chapter gives the conclusion, recommendations and the general conclusion in order to ratify the deductions formulated through the research findings by concluding towards effective integration of disaster risk assessment and disaster risk reduction.

6.2. Conclusion

The continued negative trend in terms of the functionality and operations of Lebowakgomo wastewater treatment works, posed by the overloading and the non-functionality of the plant, modelled a high risk to the nearby environment and community. The GAP analysis conducted by CSIR (2016), highlighted measured challenges with the operations and maintenance of the WWTW, indicating that the WWTW was not meeting the minimum standard requirement by the Green Drop Standard. As a way of mitigating the challenges a proposal to upgrade the WWTW is pursued by the Municipality. The continued problems highlighted in section 1.4 and the proposal for the upgrade of the WWTW the researcher saw it fit to investigate the impact of not integrating disaster risk assessment on the upgrade of wastewater treatment works, and the effect the wastewater treatment works will have on the environment and community. In order to adequately address the problems the following specific research questions were pursued:

- What are the national and municipal policy requirements on integration of disaster risk assessment in the establishment of wastewater treatment works?
- What are the impacts of not integrating disaster risk assessment in establishment of wastewater treatment works?
- What effect will wastewater treatment works have on the environment and community?
- What recommendations can be made to highlight the importance of integration of disaster risk assessment in the proposed upgrade of the WWTW?

The analysis of the legislative requirement in chapter 2 was pursued in order to determine the legal mandate and requirement that government the consideration of the disaster risk reduction of the implementation of the wastewater treatment works. In this regard, the national and municipal policies of the study clearly indicate the importance of integration of disaster risk assessment. Outlined in chapter 3 the integration of disaster risk assessment following

the disaster risk assessment process can assist in promoting the following fundamental elements:

- Identification of hazards and coordination of a response plan for all identified hazards within the area ;
- Facilitating a multi-disciplinary and multi-sectoral team;
- Encouraging community participation and resilience;
- Maintaining an iterative process;
- Advancing political will and commitment;

These can lead to the achievement of an effective disaster risk reduction. Hence, the integration of disaster risk assessment is intended to integrate, complement and enhance existing disaster risk reduction strategies. In substantiating the above viewpoint, the research findings as explained from the focus questionnaire and the interview analyses with sector departments (refer to Annexure A-H) strongly indicate the reason why there should be an advocate for integration of disaster risk assessment for the proposed upgrade of the Lebowakgomo wastewater treatment works. The arguments presented recognise the value of a disaster risk assessment as promoting a co-ordinated, uniform and standardised approach in undertaking disaster risk assessment in line with the requirements of the Disaster Management Legislation**.**

However, the reality as sketched out by the research findings is that there are certain anticipated challenges that need to be addressed. The community questionnaire findings in Chapter 5 indicate a clear picture of lack of integration between the community and the municipality. There is also a lack of coordination between sector departments and the local municipality so to address the challenges, the appropriate structures within the municipality need to be coordinated. This includes the internal and external structures that are linked to development within the municipality and furthermore systems and processes will have to be developed, improved upon and implemented to support such a mechanism**.** This can be completed by means of an integrated and co-ordinated planning process pursued by a multidisciplinary and multi-sectoral team. This should encourage the involvement of all relevant sectors and to best exploit the limited resources through a shared and common vision of disaster risk reduction. The progressive inclusion of disaster risk assessment into development and disaster risk management plans linked to the Integrated Development Plan of the municipality as a strategic measure to solve the current challenges and giving importance to the disaster risk management activities should be encouraged. The integration of disaster risk assessment process should advance the positioning of disaster risk

assessment and disaster risk reduction onto the political agenda together with the other important service delivery and developmental issues.

The analysis necessitates advocacy for awareness campaigns, training and development of all stakeholders and community members. To effectively implement such, there are prerequisites that should be satisfied or achieved prior to implementation of any wastewater treatment works project. The primary goal should be to prepare all stakeholders with the relevant knowledge and information so as to promote and sustain their decisive and active engagement throughout the disaster risk assessment process, so as to justify the view of effective stakeholder participation and validating the principles of co-operative governance.

