



# **The quality of Integrated Waste Management Plans for Metropolitan Municipalities in South Africa**

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Mini-dissertation submitted in partial fulfilment of the requirements for the degree *Master of Environmental Management* at the North-West University

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Graduation May 2019

24377333

## **PREFACE AND ACKNOWLEDGEMENTS**

*“Just remember, you can do anything you set your mind to, but it takes action, perseverance, and facing your fears” Gillian Anderson.*

I'm thankful to the Lord God Almighty who renewed my strength and gave me the ability to complete my studies.

Thank you to my loving and supportive husband, Tshifhiwa Radzilani, who supported me emotionally throughout the course. You never allowed me to give up and always encouraged me to complete.

To my beautiful baby boy, Pendo Radzilani, who was conceived during the course of the study, you became my motivation.

I would like to express my sincere gratitude to Professor Luke Sandham for his patience, guidance and support during this learning process.

Thank you to my parents who sacrificed for my first degree qualification, and my siblings for their endless support.

Thank you to my sponsor Transnet SOC Ltd for granting me the opportunity to study; Environment and Sustainability team for their endless support and motivation.

## **ABSTRACT**

Waste management is a concern in both developed and developing countries. Rapid growth in industrialization and urbanization is resulting in the increase of waste generation and volumes in metropolitan cities. Poor waste management has a detrimental impact on the environment and public health. Therefore, these detrimental impacts and concerns have resulted in waste management receiving attention both locally and internationally. South Africa's waste management practices are similar to other developing countries but are in some areas more advanced when compared to other African countries. There is still a lot to be done to achieve a sustainable state of waste management. Waste management policy and legislation is available and currently being implemented to a certain extent, however enforcement is a challenge. The implementation of a proper waste management system faces challenges such as an insufficient budget; lack of organizational capacity; lack of public awareness and political influence; and inadequate technology. The preferred waste management option in South Africa is landfilling, and it remains a preferred option in many developing countries, despite detrimental impacts associated with it.

The South African government published the National Waste Management Strategy in xxxx which introduced the Integrated Waste Management Plan (IWMP) as a tool that will give effect to the its National Environmental Management: Waste Act, 59 of 2008 and sustainable waste management strategies. IWMP is a tool that developed to shape and guide waste management practices that affects the environment and people's heath.

The aim of the study is to assess the quality of the IWMP which has been specifically developed for metropolitan municipalities in South Africa. The research objectives are to develop and adapt a review package to review the quality of IWMPs; to review the quality of sampled IWMPs from eight metropolitan municipalities in South Africa, and to analyse and interpret the results and draw conclusions regarding the quality of IWMPs in the metropolitan municipalities in South Africa. A quality review package was designed to fit the waste management legislation requirements and the approach was adopted from the Lee and Colley methodology.

The results of the quality review of the IWMP revealed that the overall quality of the sampled IWMPs was satisfactory with minor omissions. However, there are areas of concern that require attention, that once addressed has the potential to improve the quality of the IWMPs.

Keywords: Integrated waste management plan (IWMP); IWMP quality; IWMP quality review; Municipal solid waste (MSW); waste management; Metropolitan municipalities.

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## ABBREVIATIONS AND ACRONYMS

|        |                                                          |
|--------|----------------------------------------------------------|
| DEA    | Department of Environmental Affairs                      |
| DEAT   | Department Environmental Affairs & Tourism               |
| DEFRA  | Department for Environment Food & Rural Affairs          |
| ECA    | Environment Conservation Act                             |
| EIA    | Environmental Impact Assessment                          |
| EMPr   | Environmental Management Programme                       |
| EPR    | Extended Producer Responsibility                         |
| IBA    | Incineration Bottom Ash                                  |
| ISWM   | Integrated Solid Waste Management                        |
| IWMP   | Integrated Waste Management Plan                         |
| MOEP   | Ministry of Environmental Protection                     |
| MOHURD | Ministry of Housing and Urban-Rural Development of China |
| MSW    | Municipal Solid Waste                                    |
| NEA    | National Environmental Agency                            |
| NEMA   | National Environmental Management Act                    |
| NGO    | Non-Governmental Organization                            |
| NPSW   | National Policy on Solid Waste                           |
| NWMS   | National Waste Management Strategy                       |
| SACN   | South African Cities Network                             |
| SSWM   | Sustainable Solid Waste Management                       |
| SWM    | Solid waste management                                   |
| UN     | United Nations                                           |
| UNEP   | United Nations Environmental Programme                   |

## CHAPTER 1: INTRODUCTION

### 1.1 Integrated waste management planning in South Africa

South Africa as a developing country has a rapidly growing population and economy, which leads to increase in the volume of waste generated from different industries (DEA, 2011). Research has shown that the growth of urban populations are directly linked to the generation of municipal waste in the cities (Simelane and Mohee, 2012). The increase in waste generation in South Africa has consequently resulted in waste management becoming a major socio-economic and environmental problem (DEA, 2011). This concern has also seen South Africa's involvement in international protocols and conventions and also agreeing on a sustainable development strategy (Karani and Jewasikiewitz, 2007). South Africa has an obligation to adhere to international commitments by promoting an integrated waste management approach which is aligned with the municipality's objectives to manage waste sustainably (Asase *et al.*, 2009; Soltani *et al.*, 2017).

By 2011, 80% of the municipalities in South Africa had initiated integrated waste management systems and initiatives due to promulgation of the White paper policy on Integrated Pollution and Waste Management. DEA (2011) stated that most of these municipalities are struggling to implement waste management initiatives. The waste management system is under duress resulting in failure to deliver adequate and effective waste management services (Simatele *et al.*, 2017). Failure to deliver is due to limited resources, lack of capacity and adequate waste management tools similar to Integrated Waste Management Plans (IWMP) (Asase *et al.*, 2009; Bhagwandin, 2013).

All municipalities are required by the National Environmental Management Waste Act, 59 of 2008; Municipal System Act 32 of 2000 and National Waste management Strategy of 1999 to develop a IWMP. The IWMP is an important document intended to give a synopsis of the local municipality's "cradle to grave" waste management practices (Muswema, 2012). The IWMP is a planning document which includes comprehensive background information on the current waste situation in the municipality as well as the current regulatory framework. The IWMP is further expected to provide cost-effective and technical, as well as environmental solutions for the waste management of each municipality (Furter, 2003). Although the IWMP has been in place since the inception of the National Waste Management Strategy in 1999, it is still going through different trials to prove its effectiveness and determines whether it is achieving its intended purpose. In the local government most of the municipalities from the metros to the districts are still trying to find a way to fully comply with the requirements of the IWMP. Sango *et al.*, (2016) states that development of the first and second IWMPs over

the past ten years indicates municipal's progress in waste management, Municipalities are reviewing developed IWMPs to ensure alignment with the statutory requirements and improve on the quality ( Muswema, 2012)

The quality of the IWMPs is important as the plans will guide and influence effective implementation of waste management sustainably. There are various factors that influence the quality of the IWMPs produced by the municipalities. These factors vary from stakeholder participation; sufficient budget; lack of capacity; lack of waste management data; compliance and monitoring (Muswema, 2012). Given the concerns and dissatisfaction with the municipalities' waste management system, assessing the quality of the IWMPs is necessary as municipalities use these plans to guide and shape waste management within their jurisdiction. Boshoff (2013) stated that the quality of EIA reports affect decision-making which ultimately influence effectiveness of the EIA process. The quality of EIA reports will be examined to establish a methodology that will be used to assess the quality of the IWMPs.

## **1.2 Problem statement**

Fuller (1999) states that the quality of Environmental Impact Assessment (EIA) reports is associated with the quality of the EIA process. Authors like Fuller (1999) and Lee *et al.* (1999) stated that there are various aspects that influence the EIA process, such as public involvement, cost-effectiveness and impact analysis methodology used during the EIA process. To date these statements are still valid and supported by other authors such as Sandham *et al.*, (2013).

Each project is required to comply with certain legislative regulations and the requirements of that specific regulation becomes the minimum standard that the quality of the EIA report should comply with. The quality of the reports is one aspect to assess effectiveness. The quality of EIA reports or any other environmental management reports including IWMPs need to be investigated to establish its effectiveness in a specific environmental management (EIA or waste management) system (Pinho *et al.*, 2007; Sandham and Pretorius, 2008).

It is evident in the literature that the quality of EIA reports has been investigated in South Africa using a review package (Sandham and Pretorius, 2008; Sandham *et al.*, 2013). The Lee and Colley review package has been adapted to evaluate the quality of EIA reports for various projects, for example projects with the potential of affecting wetlands (Sandham *et al.*, 2008), projects in explosive manufacturing industry (Van Der Vyver, 2008), and EIA reports for filling stations (Kruger, 2012). This work was extended with quality review of

EMPr in the mining sector using the same methodology (Joubert, 2015). Some research has been done on waste management and minimization initiatives (Bhagwandin, 2013), implementing waste collection and mechanical biological waste treatment in South Africa (Trois & Simelane, 2010) and IWMP Implementation challenges and lessons learnt (Muswena, 2012). However, no research exists on the quality review produced specifically for metropolitan municipalities. Therefore the study will assess the quality of IWMPs produced by the metropolitan municipalities in South Africa.

### **1.3 Research aim and objectives**

The study aims to investigate the quality of Integrated Waste Management Plans developed for the metropolitan municipalities in South Africa.

The following objectives were set:

- To develop and adapt a review package to review the quality of IWMPs.
- To review the quality of IWMPs from eight metropolitan municipalities in South Africa.
- To analyse and interpret the results and draw conclusions regarding the quality of IWMPs in the metropolitan municipalities in South Africa.

### **1.4 Structure of dissertation**

Chapter 1 gives a brief introduction to the waste management system and available waste management policy in South Africa. IWMP is briefly introduced along with its intended objectives, and the status quo of IWMPs at metropolitan municipalities. The aim and objectives of the study are also provided. Chapter 2 provides review of relevant literature on waste management practices in developed and developing countries. The current waste management practices in South Africa was also discussed and the problems associated with the waste management system and the role of municipalities in waste management and factors affecting implementation of IWMPs. The methodology used to review the quality of EIA reports was also briefly discussed and how it was adapted to review the quality of the IWMPs of the metropolitan municipalities. The research methods used to achieve the objectives is discussed in Chapter 3. The analysis and findings of this study is presented in Chapter 4 and Chapter 5 gives the concluding remarks and recommendations for the improvement of the quality of IWMPs.

## CHAPTER 2: LITERATURE REVIEW

### 2.1 Waste Management Hierarchy

The waste hierarchy has its foundation in European waste legislation and is intended to be used as a guide for waste policies and programs (Waste Directive Framework, 2008). The Waste Directive Framework (WDF) (2008:6) stated that “the waste hierarchy sets a basis for priority order of what constitutes best overall environmental option in waste legislation and policy”. Van Ewijk and Stegemann (2016:123) describe the waste hierarchy as “a priority order for (at least three) waste management options, based on assumed environmental impacts” and further indicates that cost, contamination and capacity were the main reasons for shift in waste management space from disposal-based waste management to the waste hierarchy.

The priority order of waste management as illustrated by the waste management hierarchy (Figure 1) is prevention; re-use; recycle; recovery and disposal (Hoorweg and Bhada-Tata, 2012; Weliveta, 2014). From Figure 1 it can be seen that the shows the order of preference of the the waste hierarchy, where prevention is most preferred and disposal is least preferred. The waste hierarchy is important for sustainable development, Price and Joseph (2000) stated that the order of the preference of the waste hierarchy is taken as the point of reference for achieving sustainable waste management and are therefor also important for sustainable development.