6.3. Recommendations

The integration of disaster risk assessment in the establishment of the wastewater treatment is a purposive perspective that holistically and comprehensively addresses the various concerns, challenges and gaps obstructing the achievement of effective disaster risk management and disaster risk reduction actions. The following are recommended to be considered for establishment and/or proposed upgrade of wastewater treatment works upgrade:

- The modification of existing structures, systems and processes to incorporate the distinct principles of the integrated disaster risk assessment. Emphasis should be on effective institutional arrangements with clear terms of references and a detailed description of the allocated functions and responsibilities facilitating the prompt implementation of each stakeholder.
- Administering of appropriate procedures (such as policies, reports and action plans) to verify whether the institutional arrangements are supporting and maintaining the required outcomes in accordance with the approved mandates.
- The integration of disaster risk assessment at the initial stage of project development for the Establishment and/or upgrade of wastewater treatment works is essential as this will allow for the community's involvement, integration of resource planning like engagement with other services that can be used for the resources' release from the treatment works.
- A change on the implementation of establishment and/or upgrade of wastewater treatment works will assist in minimising the challenges posed by the plant.
- Adopting the integration of disaster risk assessment for any wastewater treatment works to be established or upgrade will assist to incorporate disaster risk reduction measure.

- The adoption of the implementation of the integration of disaster risk assessment for wastewater projects across all sectors of government, this in turn will enforce the implementation of what the law requires thereby assisting in promoting and securing senior management support for all those involved in the wastewater treatment functions and impacting positively on the disaster risk assessment process and its outcomes.

These recommendations should be regarded from a reasonable, practical and cost effective viewpoint so that they can be easy implemented and regarded in the disaster risk management environment as reflected in the concluding remarks.

The researcher sees the need for further research to be done on:

- Integrated disaster risk assessment model for the establishment of wastewater treatment works.
- Conducting disaster risk assessment for the establishment of wastewater treatment works.
- The contribution of IDPs to the reduction of Wastewater treatment works risks for urban settlements.

6.4. General Conclusion

The challenges in the functionality and operations of Lebowakgomo wastewater treatment works, displayed a high risk to the nearby environment and community, the continuous concerns raised by the Marukung community in relation to the wastewater treatment works prompt for a concern and further the lack of a uniform, structured and co-ordinated framework to guide the integration of disaster risk assessment during the establishment and/ or upgrade of wastewater treatment works provided an opportunity to engage in the study. The objectives of the research was to investigate the impact of not integrating disaster risk assessment on the upgrade of wastewater treatment works, and the effect of the wastewater treatment works on the environment and community. In achieving the afore-mentioned objectives, the descriptive method of the qualitative approach was employed with reference to this research, it involved the systematic collection of data through descriptive survey questions and interviews to examine the prevailing conceptualisation of disaster risk assessment in order to build theory that is grounded in the empirical realities of stakeholders involved in the disaster risk reduction.

The outcome of the analyses indicate that the municipality does not comply with Section 24 of the Constitution, the National Water Act, no 36 of 1998, Disaster Management and Environmental Management Legislations and further highlighted a gap between the municipality and the community. This gap can be closed only if there is a paradigm shift in how the municipality does things, hence the integration of disaster risk assessment in the establishment and/or upgrade of wastewater treatment works should be regarded as an important factor to avoid challenges experienced. The lack of engagement with the community and the impact of the wastewater treatment works on the environment and animals indicate a dire need to integrate disaster risk assessment. The benefits of integration is that disaster risk assessment contributes to a standardised, structured, uniform and co-ordinated manner in promoting pro-active disaster risk assessment and disaster risk reduction practices. Consideration to integrate disaster risk assessment in the upgrade of the wastewater treatment can inform and guide co-ordinated and integrated disaster risk assessment and disaster risk reduction planning and implementation by linking and converting the results of the disaster risk assessment process into appropriate disaster risk reduction actions to be applied in the proposed upgrade of the wastewater treatment works.

Most importantly, the application of the disaster risk management process encourages its portability and adaptability across all sectors of government, by all those engaging in the establishment and upgrading of wastewater treatment works. The effective and successful implementation of the integration of disaster risk assessment in the proposed upgrade of the wastewater treatment works warrants the necessary policy interventions by the municipality to be mandated into practice.

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ANNEXURE A: COMMUNITY QUESTIONNAIRE

INTRODUCTION

My name is Lebogang L Mosotho. I am a Master's student at the University of the Free State, in the Disaster Management Training and Education Centre for Africa (UFS-DiMTEC). I am carrying out a research project on "Integration of Disaster Risk Assessment (DRA) into the upgrade of Waste Water Treatment Works (WWTW) in Lepelle-Nkumpi Local Municipality within the Capricorn District Municipality. This research is aimed at determining the integration of disaster risk assessment (DRA) into the upgrade of wastewater treatment works (WWTW) in the municipality.