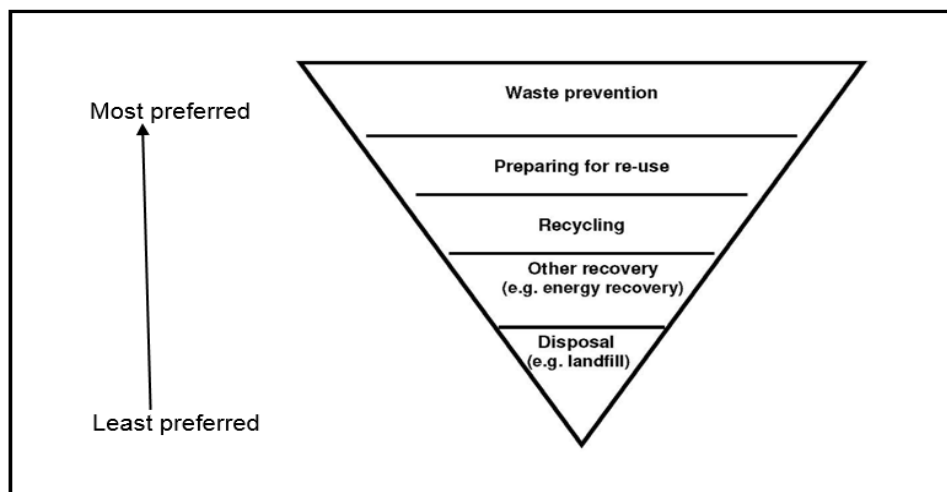


Figure 1: The Waste Hierarchy (Waste Directive Framework, 2008)

### **2.3.1 Prevention**

Prevention is the most preferred option in the waste hierarchy. The European Commission (2010) states that good practice of waste management starts with preventing waste from being produced. The Waste Directive Framework (2008:8) defines prevention as “measures taken to reduce the quantity of waste. The current global waste crisis, is calling for the prevention of waste, as the utilization of natural resource is threatened by population increase and high consumption of resources (European Union, 2010). Prevention is achieved through eco-designs, by incorporating waste prevention in the conception and design phase of the product. Eco-design focuses on environmental aspects and considers re-use of recycled material (European Union, 2010). Environmental aspects considered is that the product must consume less energy and be recyclable if discarded. The public plays a key role in waste prevention, through awareness consumers can influence manufacturers to produce products that produce less waste and use less energy (European Union, 2010).

### **2.3.2 Re-use**

According to Welivita (2014:30) re-use is defined as “using materials which are destined to end up as waste in their original form without them undergoing any processing”. Gharfalkar (2015) further defines re-use as extending the life span of products. Re-use of products is commonly practiced at households, where empty containers are re-used to store something else and carrier bags are re-used instead of being thrown away as waste. Other developing countries are encouraging households to separate waste to reusable and recyclable materials that will be collected by a third party. Countries like China are incentivizing waste separation (Tai *et al.*, 2011) while other countries have not started incentivizing the public thus discouraging the public to participate in waste management initiatives. Ngoc and Schitzer (2009) indicate that the government in developing countries should encourage the public (households and industries) to re-use material. According to the European Commission (2010) other countries are also introducing policies to encourage re-use. Industries can be forced to re-use material through policy and taxation based on the amount of waste produced (Welivita, 2014). Government can also encourage industries with a reward system for less waste taken to landfill.

### **2.3.3 Recycling**

According to European Commission (2012) recycling is done to save space at landfill as it reduces the amount of waste taken to the landfill site. According to Gharfalka *et al.*, (2015:307) recycling is when “a waste material is processed in order to alter its physio-chemical properties allowing it to be used again for the same or other applications.” Although recycling is considered an economic activity (Welivita, 2014), it is however dependent on

the technology available, quantity and quality of recyclable material (Hoornweg and Bhada-Tata, 2012). The main steps of recycling are collection, transportation and processing and there are costs associated with each of these steps in the process. The main participants in the recycling process are households, industries, municipalities and scavengers. According to Hoornweg and Bhada-Tata (2012) recycling can also be considered to be uneconomical as participants need to be provided with the right tools and equipment to recycle. The local government has to bear all the costs, as recycling is often a government initiative for sustainable solid waste management. Recycling has been successful in countries where participants are equipped and the public is forced to recycle through policy enforcement. Welivita (2014) states that recycling has been a success in Taiwan because the government introduced a mandatory waste separation policy, thus forcing households to participate in recycling.

Recycling is done to save operational cost and also to save space in landfills. To achieve these objectives, household participation is important. Incentives must be introduced, and awareness initiatives should be done to also encourage voluntary participation of waste separation at a source (European Union, 2012). The rate of recycling can also increase if industries are forced to buy recyclable material. Through policy this can be enforced, which in turn can help the industries to reduce their use of raw material tax (European Commission, 2012).

### **2.3.4 Recovery**

Recovery is defined as the “extraction of materials or energy from waste for further use” (Welivita, 2014:33). Recovery can either be in a form of energy recovery or material recovery, energy recovery is done through incineration and material recovery is done by composting (Hoornweg and Bhada-Tata, 2012).

#### **2.3.4.1 Energy Recovery**

Energy recovery is common recovery process used in many countries through incineration technology and is considered to be the most effective waste management solution (Yap and Nixon, 2015). Singh *et al.*, (2011) state that incineration reduces the volume of waste by 90% at landfill sites and provides valuable energy. Yap and Nixon (2015) indicate that energy recovery is dependent on the socio-economic dynamics and technology of a country. Investment is needed to set up an incineration plant with appropriate technology. In countries where the government has invested in incineration plants, energy recovery is successful and continue to grow (Yap and Nixon, 2015).

The European Commission (2012) argues that energy recovery through incineration is not the most efficient way of managing used material. This is because some of the material might be difficult to burn resulting in the release of hazardous chemical when burnt at high temperatures (European Union, 2012). Mikic and Naunovic (2013) indicate that incineration plants are expensive to build and can negatively impact the environment as they produce emissions and chemical residue. However, energy recovery through incineration is still considered a better option than coal power plants from a social and environmental perspective (Mikic and Naunovic, 2013).

#### *2.3.4.2 Material Recovery (Composting)*

Composting is another form of material recovery and entails saving organic waste from going to the landfill (Welivita, 2014). Composting is defined as “the biological decomposition of biodegradable solid waste under controlled predominately aerobic conditions to a state that is sufficiently stable for nuisance free storage and handling and is satisfactorily matured for safe use in agriculture” (Welivita 2014:34). The recovery of organic waste from household waste is still low due to organic waste going to landfill (Welivita, 2014). In Germany source separation of organic waste is mandatory in many municipalities with about 700 to 900 composting facilities operational.

Separation at a source will prevent large amounts of organic material going to waste and also significantly decrease the environmental impacts compared to landfilling (Sharma and Chandel, 2017). When composting is done at a landfill, there is a risk of organic waste mixing with hazardous waste, thus contaminating organic waste with heavy metal content. Coffey and Coad (2010) suggest that separation of organic waste at a source is important to avoid contamination. Contamination free organic material is crucial for food growth (Welivita, 2014).

Composting and anaerobic decomposition (absence of oxygen) are commonly used for treating and recycling the organic material of Municipal Solid Waste (MSW) in Europe. MSW composting plants were used but due to contamination with high metals, separation of waste at a source is preferred. Organic material recovery requires public participation, technology and compost quality assurance to be successful (Adhikan et al., 2010).

### **2.3.5 Disposal**

Disposal is the least preferred option on the waste hierarchy because of the adverse impacts it has on the environment as well as the public health (European Union, 2012). According to (Shekdar, 2009:1441) disposal is considered to be “any operation which is not recovering any material or any solid waste that cannot be processed or residues and other materials that are discarded after processing that are ultimately disposed by landfilling”. Landfilling is an example of disposal and is the oldest form of waste treatment (Welivita, 2014).

Landfilling can result in the production and release of methane and other greenhouse gas more harmful than carbon dioxide. Methane can combust which can cause uncontrollable fires (European Union, 2012). Dissolved heavy metals result in groundwater contamination, surface water and soil contamination which pose as a risk to public health and environment (Hoornweg and Bhada-Tata, 2012).

The European Commission is working with Environmental Authorities who are responsible for issuing permits and ensuring compliance at landfill. European legislation on landfill is making a difference with non-compliant landfills closed in Europe since the introduction of stringent legislation and the Landfilling Directive 1999/31/EC (DEFRA, 2014). The amount of waste taken to landfill has been reduced by 25% since 1995. European countries are disposing less waste at landfills, however landfill still remains a common form of municipal disposal. Hoornweg and Bhada-Tata (2012) suggest that landfill should be engineered and prepared to protect the environment and public health.

Proper landfilling remains an issue in developing countries as it is a preferred disposal option. Yet developing countries are also realizing that landfill is not adequate. Countries are implementing sustainable waste management to control landfilling in order to minimize environmental pollution (Shekdar, 2009). Source separation is one of the initiatives that has been implemented to reduce landfilling.

### **2.3.2. Disadvantages of the waste hierarchy**

The waste hierarchy is widely accepted and commonly practiced across the globe. However, there are few gaps identified that result in the waste hierarchy not achieving its intended objectives. The waste hierarchy does not look at lifecycle assessment, it fails to predict the impact waste has on the environment whilst at a landfill or where different waste treatment method have been combined during waste treatment (McDaugall *et al.*, 2003; Van Ewijk and Stegenamm, 2016). Therefore, there is a lack of overall lifecycle assessment as there is no consideration of material input and economic output (Van Ewijk and Stegemann, 2016).

According to McDaugall *et al.* (2003) the waste hierarchy does not conduct cost assessments and cannot determine the economic affordability of a waste management system. It only suggests the most preferred method to least preferred. The liability lies with the responsible person to do cost assessment. Although there is large amount of research recommending that the waste hierarchy is implemented (Price and Joseph, 2000; Gharfalkar *et al.*, 2015; Bartl, 2014; Welivita, 2014), there seems to be limited scientific or technical reviews on preferred material recycling compared energy recycling.

The waste hierarchy options need to be linked with the goal that the country wants to achieve in terms of waste management and managing environmental impacts. Developing countries are implementing the waste hierarchy without setting targets and as a result the benefits of implementing waste hierarchy are not realized. Once a target has been set it can be measured in order to determine whether it has been achieved. Brazil is an example of a developing country that set a target of closing all open disposal dumps by 2016 (Filho *et al.*, 2016) and this ensured that all the effort of implementing waste hierarchy are aimed at achieving the country's objective of closing open disposal dumps (Miguel *et al.*, 2016). Furthermore once the objective is identified, the stakeholders are able to come on board and work with the government through partnerships and also invest to achieve the common goal.

## **2.2 Sustainability and Waste Management**

Solid waste management comes from the Sustainable Solid Waste Management (SSWM) concept. SSWM originates from "sustainable cities" which is a concept of "Sustainable Development" (Welivita, 2014). The concept of SSWM is understandable once sustainable development and sustainable cities is defined. Sustainable development is defined in the Brundtland Commission Report (1987:46) as "development which meets the needs of the present without compromising the ability of future generations to meet their own needs". Following the Brundtland Commission Report was Agenda 21 developed at the "Earth Summit" in Rio de Janeiro in 1992. Agenda 21 is a statement which gave guidance to economic development in the 21<sup>st</sup> century. The conclusion from the Brundtland Commission Report criticized cities in industrialized countries as they were responsible for a "high use of world's the resources, energy consumption and environmental pollution". Sustainability considers economic, environmental and social aspects. Therefore, sustainable development in major cities has to be "economically viable, environmentally effective and socially acceptable" (Welivita, 2014:5).