I kindly request you to complete this questionnaire as objectively as possible. There are no right or wrong answers. Confidentiality of the information you provide will be strictly maintained and the completion of the questionnaire is voluntary.

Thank you very much for your understanding, cooperation and valuable information!

Lebogang Mosotho

Address: Unit 14 Villa Savoye, Waterberry Country Estate, Bendor, Polokwane, 0699

Email: b_lacklee@yahoo.co.uk

Telephone number: 084 679 0817

NB: The questionnaire will take you about 30 minutes to complete. Please mark an "X" to the answer which best suit your opinion or where need be state your opinion in the space provided.

SECTION A: BIOGRAPHICAL DATA

1. **Age** (Tick the appropriate response)

( ) 18-25 years old ( ) 26-30 years old ( ) 31-35 years old

( ) 36-40 years old ( ) 41-45 years old ( ) 46 years old and above

2. **Gender**

( ) Male ( ) Female

3. Employment Status

( ) Single ( ) Married ( ) Divorced ( ) Widowed

4. Supplementary Income

( ) Pension fund ( ) Child/children's fund

( ) Foster fund ( ) others, please specify……..

5. Household Size

( ) 0-2 ( ) 3-6 ( ) 6 and above

6. Number children

( ) 0- 3 ( ) 3-6 ( ) 6 and above

7. Duration of stay in the area

( ) 3 years & below ( ) 4-7 years

( ) 8-11 years ( ) 12 years & above

8. Main source of drinking water?

( ) Rivers ( ) Well/ Boreholes

( ) Catchment, tanks, drums ( ) Piped water

( ) Others, please specify:……

SECTION 2: Knowledge of Wastewater Treatment Works

9. Do you know what a Wastewater treatment works (Sewage) is?

Yes	
No	

10. Is there a Wastewater treatment works in/ or around your Area?

Yes	
No	

11. If Yes to Question 14, approximately when was the wastewater treatment works established?

( ) 3 years & below ( ) 4-7 years

( ) 8-11 years ( ) 12 years & above

12. Performance and management of the wastewater treatment works

Questions	Agee	Strongly Agree	Strongly disagree	Disagree
Do you think the Wastewater treatment works is operating well?				
Do you think the Wastewater treatment works has enough capacity to carry wastewater				
Do you know the problems associated with Wastewater treatment works				
Have you ever experienced any problems from the Wastewater treatment works mentioned above				

13. Duration of existence of problem in the area.

( ) >5 years ( ) 6-10 years ( ) more than 10 years

14. Do you think the Wastewater treatment works is functioning well?

Yes	
No	

If yes, Please explain your response:
……
……

15. Which of the following are affected by Wastewater treatment works in your Area (Select the applicable ones)?

Environment	Yes	No
• *Surface (land)*		
• *River*		
• *Air*		
• *Water*		
• *Underground water*		
Farming land		
Livestock (e.g, Cattle)		
Health		
Houses		
Roads		
Schools		
Others, please specify		

SECTION3: Municipality Engagement with Community

16. **During the establishment and the proposed upgrade of the Wastewater treatment works did the municipality engage with the Community**?

Yes	
No	

If Yes, did you participate in the engagements please explain: ……

17. **Does the Municipality conduct awareness campaigns on Risk associated with the Wastewater treatment works?**

Yes	
No	

If Yes, did you participate in the awareness campaign please explain: ……

18. **Do you think the Wastewater treatment works should be upgraded?**

Yes	
No	

If yes, Please explain your response:
……
……

19. **Do you think the Wastewater treatment works should be relocated?**

Yes	
No	

If yes, Please explain your response:

……
……

20. **Is there any other thing that you will like to indicate about the Wastewater Treatment works in this area?**

Please explain your response:

……
……

THANK YOU FOR YOUR VALUABLE TIME AND INFORMATION!!!

ANNEXURE B: INTERVIEW QUESTIONS FOR INFRASTRUCTURE UNIT OFFICIALS (Water Quality, Design, Planning, O&M)

1. **Age (tick the appropriate response)**

( ) 18-25 Years Old ( ) 26-30 Years Old ( ) 31-35 Years Old

( ) 36-40 Years Old ( ) 41-45 Years Old ( ) 46 Years Old And Above

2. **Gender**

( ) Male ( ) Female

3. **Currently employment position (tick one)**

Manager	
Technicians	
Snr. Process Controller (Supervisor)	
Plant Operators	

4. **Approximately, how long have you been working at the current clinic?**

( ) 3 Years & Below ( ) 4-7 Years

( ) 8-11 Years ( ) 12 Years & Above

5. **Was disaster risk assessment conducted for the proposed upgrade of the WWTW?**

.....
.....

6. **Do you have a disaster risk management plan for the proposed upgrade of the WWTW?**

.....
.....

7. **Was the public consultation conducted for the proposed upgrade of the WWTW**?

.....
.....

8. **What are the main challenges with the current WWTW and how are they being addressed?**

.....
.....
.

9. **Which role players should be involved in the establishment of the proposed upgrade of the WWTW?**

.....
.....

10. **Which role players should be involved in ensuring the integration of DRA in the proposed upgrade of WWTW?**

.....
.....

11. **Do you think it is important to conduct disaster risk assessment for the proposed upgrade?**

.....
.....

12. **What internal challenges could hinder implementation of the proposed upgrade WWTW?**

.....
.....

13. **What external challenges could hinder implementation of the proposed upgrade of WWTW?**

.....
.....

THANK YOU FOR YOUR PARTICIPATION IN THIS STUDY!!!!!!!!

ANNEXURE C: INTERVIEW QUESTIONS FOR DEPARTMENT OF AGRICULTURE

1. **Age (tick the appropriate response)**

   ( ) 18-25 years old ( ) 26-30 years old ( ) 31-35 years old
   ( ) 36-40 years old ( ) 41-45 years old ( ) 46 years old and above

2. **Gender**

   ( ) Male ( ) Female

3. **Currently Employment Position (Tick One)**

Animals Specialist Doctor	
Director	
Managing director	

4. **What is the impact of wastewater on animals?**

……
……

5. **What are the animal diseases associated with wastewater (drinking)?**

……
……

6. **What is the impact/effect on human if they consume such meat?**

……
……

7. **What is the impact of wastewater on agriculture?**

……
……

8. **Are you aware of the challenges around MAKURUNG relating to the WWTW?**

……
……

9. **Do you conduct awareness campaigns?**

……
……

10. **Anything that you may want to add?**

……
……

THANK YOU FOR YOUR PARTICIPATION IN THIS STUDY!!!!!!!!

ANNEXURE D: INTERVIEW QUESTIONS FOR DEPARTMENT OF WATER AFFAIRS MANAGEMENT and LEDET

1. **Age (tick the appropriate response)**

   ( ) 18-25 years old ( ) 26-30 years old ( ) 31-35 years old
   ( ) 36-40 years old ( ) 41-45 years old ( ) 46 years old and above

2. **Gender**

   ( ) Male ( ) Female

3. **Currently Employment Position (Tick One)**

Director	
Manager	
Assistant manager	
Officers	

4. **Who is responsible for the development and maintenance of Lebowakgomo WWTW?**

……
……

5. **What is the departmental mandate on establishment and upgrades of WWTW?**

……
……

6. **Are you aware of the problems associated with the Lebowakgomo WWTW, if yes? What is the department doing to address the problems?**

……

7. **What is the department doing to ensure legislative enforcement to address the problems?**

……

THANK YOU FOR YOUR PARTICIPATION IN THIS STUDY!!!!!

ANNEXURE E: QUESTIONS FOR DEPARTMENT OF EDUCATION (SCHOOLS AROUND MAKURUNG VILLAGE)

1. **School**

Primary	
Secondary (high)	

2. **Age** (Tick the appropriate response)

( ) 18-25 years old ( ) 26-30 years old ( ) 31-35 years old

( ) 36-40 years old ( ) 41-45 years old ( ) 46 years old and above

3. **Gender**

( ) Male ( ) Female

4. **Currently employment position (tick one)**

Clerk	
Educator	
Head of department	
Vice principal	
Other, specify	

5. **Approximately, how long have you been working at the current school?**

( ) 3 years & below ( ) 4-7 years

( ) 8-11 years ( ) 12 years & above

6. **As the school are you affected by the Lebowakgomo WWTW?**

YES	**NO**

7. **If yes Q6, how affected are you? Tick one**

Strongly affected	**Partially affected**	**Least affected**	**Not affected**

8. **As the school are you aware of the challenges (risks) associated with WWTW?**

YES	**NO**

If yes, state them:

……

……

9. How are these identified challenges (risks) affecting your school?

Please explain:

……

……

10. What programmes are the school conducting to bring awareness on the identified challenges (risks)

……

……

11. Do you think it is important for the municipality to conduct awareness on risks associated with the WWTW At schools?

Yes	**No**

If yes, explain:

……

……

12. Please indicated five factors that will improve Lebowakgomo wastewater treatment plant and benefit the school?

……

……

THANK YOU FOR YOUR PARTICIPATION IN THIS STUDY!!!!!!!!