To link the sustainability concept with sustainable solid waste management it needs to be understood that the majority of urban population is found in the cities because of numerous economic development activities that happen there (Hoornweg and Bhada-Tata, 2012; Welivita, 2014) . As a result, cities are faced with a problem of solid waste management. Solid waste management in the cities receives public attention due to unpleasant visibility of waste and impact on the public health (Gupta and Gupta, 2015). In the endeavor of local authorities addressing the issue of solid waste management, it has to be done in a sustainable manner (Welivita, 2014). Zaman (2015) further states that sustainable production and consumption such as energy production is stimulated by zero waste initiatives to minimize waste going to the landfills in the city.

Sustainable solid waste management can be achieved through “the waste hierarchy” (Welivita, 2014; Hoornweg and Bhada-Tata, 2012). However developing countries are not fully utilizing the waste hierarchy, and as a result sustainable solid waste management is not implemented effectively (Shekdar, 2012). The sustainable management of solid waste requires an integrated system that will integrate all elements, aspects and key stakeholders (Marshall and Farahbakhsh, 2013).

### **2.2.1 Integrated Solid Waste Management (ISWM)**

Hoornweg and Bhada-Tata (2012) state that to deal with solid waste a comprehensive approach is required that carefully considers the sustainable application of technology, local conditions and the relationship or partnership between the community and local authorities (government or municipalities). Hoornweg and Bhada-Tata (2012) state that the effectiveness ISWM depends on the competency of the local authorities; local community participation and the environment conditions within which the system is implemented. Hoornweg and Bhada-Tata (2012) further indicate that ISWM is based on the options of waste hierarchy (prevention; reduce; reuse; recycle and recovery) and should be objective driven. The objectives of ISWM are outlined in the ISWM plan, which is developed by the local authorities. The ISWM plan consist of the following components:

**Table 1: Summary of components of a ISWM plan (Hoornweg and Bhada-Tata, 2012)**

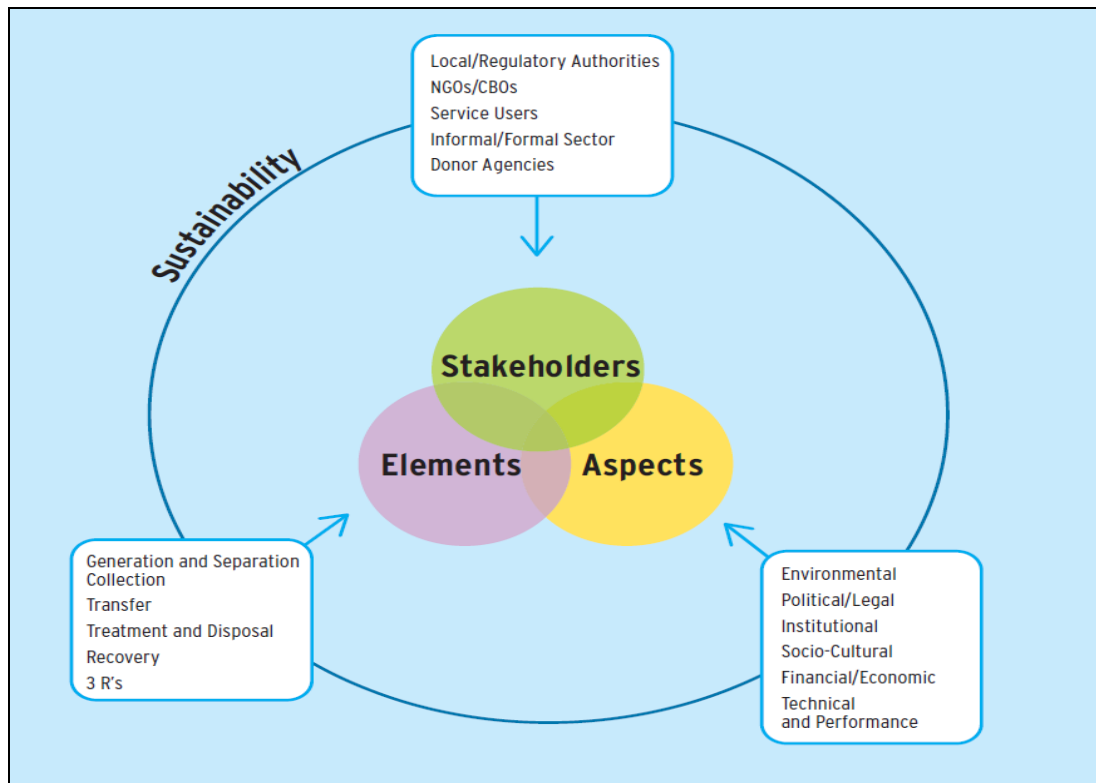
|                                                                                    |                                                                                                                                                            |
|------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1. Municipalities' policies, aims, objectives and initiatives of waste management. | 8. Regulated institutions to support the plan                                                                                                              |
| 2. Geographical location; demographics and development of the municipalities,      | 9. Financial assessment of the plan, investment analysis and cost of waste management (including waste management services ) for the duration of the plan, |
| 3. Waste data for present and future years (any data between 10-25 years).         | 10. Specify Financial and investment sources required for the implementation of the plan.                                                                  |

|                                                                                                                              |                                                                                                                                                                                                                  |
|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Waste composition and characteristics (moisture content and density) for current and future predictions.                     |                                                                                                                                                                                                                  |
| 4. Identify waste collection, transportation, treatment and disposal options for all waste types                             | 11. Requirements for managing arising issues that are not related to management of solid waste, facilities required, responsible party and services required. Cost associated and who is responsible for payment |
| 5. Assessment of best practical environmental options that integrate technical, environmental, social and financial aspects. | 12. Proposed implementation plan is valid for 50-10 years, with immediate action plan for 2-3 years                                                                                                              |
| 6. Specific waste amount and the treatment system from collection, transportation, treatment and disposal.                   | 13. Summary of public consultation conducted during the plan preparation and future consultations                                                                                                                |
| 7. Specific continuous monitoring and control measures that will be recorded and reported regularly.                         | 14. Summary of program for waste management at key facilities ( landfill, composting plant and transfer stations)                                                                                                |
|                                                                                                                              | 15. Assessment of GHG emissions and the role of Municipal solid waste in the entire city operation.                                                                                                              |

### 2.2.2 Integrated Sustainable Waste Management system

According to Hoornweg and Bhada-Tata (2012) equality, efficiency, effectiveness and sustainability are the four main principles of ISWM. Equity ensures that all citizens have access to an ISWM system that effectively manages waste efficiently in order to maximize the benefits, minimize the cost of implementing the ISWM system and enhance the use of resources. There are three components of ISWM that are inter-dependent and inter-connected. The three components are: stakeholders; elements and aspects. These are important to consider and should be simultaneously addressed when developing an ISWM system (Hoornweg, and Bhada-Tata; Marshall and Farahbakhsh, 2013). Figure 2 shows the interconnected nature of these components.

The Stakeholder component are the groups or individuals that are impacted or interested and should be identified during the development of the ISWM system. The elements are mostly technical aspects. Each stakeholder is linked to one or two aspects, for example local authorities are responsible for collecting waste while the local communities generate waste and separate at the source which is their home. Hoornweg and Bhada-Tata (2012) state that to have an efficient and effective ISWM system, all elements are to be considered concurrently. Lastly the Aspects component entails all the regulatory, environmental and financial conditions within which an ISWM system is implemented and operated.



**Figure 2: ISWM Framework (Hoornweg and Bhada-Tata, 2012:26)**

UN-Habitat (2009) brings another perspective to the key elements of ISWM by stating that there are three important elements that are critical for successful and sustainable ISWM. ISWM ensures that (1) *public health* is protected by collecting waste regularly. The (2) *environment* is protected during waste management activities such as collection, disposal and treatment of waste regularly and (3) *resource* management is done through high recycling and re-use of material (UN-Habitat, 2009). Hoornweg and Bhada-Tata (2012) state that there is a demand of secondary material due to lack of raw material because of cost and environmental impacts of producing raw/virgin material. The consideration of all key aspects will therefore ensure the sustainability of the ISWM system (Hoornweg and Bhada-Tata, 2012).

### **2.3 Waste Management Practices in Developed Countries**

Waste management in developed countries is at an advance stage, although there are still areas of concern overall waste management practice is ahead of developing countries. The waste hierarchy was developed in Europe and countries such as Sweden is considered one of the most experience country in waste management practice (Suresh and Vijayakumar, 2011). Sweden's SWM system is effective and efficient with comprehensive legislation i.e waste management, Swedish Waste Policy and landfill tax and Landfill Ban Policy in place

### **2.3.1 Sweden**

Sweden is one of the most experienced developed countries in waste management practices (Suresh and Vijayakumar, 2011). The SWM system in Sweden is considered to be advanced and matured. Sweden has comprehensive legislation governing waste management i.e waste management, Swedish Waste Policy; Environmental Protection Act; Landfill tax and Landfill Ban Policy (Suresh and Vijayakumar, 2011). The Swedish Environmental Protection Agency (SEPA) is the custodian of policy implementation and protecting the environment. The Swedish government introduced the “landfill tax” and “Landfill Ban policy” with the aim to reduce the amount of waste going to the landfill.

Swedish households are required to separate their waste at home into recyclable and food waste. The participation of the households is achieved through the enforcement of Producers Responsibility Ordinance (PRO) (Suresh and Vijayakumar, 2011). The municipality is responsible for collection of waste that is not classified under household and collection of such waste is done by the municipalities itself or contracted companies (Suresh and Vijayakumar, 2011). Swedish municipalities provided the necessary equipment to the household as part of the waste collection system.

According to Suresh and Vijayakumar (2011), 90% of Swedish municipal solid waste is recycled and only 10% of the waste goes to the landfill. Waste collected from households is taken to the recycling facilities and treatment plants (Bernstad *et al.*, 2011). Material recovery operation is fully functional, organic waste is recovered, composting is also done and energy is produced through incineration. It can be concluded that the solid waste management system is effective and efficient in Sweden.

Municipalities in Sweden are required to have a waste management plan and may issue fines to households. The role and responsibilities of different stakeholders and key role players in waste management are clearly defined (Milios, 2013). The clear role description makes it easier for everyone involved in waste management to play their part and also for the waste management system to be effective and efficient.

### **2.3.2 Singapore**

According to the National Environmental Agency (NEA) (2017) Singapore has a population of 5.1 million and generates waste at a rate of 1.1kg per capita per person. In 2017, 70 million tons of waste was generated which was 9.8% less than the previous year (NEA, 2017). According to Yep (2015) Singapore was producing 7.600 tons of waste a day in 2000 and was quickly running out of landfilling space. Singapore promptly and efficiently

responded by implementing new waste management initiatives. Singapore's economy was developed at that time and it assisted in resolving the problem (Yep, 2015). According to United Nations Environmental Programme (UNEP) (2017). Singapore's waste management system is well developed and effective. Waste management is not a problem in Singapore because of the use of advanced technology for landfilling, recycling, incineration and composting (Ngoc and Schitzer, 2009; Othman *et al.*, 2013).

Singapore is an island with limited land space (Zhang *et al.*, 2010). As a result Singapore developed three strategies to reduce the need to use landfill. The three strategies were adopted from the waste hierarchy: (1) waste minimization, (2) recycling, and (3) incineration. The aim of these strategies was to increase the recycling rate from 40% to 60%; achieve zero landfill and minimize the need for new incineration plants (Yang *et al.*, 2010).

The waste management system in Singapore include collection, transportation, treatment, disposal and prevention (Yang, 2010). The preferred waste management option is incineration (NEA, 2017), which reduces the volumes of waste going to landfill and also produce electricity (Yep, 2015). Singapore prefers incineration because of the lack of land for landfilling (UNEP, 2017; Guo and Wu, 2017). Singapore currently has four incineration plants and it is expected that incineration will reduce the volume of waste by 90% (Guo and Wu, 2017). Singapore is planning to have a fifth plant running in 2019 and it is also planning to build another plant that will handle all types of waste in one plant. This plant will assist in boosting energy efficiency and maximize waste recovery rate (Yep, 2015). The fifth incineration plant is contrary to what Singapore had initially planned when introducing waste management strategies. One of the aim was to reduce the need for a new incineration plant.

Incineration ash known as "Incineration Bottom Ash" (IBA) is a problem in Singapore due to high incineration activities (Guo and Wu, 2017). Gine *et al.*, (2009) suggest that an environmental impact assessment of IBA must be done prior to reuse. IBA is commonly re-used for road works such as pavement, however if IBA is in contact with water, hazardous chemical will leach resulting in environmental pollution (Guo and Wu, 2017). Therefore the use of IBA is regulated by environmental and engineering laws. The studies conducted by Guo and Wu (2017) suggest that IBA can be used for land reclamation as filling material. IBA should first be subjected to certain chemical processes to reduce hazardous chemical concentration.

The waste collection system is efficient in Singapore. However, there is a problem of operational cost due to the high volumes of waste that needs to be disposed of and the

landfill is located 23 kilometres away from the city (Bhagwandin, 2013). As a results, waste collecting trucks make many trips daily around the city collecting waste (Xue and Cao, 2016). This is considered to be an expensive option (Bhagwandin, 2013). Borongan and Okumura (2010) indicate that the cost of waste disposal is recovered from disposal gate fee charged at disposal facilities. The government's aim is to reduce waste generation and promote recycling by making waste producers to pay for the cost of disposing the waste (Borongan and Okumura (2010).

Boron and Okumura (2010) state that the partnership between people in the private and public sector is important for sustainable integrated solid waste management systems. Singapore has existing partnership events, including an annual recycling day that raise awareness and educate the public on recycling and reducing waste. There is also a partnership to integrated recycling activities. Singapore through partnership introduced a recycling program at a school level. This partnership will ensure that the habit of recycling is instilled at an early age (Boron and Okumura, 2010).

#### **2.4 Waste management in Developing countries**

Developing countries in Asia are characterised by a high population growth and rapid economic development activities, with a consequence of high waste generation (Manaf *et al.*, 2009). According to Shekdar (2009) Asia consist of both of developed and developing countries, such as Japan and Singapore which are managing solid waste sustainably. While other countries like China and Malaysia are working on improving their SWM system. China has the highest rate of solid waste generated (Hoornweg and Bhada-Tata, 2012) while Hong Kong has the highest waste generation per capita rate in Asia with no comprehensive waste management system (Lee *et al.*, 2016). The main problem with the waste management system in Asia is the inability to deal with the substantial increase in waste volumes due to urbanisation and economic development activities (MacRae and Rodic, 2015). Guerrero *et al.*, (2013) states that there are different factors that affect waste management, including increasing population, growing economy, and urbanisation which have contributed to the rise of MSW generation in developing countries (Guerrero *et al.*, 2013).

As urbanization and economic growth continue to overwhelm big cities poor waste management is a big threat to the environment and public health (Hoornweg and Bhada-tata, 2012). Local governments have the responsibility to provide waste management services effectively and efficiently (Guerrero *et al.*, 2013). Local government experience problems in providing waste management services effectively due to technical, financial, institutional, economic, and social factors. These factors are also a hindrance to functioning

and effective waste management systems (Manaf *et al.*, 2009). According to Shekdar (2009) an integrated approach is a possible solution to waste management problems faced in Asian developing countries. Developing countries can learn from developed countries how the integrated sustainable SWM system was developed. An integrated approach encompasses many aspects such as: “policy and legal frameworks, institutional arrangements, financial provisions, technology, operations management, human resource development, and public participation and awareness” (Shekdar, 2009:1445). China and Brazil will be discussed as examples of developing countries.

#### **2.4.1 China**

In 2004, China was recorded to be the largest developing country producing 190 million tonnes of waste annually making it the world largest municipal solid waste (MSW) generator (World Bank, 2005; Hoornweg and Bhada-Tata, 2012; Ren and Hu, 2014). According to Ministry of Housing and Urban-Rural Development of China (MOHURD) (2012) China has been experiencing 5% increase of MSW every year for the past 10 years. For the past 10 years China has been building MSW treatment facilities but 71.3 % of those facilities are adequately managed (MOHURD, 2012). However, 88% of MSW is poorly managed ending up in landfills or in open dumps that are not controlled resulting in environmental pollution (MOHURD, 2012). Because of poor MSW management, China’s citizens are opposed to new incineration plants and landfills. As a result, some citizens have protested the government’s proposed establishment of new landfills and incinerators (Xu *et al.*, 2015).

China put effort into addressing the waste challenge by investing in the municipal solid waste treatment infrastructure. China also made progress by introducing the new regulations and policies (Chen *et al.*, 2019). A legal framework on waste management hierarchy was established in 2009 (Chen *et al.*, 2010). China further published a guideline for environmental protection model with strict standards for municipal solid waste disposal. According to Ministry of Environmental Protection (MOEP) (2008) cities that aim to achieve set standards in the guideline considered waste minimization and safe disposal in their plan. China has laws on solid waste which regulates environmental pollution caused by solid waste (Chen *et al.*, 2010).

The law of solid waste specifies the “principles of waste management, responsibilities for waste supervision and administration, pollution control measures and legal responsibilities” (Chen *et al.*, 2010:717). All the administrative and ministerial regulations of Municipal solid waste management must comply with the Law on Solid Waste. As part of complying with the law, different ministries are required to develop waste management plans that are integrated

in their economic development plans. This was done to encourage ministries to reach targets set in the national plan (Chen *et al.*, 2010).

Municipalities in China commercialized some of their functions such as waste treatment, this was done to ensure effectiveness and efficiency of MSW management (Chen *et al.*, 2010). Assigning some of the functions to private sector increased the MSW management funds as other government institution and international organisations have also brought in funds (Chen *et al.*, 2010). According to Chen *et al.*, (2010), funds for MSW management are not distributed evenly. Cities with high fiscal income get more funds allocation and achieve better performance in waste management.

Although China has made investment into MSW management, there are still problems that continue to challenge the success of China's municipal solid waste management such as:

- Safe disposal and waste treatment capacity. According to Chen *et al.*, (2010) the inland cities have high population numbers of over 50 million people and the rate of urbanisation continue to increase and unsafe waste disposal activities are common. As a result, the cities have a problem to plan for future waste generation due to population growth.
- Local conditions differ between Chinese cities. One solution cannot be effective in all the cities (Chen *et al.*, 2010). Policies that are effective in certain areas might not yield the same results in other areas where there is poor or limited infrastructure (Chen *et al.*, 2010).
- Insufficient research on waste generation, waste types and characteristics. According to Chen *et al.*, (2010) reliable data on waste generation, composition and waste properties is critical during waste planning.
- Public consultation in waste planning is not sufficient and it is important for planning. The Law on Environmental Impact Assessment (2003) allows for the Public to participate in the waste planning through forums in which the public can express their opinion.

According to Chen *et al.*, (2010), an integrated approach is necessary to address waste management challenges faced by China. Different methods and collaboration among all stakeholders was adopted. Some of the challenges are interconnected: safe disposal can be address through planning and also allowing the public and private sector to get involved. The building of partnerships and coordination of stakeholders and planning of the MSWM system with the consideration of local conditions is necessary (Chen *et al.*, 2010).

In an attempt to deal with municipal solid waste problems, the Chinese government has launched different waste source separation programmes (Tai *et al.*, 2011). An “incentive-based source separation model” is also one of the pilot programmes that was launched. China introduced an “incentive-based source based separation model” to encourage recycling by the community and sustainable waste management in different cities. Prior to this a number of recycling programmes failed due to lack of awareness on waste, no incentives and insufficient waste facilities (Xu *et al.*, 2015).

The “incentive-based source separation model” was seen as a threat to the traditional Municipal Waste Management treating enterprise (Xu *et al.*, 2015). However, the model has the potential to not only yield economic benefits, but also to enhance waste minimising programs. The economic benefits are realised when considering the MSWM system as a whole. To promote “incentive-based source separation model” in the community, policy and regulation is important as they can be used to enforce the model. Therefore the existing policies need to be improved to promote the model (Xu *et al.*, 2015).

According to Chen *et al.*, (2010), most of these programmes have experienced slow progress and are running at a financial loss due to lack of enforcement regulations to ensure citizen separate waste from the source. (Zhang *et al.*, 2016). In Beijing residents avoid implementation of waste source separation because it is not supported by the government thus making it to be voluntary (Zhang *et al.*, 2016). Voluntary compliance is a problem in developing countries, as it can only be achieved with awareness and where there is lack of awareness there will almost certainly be resistance.

#### **2.4.2 Brazil**

According to Costa and Campos (2017) Brazil is the most populated country with the fastest growing economy in South America. The population growth in Brazil has contributed to an increase in waste generation which is affecting the environment and public health. Brazil generates about 63 million tonnes of MSW (Liikanen *et al.*, 2018). Only 58.7% of MSW is collected and correctly disposed of, while 41.3% is inappropriately disposed of (Costa and Compas, 2017).

In 2010, Brazil established a “National Policy on Solid Waste” (NPSW) which was considered to be the biggest milestone for waste management in Brazil. According to Filho *et al.*, (2016:4379) the NPSW determines “*principles, objectives, instruments, and guidelines for integrated solid waste management in Brazil, including hazardous waste, the*

*responsibilities of generators and the public power and the applicable economic instruments*". Costa and Compas (2017) indicate that there has not been much improvement in waste management since the policy was introduced. The biggest waste management concern in Brazil is the open dumps used for waste disposal (Filho et al., 2016). The NPSW require that all open dumps be closed by 2014. However, Miguel et al., (2016) indicated that by 2016 most Brazillian cities had not complied with the policy and as a result Brazil decided to extend the deadline to 2021, with cities having different deadlines. For example, metropolitan cities are expected to have closed all their open dumps by 2018 while cities with a populations of 50 000 and less should have closed all their open dumps by 2021 (Chamber of Deputies, 2015).

The NPSW encourages partnership between the government, public and private sector to work together to promote sustainable development, educational awareness, and to reduce waste and manage it appropriately. Ferreira et al., (2017) suggest that waste management done through public and private sector partnership is more advantageous when dealing with MSW. Municipalities in Brazil are required to prepare a MSW plan for a period of 20 years, and the plan must be undergo revision every four years. The government is able to allocate funds to assist the municipalities to achieve target set in the MSWM plan (Costa and Campos, 2017). To date most municipalities have not produced their municipal solid waste management plan. The failure of municipalities to produce the plan results in the government not assisting them financially, and waste management not being implemented properly.

According to Costa and Campos (2017) there has been an improvement in the waste management in accordance with NPSW, however Brazil has not reached a desirable state in terms of implementing integrated MSW. For Brazil to have an effective waste management system, the should consider cultural and behavioural changes in terms of waste management. People's attitude towards waste management needs to change. Costa and Compas (2017) state that in 2015 Brazil experienced economic recession, during which the majority of citizens did not have buying power, and so economic growth was reduced by 3.8 %. But waste generation increased by 1.7% in that year. Liikanen et al., (2018) indicate that despite the economic problems that Brazil is currently facing, it is expected that MSW generation will continue to grow, mostly due to population growth.