ANNEXURE F: QUESTIONS FOR DISASTER MANAGEMENT OFFICIALS

NB: *DRA (Disaster Risk Assessment) *WWTW (Wastewater Treatment Works) *EIA (Environmental Impact Assessment)

1. **AGE (Tick the appropriate response)**

( ) 18-25 years old ( ) 26-30 years old ( ) 31-35 years old

( ) 36-40 years old ( ) 41-45 years old ( ) 46 years old and above

2. **GENDER**

( ) Male ( ) Female

3. **Currently employment position (tick one)**

Manager: Disaster Management	
Disaster Management Officer	
Disaster management coordinators	

4. **Approximately, how long have you been working at the current clinic?**

( ) 3 years & below ( ) 4-7 years

( ) 8-11 years ( ) 12 years & above

5. **What are the current DRA Practices within the municipality?**

.....

.....

6. **Is DRA identified as one of the strategic goals of the organisation?**

.....

.....

7. **Was DRA Conducted for the Lebowakgomo WWTW?**

.....

.....

8. **If yes, were you involved?**

.....
.....

9. **Does the municipality have a disaster risk management plan?**

.....
.....

10. **If yes, is the disaster risk assessment integrated in the municipal disaster management plan?**

.....
.....

11. **Have you ever responded to a disaster incident related to the WWTW?**

.....
.....

12. **As a disaster management practitioner do you think it is important to conduct and integrate disaster risk assessment for the planned project (upgrade)?**

.....
.....

THANK YOU FOR YOUR PARTICIPATION IN THIS STUDY!!!!!!!!

ANNEXURE G: INTERVIEW QUESTIONS FOR ENVIROMENTAL MANAGEMENT OFFICIALS

NB *DRA (Disaster Risk Assessment) *WWTW (Wastewater Treatment Works) *EIA (Environmental Impact Assessment)

1. **Age (Tick the appropriate response)**

( ) 18-25 years old ( ) 26-30 years old ( ) 31-35 years old

( ) 36-40 years old ( ) 41-45 years old ( ) 46 years old and above

2. **Gender**

( ) Male ( ) Female

3. **Currently employment position (tick one)**

Manager: Environmental Management	
Environmental Management Officer	
Others	

4. **Approximately, how long have you been working at the current clinic?**

( ) 3 years & below ( ) 4-7 years

( ) 8-11 years ( ) 12 years & above

5. **What are the responsibilities of the office of environmental management in the municipality?**

.....

.....

6. **Do you have plans and policies that govern the implementation of environmental management within the district?**

.....

.....

7. **Were you involved in the establishment of the Lebowakgomo WWTW? if yes, how?**

.....

.....

8. **Are you involved in the proposed upgrade of WWTW, if yes what is your involvement?**

……

……

9. **Is EIA conducted for the proposed upgrade of WWTW, if yes do you have the report?**

……

……

10. **What are the environmental problems associated with the current WWTW?**

……

……

11. **Which of the associated problems have been reported since the establishment of WWTW?**

……

……

12. **Do you conduct environmental compliance monitoring inspections for the Lebowakgomo WWTW and around the Makurung area, if yes how many times?**

……

……

13. **Do you conduct environmental awareness on problems associated with the WWTW**?

……

……

14. **Does the WWTW adhere to the environmental management policies (either nationally or locally)?**

.....

.....

15. **Any other thing that you may want to add?**

.....

.....

THANK YOU FOR YOUR PARTICIPATION IN THIS STUDY!!!!!!!!