As Brazil tries to close all open dumps, Costa and Compas (2017) suggest that there should be financial penalties imposed on municipalities that are failing to comply with the law, particularly the requirement to close all open dumps on the stipulated date. Open dumps are

a concern in Brazil, and the government and private sector should be working together to achieve the goal of closing all open dumps.

Brazil started integrating the informal sector in 2010 through NPSW. Municipalities were encouraged to legitimise the informal sector that can provide service of waste collection and sorting. According to Silva de Souza Lima and Mancini (2017) a number of waste pickers in small cities are organizing themselves into small groups that are being integrated into the formal MSW system. Integrating the informal sector has brought better social, economic and environmental benefits, since previously the informal sector operated in high risk conditions and was susceptible to exploitation (Silva de Souza Lima and Mancini, 2017). Research indicates that most of these informal participants lack the technical and financial means to successfully offer waste management services such as collecting, transporting and recycling, and as a result they are not able to service entire urban areas (Silva de Souza Lima and Mancini, 2017).

Brazil has been successful in recognizing the informal sector, however, there are still no incentives for recyclable material (Silva de Souza Lima and Mancini, 2017). The lack of incentives for recycling materials discourages the community to participate in recycling. Brazil can learn from China which introduced incentive-based waste source separation and introduced certain incentives to encourage participants.

#### *2.4.2.1 The city of Curitiba*

Curitiba is the fourth largest city in Brazil and was recognised as a Global Sustainable City in 2010 (Soltani and Sharifi, 2012). The success of recycling date as far back as 1989. The recycling system is considered to be equivalent to that of first world countries (Axlele, 2017). According to Soltani and Sharifi (2012) 70% of the city's waste is recycled by the public. The recycling program has social and environmental benefits embedded in it (Soltani and Sharifi, 2012; Axlele, 2017). The residents sell their waste for food, school children exchange waste for stationary and toys, and waste is also exchanged for agricultural tools (Soltani and Sharifi, 2012). The "purchasing of garbage program" as it is known ensures that by residents selling their waste, environmental pollution and health risks is minimised (Soltani and Shariff, 2012). Curitiba was able to achieve a sustainable balance by integrating "sustainable decision making, sustainable society, sustainable environment and sustainable economy" (Soltani and Sharifi, 2012:132). Finding a balance between the three aspects of sustainability is a challenge in many developing countries.

A study conducted by Mott MacDonald (2015) revealed that Curitiba is facing a challenge of waste generation as the population continues to grow. The waste management initiatives are no longer sustainable, and new initiatives are needed with long-term solutions. Mott MacDonald (2015) also found that the city is relying on a single landfill site which was established for short-medium term provided the population doesn't rapidly increase. Mott MacDonald (2015) states that Curitiba city acknowledges the need to rethink the way the city is managing waste. For a city that has done exceptionally well in sustainable development, there are opportunities that can be explored like finding more valuable uses for waste materials.

## **2.5 Waste Management Practices in Africa**

Having dealt with waste management in developing countries in the previous sections. The following section will deal with the waste management practices in the previous sections in different African countries.

### **2.5.1 Botswana**

Botswana is faced with environmental problems due to a high rate of development and poor management of solid waste (Suresh and Vijayakumar, 2011; Taye and Kanda, 2011; Kwailane *et al.*, 2016). The growing population and high consumption level is also contributing to high volumes of solid waste generated (Kgosiesele *et al.*, 2010). SWM in Botswana is following a linear pattern, where natural resources is consumed and waste is produced and disposed of at landfill without any recovery or recycling of material (Suresh and Vijayakumar, 2011).

#### *2.5.1.1 Institutions and waste legislation*

There are two legal tools used for SWM in Botswana: "Waste Management Act and Botswana's "Strategy for Waste Management" (Suresh and Vijayakumar, 2011:2). The Waste Act regulates waste delivery services (collection, disposal and recycling and the local) while authorities are responsible for implementing the act. The strategy is responsible for coordinating the waste issues through relevant stakeholders in the waste management sector (Kgosiesele *et al.*, 2010). The waste authorities are mandated to reduce the amount of waste generated, prevent pollution and promote implementation of waste hierarchy. The waste management authorities are criticised for not having regulatory measures for particular waste streams and is considered to be ineffective (Suresh and Vijayakumar, 2011). The local authorities also lack waste management plans that helps with the daily operations of waste management operations (Suresh and Vijayakumar, 2011). Furthermore, the waste legislation has not been updated since it was promulgated in 1998, but the

population has since increased and the amount of waste generated also increased with different streams of waste requiring new technology and relevant skilled resources. This is contributing to waste legislation being considered ineffective as compared to developed countries where their laws are constantly updated to cater for recent needs and changes. Suresh and Vijayakumar, (2011) state that a lack of interest from the government is resulting in waste laws not being updated continuously. For Botswana to successfully manage their waste and in a sustainable way, waste management authorities need to improve their regulatory measures.

According to Kwaitlane *et al.*, (2016) many developing countries have the best environmental legislation, which is often better than some of the developed countries. The challenge in Botswana is not lack of policy and legislation but the lack of implementation and enforcement. This was evident in previous studies conducted (Mmereki *et al.*, 2012; Taye and Kanda, 2011; Nagabooshnan, 2012) that has shown that policy implementation remains a problem despite the progress made by Botswana. Lack of enforcement is mostly influenced by political, legal, socio-cultural, environmental, economic factors and available resources (Kwaitlane *et al.*, 2016). Mmereki (2014) states that the reason for the lack of policy implementation is due to the local authorities failing to deal with the problem of unsustainable MSW management practices and behaviour of the public.

Although waste is defined in the Botswana waste act, municipal solid waste is not defined thus creating inconsistency in the legislation. A lack of proper definition of MSW further creates challenges in addressing waste management activities, planning and also determining the composition of MSW and relevant stakeholders and awareness on good waste management practices due to the above mentioned problem sustainable MSW is not achieved (Mmereki, 2018). This is a call for waste legislation to be updated to also include relevant terms such as municipal solid waste and other terms that are currently used by other countries with developed waste management systems.

There are different government ministries that are responsible for waste management from issuing licenses and permits, developing policies for waste management, monitoring and disposal and treatment facilities and environmental pollution control (Mmereki *et al.*, 2014). Mmereki *et al.*, (2018) state that all these ministries have overlapping responsibilities due to a lack of clear of role descriptions relating to waste management. Mmereki *et al.*, (2018) also indicate that this shows lack of cooperation between different authorities thus affecting effective progress and sustainability of MSW management.

#### *2.5.1.2 Public participation and partnership*

Public participation is identified as one of the key aspects of integrated sustainable waste management, however public participation is not practiced regularly in Botswana (Mmereki, 2018). Involvement of the community in sustainable waste management is a challenge. Public participation can be encouraged through campaigns and awareness programs (Kwailane *et al.*, 2016). Kwailane *et al.*, (2016) recommend that the public be involved in all stages of waste management: planning, implementation and monitoring.

Another problem in Botswana which is also common in other developing countries is illegal dumping and littering, which is evident as mini dumping sites across the country are created (Mmereki, 2018) while littering is most evident along road sides (Suresh and Vijayakumar (2011). Mmereki (2018) indicates that illegal dumping sites can result in loss of valuable natural resources and the economic benefits thereof. Valuable land that can be used for agricultural purposes may be contaminated because of illegal dumping. Water resources located near the dumping sites can also be contaminated due to leachate of hazardous chemicals from these dumping sites.

Botswana has also not shown any indication of adopting an integrated approach which will allow the public and private sector, and waste policy makers to collaborate and improve efficiency of waste management (Mmereki, 2018). Therefore coordination of ministries and implementing an integrated approach is a problem that affects the standardization of dealing with MSW. Partnership between the government and the public and private sector needs to be established to improve the waste management practices in Botswana.

#### *2.5.1.4 Equality*

Kwailane *et al* (2016) state that public perceptions regarding waste management and socio-cultural practices influence the success and failure of the SWM system. Botswana offers equal waste management services to different areas. Kwailane *et al.*, (2016) state that different socio-economic areas receive equal waste management services. High income and the low income areas receive satisfactory services despite their socio-economic status.

### **2.5.2 Mozambique**

SWM is a concern in many developing countries as it affects the development of modern cities. Mozambique is a less developed country and has many problems to solve in an attempt to improve SWM solid waste management (Sallwey *et al.*, 2017). Although Mozambique is a least developed country, economic activities started to grow between 2010 and 2015 resulting in high volumes of waste being generated (Sallwey *et al.*, 2017;UNDP,

2016). Maputo, the capital city of Mozambique is experiencing a problem of solid waste management with highest production of waste of 1kg per day per person as opposed to 0.5kg per day per person in the sub-urban areas (Sallwey et al., 2017). This is evident along the streets in the city where overflowing large waste containers is a common sight while informal settlements do not have enough waste containers and open land space is used as dump sites (Tveden and Candiracci, 2014). The problem of waste in the Maputo city was also raised as a concern by the city's mayor who was on record stating that "*waste management is one of the most serious challenges that the city faces*" (Tveden and Candiracci, 2014:2). The SWM system in Mozambique is dysfunctional due to different perspectives and practices and financial problems and poor planning has been the main hindrance to effective SWM (Sallwey et al., 2017; Tveden and Candiracci, 2014).

#### *2.5.2.1 Legislation*

Mozambique has waste management legislation like Environment Act (Law 20/97); Solid Waste Management Regulations (Decree 13/2006), and Finance and Municipal Heritage Act (Law 11/97). There is also a policy which gives guidance on sustainable waste management. Similar to other developing countries, municipality is responsible for implementing and enforcing waste management legislation. According to Tveden and Candiracci (2014) it can be concluded that waste management legislation and policy is in place however, implementation remains a challenge.

#### *2.5.2.2 Recycling activities*

The recycling activities in Mozambique have not progressed compared to other developing countries (Ferrari et al., 2016). According to Sallwey et al., (2017) 85% of solid municipal waste is recyclable but only 1% is recycled. This is due to industries demanding less recycled material, and as a result recycled material is exported (Sallwey et al., 2017). This called for the government to introduce a strategy that will encourage recycling and stimulate market demand for recycled material (UN, 2011). There is an illegal recycling market for metal scraps which export metal scraps to other countries (Ferrari et al., 2016). However, there is a Non-Governmental Organisation (NGO) which is promoting use of recycled material by local industries while the government is connecting all stakeholders from recycling industries.

#### *2.5.2.3 Enforcement*

Waste pickers, also known as scavengers are operating in Mozambique, and waste scavenging is common all across Africa. There are pieces of legislation that regulates illegal waste picking. The legislation state that "waste belongs to the municipality council of Maputo

and picking waste from containers is punishable” (Sallwey *et al.*, 217: 628). However that does not stop scavenging activities from happening, because the municipality does not have the capacity to implement and enforce this law. Municipalities are also failing to execute their mandate to collect waste fees. According to Ferrari *et al.*, (2016) only three municipalities in Mozambique have been successful in implementing a waste fee system but enforcement remains a challenge.

#### *2.5.2.4 Waste Education and Awareness*

When implementing an integrated approach to SWM, waste education and awareness is important. All key role players in waste management need to be educated particularly on issues related to environment and health risks associated with poor management of municipal solid waste management (Sallwey *et al.*, 2017). According to dos Muchangos and Hanashima (2015) awareness and public participation is not satisfactory in Mozambique. NGOs are ensuring that everyone involved in the waste industry is receiving training at recycling centres. This is compulsory for everyone who is a participant in recycling (Sallwey *et al.*, 2017). This is a good opportunity for government to partner with NGOs to ensure successful implementation of a SWM system.

Most of solid waste management activities are happening in Maputo city while small cities receive minimum or no services at all (Sallwey *et al.*, 2017). There is lack of waste collection, transportation and disposal. Considering that waste is a problem for the city, Maputo’s local authorities do not have an efficient system that removes waste from informal settlements to legal dumping sites or recycling facilities. Tveden and Candiracci (2014) argues that this is due to lack of cooperation between the municipalities and informal settlements. The municipality presents the issue of waste as a technical matter and considering the illiteracy problem in the country, the informal settlement community is failing to understand the waste issue. Tveden and Candiracci (2014) suggest that if the community understands the waste issue, they will be interested in working with the municipalities in waste management initiatives to clean the area. Ferrari *et al.*, (2016) further states that illiteracy and poor level of education is considered to be a challenge for waste management awareness and initiatives.

Municipalities are depending on NGOs or international partners to assist with awareness and education initiatives on waste management (dos Muchangos and Hanashima, 2015). Sallwey *et al.*, (2017) indicate that where partners have withdrawn the waste awareness also ceased. This is similar to the concern discussed above regarding Mozambique depending on donors for financial support. Due to the high rate of illiteracy in Mozambique, education and awareness on proper waste management require different institutions (schools, universities,

local authorities, NGOs and the private sector) to work together to be able to reach communities at different levels and cater for their specific needs (Sallwey *et al.*, 2017) .

## **2.6 Waste Management Practices in South Africa**

Having discussed waste management practices in developed and developing countries. The following section will deal with the waste management practices in South Africa.

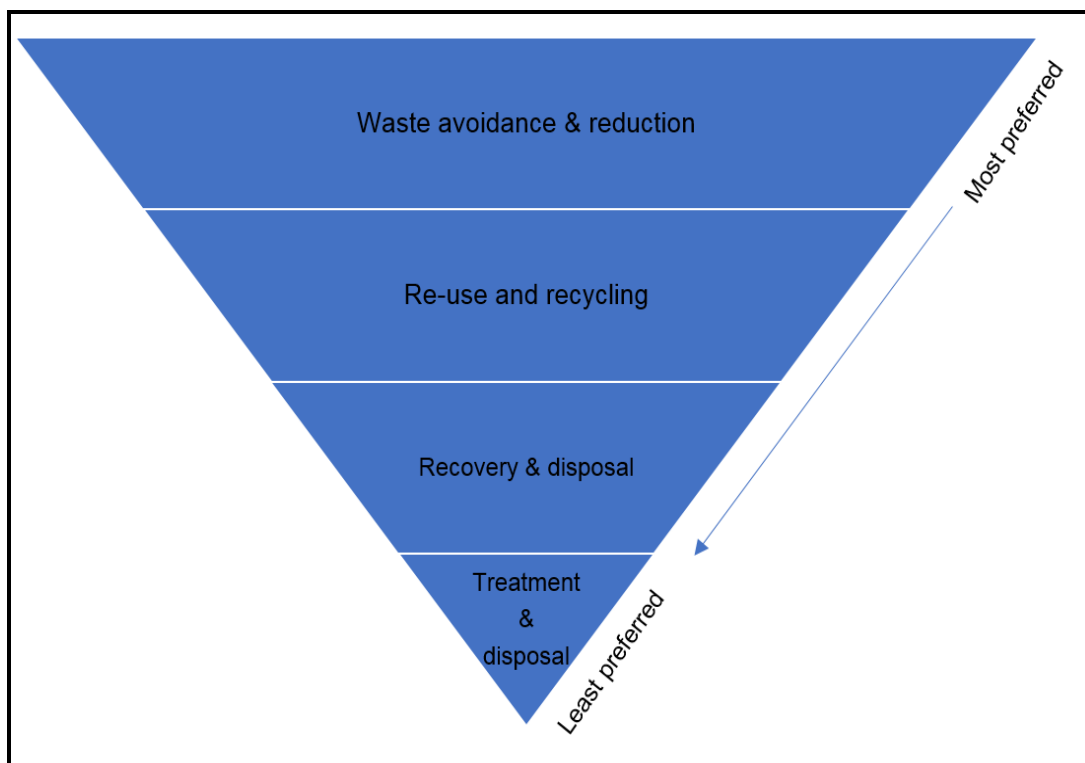
### **2.6.1 Overview of waste management in South Africa**

According to DEA (2011) 108 tonnes of waste was generated in 2011 in South Africa, with 98 million tonnes being disposed of at landfills and only 10% of the waste was being recycled (Chisadza, 2015). DEA (2012) revealed that South Africa produce about 54 500 million tons of waste per day, making South Africa the 15<sup>th</sup> highest producer in the world. However, it is expected that waste generation will drop as the country continue to develop and introduce better waste management initiatives and practices. Much of the increase in waste was attributed to increasing rural to urban migration of people and influx of immigrants from other African countries, thus resulting in the development of informal settlements along the urban periphery (Chisadza, 2015).

Waste management in South Africa dates as far back to the introduction of the Environment Conservation Act (ECA) in 1989, which defined waste and regulated the permitting and managing of waste disposal facilities (Godfrey and Oelofse, 2017). The major constraints to successful implementation of waste management since 1989 has been poor funding; inadequate waste collection services, lack of infrastructure, lack of public participation and an overall lack of coordination in waste collection and management (Nahman and Godfrey, 2010; Makgae, 2011; Ogola *et al.*, 2011). However, improvements have been made with the introduction of the ISWM system and better funding (Chisadza, 2015). The improvements can be attributed to International pressure on developing nations to utilize better waste management systems which has led to the introduction of better methods of waste management with the emphasis on environmental conservation (Chisadza, 2015).

In 1999, DEA (previously known as DEAT), through the National Waste Management Strategy (NWMS) provided suggestions for implementing ISWM system (Nahman and Godfrey, 2010; Makgae, 2011). The ISWM system option was introduced in South Africa with the aim to incorporate sustainability and the conservation of natural resources in waste management practices (Chisadza, 2015). The ISWM system involves activities such as collection, separation, sorting, recycling, re-using, transportation, and disposal (Chisadza, 2015).

The National Environmental Management:Waste Act and NSWS adopted the waste hierarchy (from Europe. Figure 3 shows the South African waste hierarchy as adopted from Europe and published in the Waste Framework Directive (2008/98/EC). The emphasis of the waste hierarchy, in order of preference, is waste avoidance and reduction, then recycling, and finally treatment and disposal (Jewaskieswitz, 2011). All integrated waste management plans are required to encompass the entire concept of the waste management hierarchy. Central to this theme is recycling, which is seen by many as a solution to the creation of jobs in the waste sector.



**Figure 3: Waste Management Hierarchy (NWMS, 2010)**

## **2.6.2 Waste policy and Regulation in South Africa**

South Africa has a comprehensive environmental management legislation framework and the section below deals with waste management legislation.

### *2.6.2.1 Constitution of Republic of South Africa Act 108 of 1996*

The South African constitution (Act 108 of 1996) remains the foundation for environmental legislation and the existing environmental legislation emanates from the Constitution (Bhagwandin, 2013). The South African Constitution plays an important role in supporting

environmental considerations and the principles of sustainable development (Sentime, 2014).

According to Section 24 of the Constitution “*everyone in the country has the right to the environment that is not harmful to their well-being*” (RSA, 1996:1251). The Constitution has made provision for legislation that ensures for environmental protection, prevent pollution and ecological degradation. The Constitution further outlines the functions of national, provincial and local government in Schedule 4(b) and Schedule 5(b), such functions also include waste management in terms of waste removal, landfills and dumps and solid waste disposal.

#### *2.6.2.2 The National Environmental Management Act (NEMA) Act 107 of 1998*

Solid waste management was regulated under Environment Conservation Act 73 of 1989 before the promulgation of NEMA. In 2006, waste management was placed under NEMA. NEMA provides a framework for cooperative governance for environmental issues and coordinating environmental roles executed by organs of state (Bhagwandin, 2013; Zingisa, 2015). NEMA (1998:10) aims to promote sustainable development, Chapter 1 of NEMA upholds sustainability principles and states that “development must be socially, economically and environmentally sustainable”. NEMA also embodies a polluter’s pay principle in Section 2(4)(p) where it states that the polluter is accountable for paying the costs of pollution remedy and environmental degradation.

The following section in NEMA is worth considering to anyone intending to undertake activities that have potential to impact on the environment: Chapter 3 of NEMA requires that all organs of state responsible for waste management should develop and implement environmental management plans. While chapter 2 deals with “*duty of care and remediation of environmental damage*”. section 28 clearly stipulate that anyone undertaking activities that have potential to impact the environment or have impacted the environment significantly by polluting or degrading the environment is responsible for putting measures in place to avoid, minimize or rectify these impacts either pollution or degradation. Thus anyone who has polluted or cause harm to the environment should implement necessary remedy to correct the harm.

#### *2.6.2.3 National Water Act (NWA) 36 of 1998*

Chapter 1 (1) of the National Water Act defines waste as “any solid material or material that is suspended, dissolved or transported in water (including sediment) and which is spilled on land or into water resource in such volume, composition or manner as to cause, or be reasonably likely to cause the water resource to be polluted” (NWA 36 of 1998)”. The

National Water Act regulates waste in the following manner: firstly, it provides a framework for water use and various permits and licenses required for different water uses. Secondly it makes provision for addressing water pollution that is associated with waste disposal (eThekweni Municipality, 2004). Therefore a waste disposal site might detrimentally affect water resources through leachate that ultimately enters groundwater thus polluting groundwater. Therefore Section 21 stipulates that a water use license is required for waste disposal facility particularly if it is done in a way that has the potential to significantly impact on a water course.

#### *2.6.2.4 The National Environmental Management: Waste Act (NEMWA) Act 59 of 2008*

NEMWA is the first South African law to solely address waste management and provide a legal framework for regulating waste management activities (Bhangwandin, 2013). The publication of the Waste Act has seen municipal cities adopting innovative waste management strategies and implementing them depending on their capacity (Gumbo, 2014). The act adopts the international recognized waste hierarchy. The NEM:WA also seeks to prevent pollution and ecological degradation and promote effective delivery of waste services. Section 11 of the NEM:WA mandate certain organs of state to develop Integrated Waste Management Plans (IWMP). Municipalities are expected to submit their IWMPs to the MEC for approval and the IWMP must form part of the Integrated Development Plan (IDP). Contents of IWMP are stipulated in Section 12 of the Waste Act. Section 16 of the Waste Act stipulate that anyone who generates waste is responsible for implementing the waste hierarchy with intension to minimize impacts on the environment or human beings.

#### *2.6.2.5 The National Waste management Strategy (NWMS)*

The NWMS was published in 2011 following the promulgation of the Waste Act, with the objective to promote the waste hierarchy. The NWMS consists of the strategy and the action plan that seeks to achieve government's vision for IWMP. NWMS adopts a four tier institutional framework: the national, provincial, local and civil society. DEA is designated as the lead agent for integrated waste management (Nahman and Godfrey, 2010). DEA and the provinces are responsible for monitoring the percentage of municipalities which produced IWMP and included them in the IDPs (DEA, 2011). In South Africa, waste management has previously received less funding, but through the NWMS two economic instruments were identified that can be used to generate funds towards waste management. According to NWMS, funds could be generated through the polluters pay principle and tax.

#### *2.6.2.6 Municipal Structure Act (MSA) 117 of 1998*

The Municipal Structures Act makes provision for separation of functions between district and local municipalities. Municipalities are to determine a waste disposal strategy within their area of jurisdiction (Oelofse, 2015). Municipalities have the mandate to regulate waste disposal and disposal sites. According to section 84(1) of MSA district municipality has the responsibility to conduct integrated development planning for the district municipality.