APPENDIX H: REPORT ON SEWAGE TREATMENT FACILITIES IN THE LIMPOPO PROVINCE

Sewage Treatment Facilities Status Report Capricorn District 2014-15, Source (LEDET, 2016)

CAPRICORN DISTRICT MUNICIPALITY				
Lepelle-Nkumpi Local Municipality				
Name of Facility	**Ownserhip**	**Local municipality**	**Status**	**Action required**
1. Lebowakgomo Zone B and F Oxidation Ponds	Capricorn District Municipality	Lepelle-Nkumpi Local Municipality	• No License • No Operational Plan • Inadequate equipment • Effluent analysis not done	• Application for License • Operational Plan • Vegetation control • Ablution facilities • Effluent analysis • Equipment
2. Habakkuk Oxidation Ponds	LIMDEV	Lepell- Nkumpi Local Municipality	• Abandoned and in a very bad/ critical state	• Transfer to CDM as WSA • Application for License • Operational Plan • Vegetation control • Ablution facilities • Effluent analysis •
3. Lebowakgomo Zone A Sewage Works	Capricorn District Municipality	Lepelle-Nkumpi Local Municipality	• No License • No Operational Plan • Adequate equipment • Personnel available • Effluent analysis not done	• Application for License • Operational Plan • Effluent analysis
4. Sekutupu Sewage Works	Department of Health and Social Development	Lepelle-Nkumpi Local Municipality	• No License • No Operational Plan • Adequate equipment • Operator available • No ablution facilities	• Application for License • Operational Plan • Ablution facilities
Aganang Local Municipality				
5. Harry Oppenheimer Oxidation Ponds	Department of Education	Aganang Local Municipality	• No License • Operational Plan not available • Adequate equipment • No Operator • Effluent analysis not done	• Application for License • Operational Plan • Effluent analysis • Vegetation control
6. Roman Catholic Faith Mission Oxidation Ponds	Roman Catholic Faith Mission	Aganang Local Municipality	• The sewage treatment system consists of 13 septic tanks and two oxidation ponds which are recent and were poorly constructed without a Waste Management License being obtained.	• Application for License • Refurbishment of the system

			• There is neither a Water Use License nor an Operational Plan. • The sources of wastewater are Roman Catholic Mission, Motse Maria High School, Motse Maria Boarding Dormitories and St Girls Center. • There is neither a screen, a flow meter nor an operator for the site. • There is scum and flies on the surface of the ponds. • The site is not fenced thereby allowing animals to gain access to the ponds. • Effluent is neither disinfected nor analysed before it is discharged to the environment.	
7. WF Knobel Hospital Oxidation Ponds	Department of Health and Social Development	Molemole Local Municipality	• The plant has been abandoned and its condition is in a worse/critical state.	• The plant needs refurbishment • Application for License • Operational Plan • Operator • Effluent analysis • Ablution facilities
Blouberg Local Municipality				
8. Senwabarwana Oxidation Ponds	Capricorn District Municipality	Blouberg Local Municipality	• No License • No Operational Plan • Inadequate equipment • Effluent analysis not done • Excessive vegetation	• Application for License • Operational Plan • Vegetation control • Effluent analysis
9. Blouberg Health Care Facility Oxidation Ponds	Department Of Health	Blouberg Local Municipality	• No License • No Operational Plan • No Operator • No proper fence • Residential development encroaches the facility • Effluent analysis not done	• Application for License • Operational Plan • Effluent analysis • Vegetation control

			• Excessive vegetation	
10. Alldays Sewage Works	Capricorn District Municipality	Blouberg Local Municipality	• No remarkable improvement instead raw effluent is discharged into the environment • No License • No Operational Plan • No Operator • Effluent analysis not done • Excessive vegetation	• Application for License • Operational Plan • Effluent analysis • Vegetation control
Molemole Local Municipality				
11. Morebeng / Soekmekaar Sewage Works	Capricorn District Municipality	Molemole Local Municipality	• No License • No Operational Plan • Effluent analysis not available	• Application for License • Operational Plan • Effluent analysis • Personnel
12. Molemole Oxidation Pond	Capricorn District Municipality	Molemole Local Municipality	• No License • No Operational Plan • No Operator • Abandoned • Effluent analysis not done	• Application for License • Operational Plan • Effluent analysis
13. Mogwadi Oxidation Ponds	Capricorn District Municipality	Molemole Local Municipality	• Project on developing of an artificial wetland abandoned • Newly developed change room inhabited by an unknown person. • No License • No Operational Plan • Effluent analysis not done	• Application for License • Operational Plan • Effluent analysis

APPENDIX: I - CERTIFICATES OF EDITOR

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CERTIFICATE

This serves to certify that I have language edited the Mini-Dissertation of

Ms Lebogang Linah Mosotho,

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entitled:

"INTEGRATING DISASTER RISK ASSESSMENT INTO THE UPGRADE OF THE WASTEWATER TREATMENT WORKS (WWTW) IN LEPELLE-NKUMPI LOCAL MUNICIPALITY, LIMPOPO PROVINCE"

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