#### *2.6.2.7 Municipal Systems Act 32 of 2000*

Municipalities are required to collect waste within their area of jurisdiction in terms of Municipal Systems Act. Every municipality is mandated to develop IDP, and one of the elements of IDP is IWMP which will implement the waste hierarchy in terms of NWMS, therefore IDP is considered an important tool for municipal service delivery (Karani and Jewasikewitz, 2007). The municipalities are expected to put effort into ensuring that the service that they provide is done in a financially and environmentally sustainable way (Matete and Trois, 2008).

Figure 4 illustrates where South Africa is in terms of legislation, regulation and policy that governs waste management. This is the regulatory framework that has influenced the waste sector for the past 30 years (Godfrey and Oelofse, 2017). Godfrey and Oelofse (2017) state that the South African environmental legislation as a whole is mostly influenced by the European Environmental Regulatory Framework. The NSWMS strategy that was published promoting different waste management options in the order of preference adopted the waste hierarchy from Europe as published in the Waste Framework Directive (2008/98/EC). This shows that South Africa is not far behind developed countries regarding legislation.

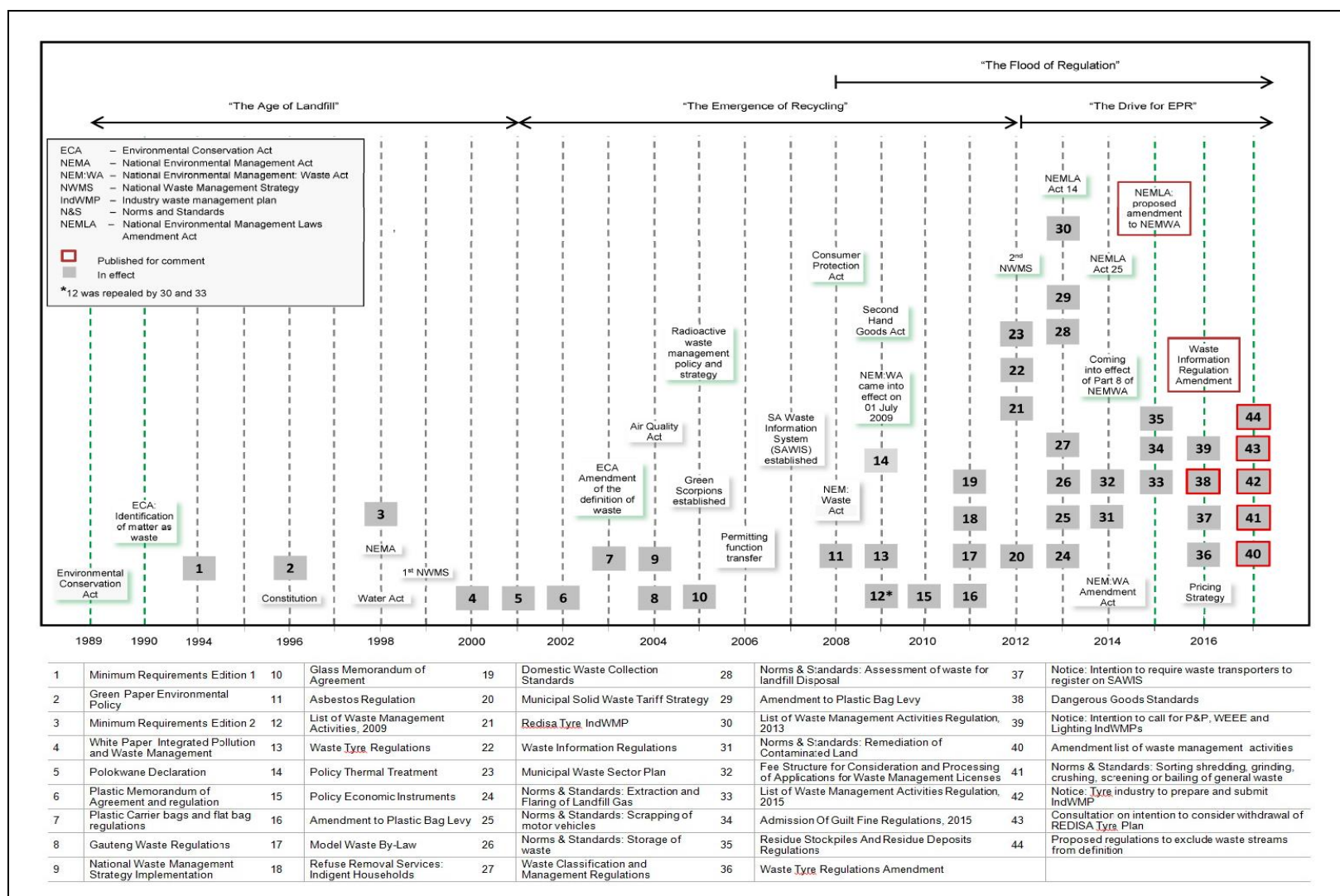


Figure 4: South African waste regulatory framework (Godfrey, 2017:3)

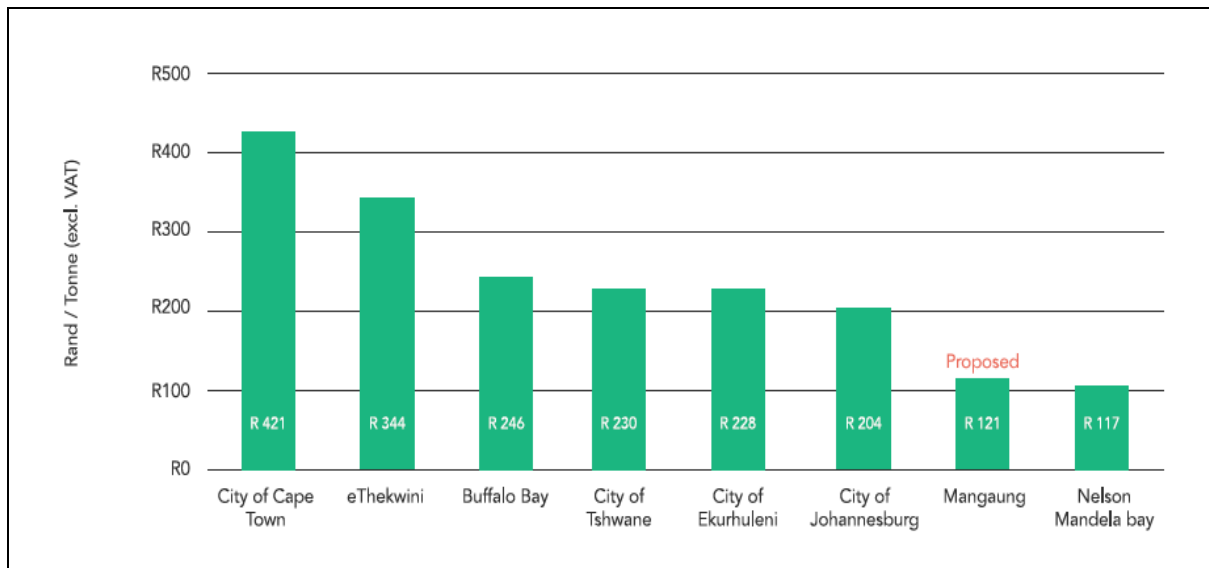
### **2.6.3 Current Waste Management Practice**

The regulatory framework that governs the waste management was discussed in detail. This section will now deal with the current waste management practice in South Africa.

#### *2.6.3.1 Landfilling in South Africa*

South Africa has approximately 581 waste disposal sites recorded of which only 150 sites are licensed while 431 are not licensed (Pienaar, 2014; Godfrey and Oelofse, 2017). This is shocking compared to other international countries that are moving away from landfilling. Disposal of waste at landfill remains a preferred waste management option on the waste hierarchy in South Africa. South African's landfills found in cities are quickly reaching their full capacity, although South Africa has plenty of land space there is limited suitable land for new landfill and the regulations have become more stringent (SACN, 2014). Thus opening a new landfill is not an option. According to DEA (2012) 90% of South Africa's waste goes to landfill, while in developed countries only 10-20 % of waste goes to landfill (Godfrey and Oelofse, 2017).

Landfilling remains a preferred waste management option, because South Africa has plenty of open land available compared to other countries like Singapore. Minimum disposal fees charged at landfill site, and authorities not coming up with new solutions to minimise waste disposal at landfill sites are some of the reasons why South Africa is complacent about landfilling (Godfrey and Oelofse, 2017). Furthermore the charge fees for South African landfill sites (as indicated in Figure 5) are far lower than those in the European countries (Godfrey and Oelofse, 2017; SACN, 2014). The fees are below what Europe is charging. Europe's fee is between £20-40, while South Africa is charging £10-20 (Godfrey and Oelofse, 2017). While there is a charge fee at the landfill sites, some waste streams such as construction rubble or garden waste remains free (Godfrey and Oelofse, 2017). Nahman and Godfrey (2010) argue that the extent to which the municipalities charges for waste is not clear, since it remains uncertain whether the charge fee is based on the volume or weight of waste being disposed. This is a problem to initiating new technology as the waste sector is not generating sufficient income to initiate research and development that could help with introducing new technology that will reduce landfilling.



**Figure 5: 2017/2018 landfill gate fees for metropolitan municipalities in South Africa (Green Cape, 2017:13)**

#### 2.6.3.2 Waste Recycling

According to (Ogola et al., 2012) 60% of waste collected in South Africa can be recycled, however large amounts of recyclable material still ends up in landfill sites (SACN, 2014). If more waste can be recycled, South Africa will reach the target of 50% of waste reduction by 2020 set at the Polokwane declaration on waste management in South Africa in 2001. However if no waste separation is happening at a source, recycling initiatives will not be efficient (Jewaskiewitz, 2011). Internationally it was proven that waste separation at a source contributes to the efficiency of recycling (Jewaskiewitz, 2011). Another challenge with the MSW, is that there is no sorting of waste at a source, and waste is mixed making it difficult to remove recyclable materials (Godfrey and Oelofse, 2017).

Minimising the quantities of waste going to landfill is not the only benefits of recycling, other benefits associated with recycling are: “reduce energy consumption, protect the environment and reduce pollution; sustainable use of resources and create green jobs” (SACN, 2014: 27). There are opportunities to improve recycling in the cities, and South Africa is working on finding ways to reduce landfilling, which will enhance and prioritise recycling.

There are currently two guidelines that were published to assist with the implementation of NSWMM strategy by the municipalities. The first Guideline on waste collection is titled “working with waste: Guideline on waste collection in high density and unserved area” and the other guideline is titled “working with waste: guideline for recycling waste”. Both guidelines were sponsored by an international agency.

In 2003 there was a ban of single use of plastic bags and the implementation of plastic tax. The local industry was now forced to participate in recycling, with manufacturers and companies voluntarily allowing collection of material. Godfrey and Oelofse (2017) argue that perhaps government could have enforced an "end-of-life" product policy similar to what was done in Europe in an attempt to force industries to recycle, rather than allowing voluntary participation. This would have influenced design and production immensely as well as the recycling industry, since material can always be re-used instead of taken to a disposal site.

South Africa can learn from Sweden, where their recycling system has evolved and is using modern technology. Sweden is currently at a stage where it is importing waste from other countries for incineration to produce energy (Milios *et al.*, 2018, 2018). As a result only 10% of waste goes to the landfill (Suresh and Vijayakumar). South Africa can use the opportunity to work with Sweden to adopt some of their technology that can assist with minimising the amount of waste going to the landfill and enhance recycling. However, this technology should still be the be compatible with local conditions.

According to Godfrey and Oelofse (2017) a recycling company called PETCO was established in 2001 and the recycling industry has since evolved, from 16% in 2005 to 55% in 2016 (plastics) and 41.6% in 2007 to 57.1% in 2015. Although South Africa has improved, it is still behind compared to countries like Singapore where 90% of waste is recycled. South Africa is doing well compared to other African countries like Botswana and Mozambique where only 1% of their waste is recycled. Although recycling is in line with developed countries, separation at a source is lacking. However an informal sector has emerged which collects waste from households before it is collected by municipalities or contractors.

#### *2.6.3.3 Informal Waste Sector*

Informal recycling activities are happening at landfill sites (SACN, 2014). Informal recycling is common in South Africa's landfill sites and there are health and safety risks associated with this activity for waste scavengers. According to Godfrey and Oelofse (2017) 80-80% of waste is mostly collected by the informal waste pickers for recycling and currently about 60 000-90 000 informal waste pickers are earning a living from picking waste at landfill sites or in front of households across South Africa. The informal sector is currently saving the municipalities almost R309-R748.8 million in landfilling (Godfrey *et al.*, 2016). It can be concluded that the informal sector has been very much involved in the waste chain and

ought to be integrated into the formal municipal waste management service. The increase in informal waste pickers is attributed to the high rate of unemployment in South Africa.

South Africa has made an attempt to integrate informal sector through co-operatives to encourage job creation and enterprise (Godfrey and Oelofse, 2017). The initiatives were faced with many challenges, such as a lack of infrastructure, operational challenges, inaccessible recycling markets, and lack of capacity to operate a recycling business (Godfrey and Oelofse, 2017). The South African government can learn from Mozambique, where the government is working with NGOs to link waste reclaimers with recycling markets. Research coupled with other initiatives is underway to find solutions to recycling industry challenges faced in the country and also to find ways to best integrate the informal recycling sector into the waste management industry. As a result of above mentioned challenges, South Africa has only been able to recycle 10% of waste intended for landfilling.

The National Planning Commission (NPC) identified the waste sector as having the potential to contribute to the country's economy. Therefore, South Africa has to ensure that the informal waste sector is integrated, as it is significantly contributing in the waste sector which will ultimately boost the country's economy (NPC, 2011 and DST, 2017). South Africa can draw lessons from Brazil which initiated a process of integrating the informal sector into main stream waste management sectors (Silva de Souza Lima and Mancini, 2017). Once the informal sector is legalised, waste pickers can earn a proper income, which can help South Africa in reducing unemployment by creating jobs in a green sector (Godfrey and Oelofse, 2017).

#### *2.6.3.4 Economic tools for waste management*

South Africa has introduced economic tools such as plastic tax, and Extended Producer Responsibility (EPR) (Godfrey and Oelofse, 2017). The initiative was not well received by the industries as they were of the view that the government is only trying to collect money for the Fiscus more than encouraging the use of recycled materials (Godfrey and Oelofse, 2017). Nahman and Godfrey (2010) indicated that collected revenue is mostly channelled towards government funds instead of financing environmental expenditure. Plastic tax was recorded to have gone into government funds rather than to finance plastic recycling initiatives (Nahman and Godfrey, 2010). EPR and weight billing system has been implemented in other developing countries and is yielding benefits. Singapore introduced the Producer Responsibility Ordinance which charges the producer depending on the amount of waste they generated (Dahlén and Lagerkvist, 2010) and Sweden introduced landfill and incineration tax to divert waste going to landfill (Millios, 2013). Both these tools were

implemented successfully in Singapore and Sweden, and so South Africa can remodel its existing economic tools drawing lessons from developed countries and implement them in ways that force waste producers (households and industries) to participate and comply. The weight and volume billing system needs to be enforced, as most landfill sites are not complying (Godfrey and Oelofse, 2017).

South African citizens pay for waste collection services through the municipal rates. These rates are fixed and only increase on an annual basis. The municipal rates for waste do not influence the South African citizens enough to change their behaviour and attitude towards waste, or reduce the amount of waste produced per household. Producer responsibility can be introduced specifically for households in an attempt to control and manage household waste. However, Polluters Pay Principle introduced through NWMS is mostly enforced in industries even though it's applicable to both households and industries (Nahaman and Godfrey, 2010). South Africa needs to learn from developed countries how both industries and households can willingly and fully participate and comply with the waste management initiatives.

## **2.7 Overview of integrated Waste Management (IWM) Planning**

According to DEA (2000:2) the purpose of integrated waste management planning is to “integrate and optimize waste management, in order to maximize efficiency and minimize associated environmental impacts and financial costs, while improving the quality of life of all South Africans”. Therefore, integrated planning should consider all three (environmental, social and economic) aspects of sustainability. During planning it is important that there is an integration of all stakeholders from government departments to the public and other participants. The process of integrated waste management planning includes: 1. Review of existing baseline information (situation and legal environment); 2. Future projects 3. Setting objectives; 4. Identifying system components; 5. Identify and evaluate alternative methods; 6. Develop and implement IWMP; 7. Evaluate and review performance against set objectives. The seven stages of integrated waste management planning becomes the outline of IWMP, a guideline exists on how to compile the IWMP according to the seven stages stated above.

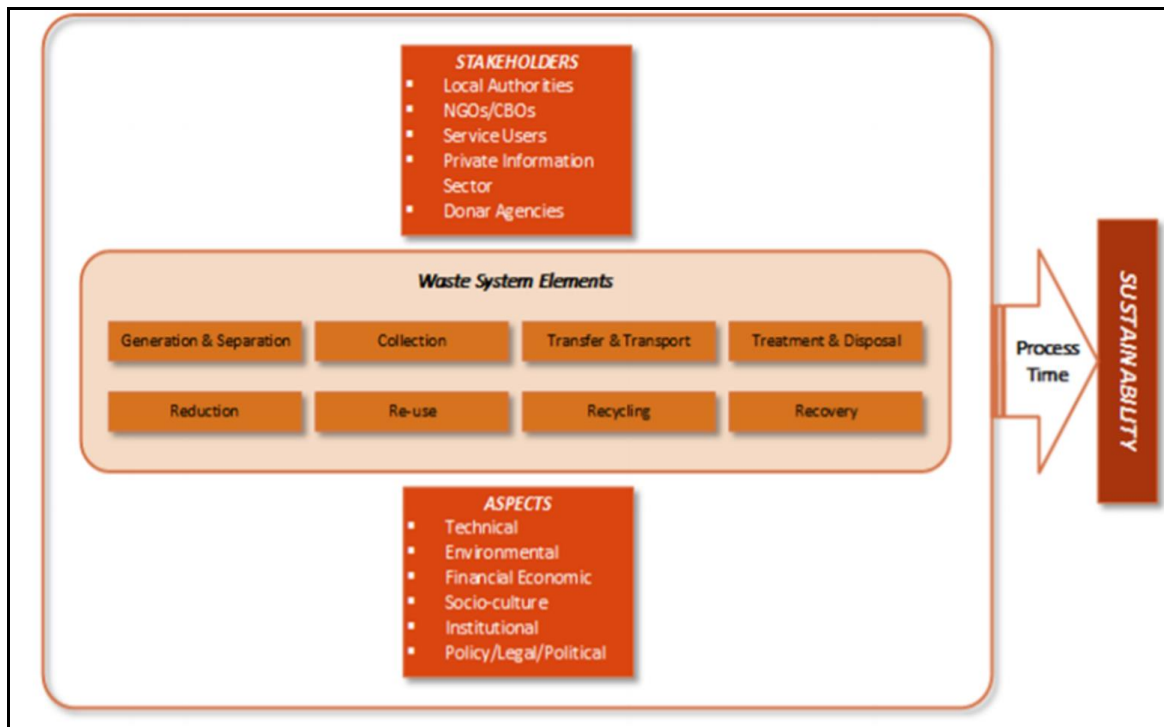
During planning it is important to understand policy objectives as it ensures effective implementation of IWMP (DEAT, 2000). Some of the policy objectives are those principles stipulated in the Waste Act, NEMA and NWMS: “accountability, cradle-to-grave, cost, integration, transparency and access to information, participation and polluter pays” (DEA, 2000:2). Waste management hierarchy and waste minimization aspects are the main

objectives of policy and should be the main basis of IWM planning. The political agenda is mainly to create jobs, alleviate poverty and pay attention to previously disadvantaged communities. These aspects should be considered during planning as local government works together with politically appointed structures. DEAT (2000) suggests that some goals might require trade-offs, such as whether to focus on job creation or waste minimization. However, some goals are supportive of each other “meaning [that] by virtue of achieving one goal the other goal will ultimately be achieved ( Naidoo, 2009).

The IWM Planning responsibilities are allocated by NWMS as follows:

- National department (DEA) is responsible for drafting and promulgating regulations and publishing guidelines on IWM planning for all waste streams (DEA, 2000).
- The provincial departments (environmental departments) are required to produce “hazardous waste management plans” and prepare provincial environmental and waste management and include IWMPs submitted by local government and industries.
- Developers are responsible for developing waste management plans for the waste they will generate and dispose of at disposal site. The waste plans will be submitted to the relevant provincial department.

IWMP (planning) has three main focus areas as indicated on Figure 6 below: Stakeholders’ consultation, Technical aspects, Planning and assessment of local context. Stakeholders are key role players in drafting IWMP and should be consulted as they ultimately influence the successful implementation of IWMP (DEAT, 2000). The waste management system has to be practical and implementable considering all technical aspects. The consideration of local context is very important during planning. IWMP must be relative to the local environment and community, hence situational analysis forms part of IWMP content (DEAT, 2000).



**Figure 6: Integrated Waste Managed System (SACN, 2014)**

## **2.8 The importance of Integrated Waste Management Plans (IWMP)**

According to Alberts (2014) an IWMP is an important waste management tool for local government and was developed as a basis or instrument to achieve objectives of the National Waste Management Strategy (NWMS). Furthermore, IWMP was developed to implementing and complying with NEMWA (Alberts, 2014). IWMP gives effect to SWM strategies that allows for provision of sustainable and affordable services and compliance with the Waste Act and NWMS (City of Cape Town, 2017). An effective IWMP has to be sustainable and make use of available technology (Marchettini *et al.*, 2007; Albu and Chitu, 2011). Thus, IWMP seek to prevent and reduce waste generated in the country and reduce the detrimental impacts on people's health and the environment (Albu and Chitu, 2011).

According to NWMS, local authorities are required to produce IWMPs that will be incorporated in the provincial waste management plan (Englesman, 2013). IWMPs are initially focused on addressing non-compliances within municipalities in relation to the NEMA: WA and other relevant waste management policies and guidelines over a short-term period. Thereafter, the plan aims to improve the overall efficiency and sustainability of waste management practices within district municipalities over medium to long-term periods (de Wet, 2012). In terms of the Waste Act, IWMP is a plan which "defines the vision, objectives and targets for provision of waste management services".

According to Muswema (2012) IWMP should be reviewed and updated regularly, and the updated version should include an action plan, time frames, and a budget. This key document helps the municipality to plan successfully and allocate budget for waste management activities. Research has shown that managing waste is more challenging and requires appropriate technical solutions, sufficient capacity, and stakeholder involvement. An integrated approach to waste management is widely accepted across the globe and in developed countries it is already yielding results (Seadon, 2006).

The IWMP allows for utilization of various treatment methods that are specified by the type of waste (Herva *et al.*, 2014). These treatment methods include: Chemical treatment such as neutralization, oxidation, reduction, precipitation, and hydrolysis, physical methods such as filtration, thermal methods such as incineration of hazardous materials, and biological methods such as the use of microbes to increase decomposition of organic wastes or to reduce the hazardous properties of waste (Makgae, 2011).

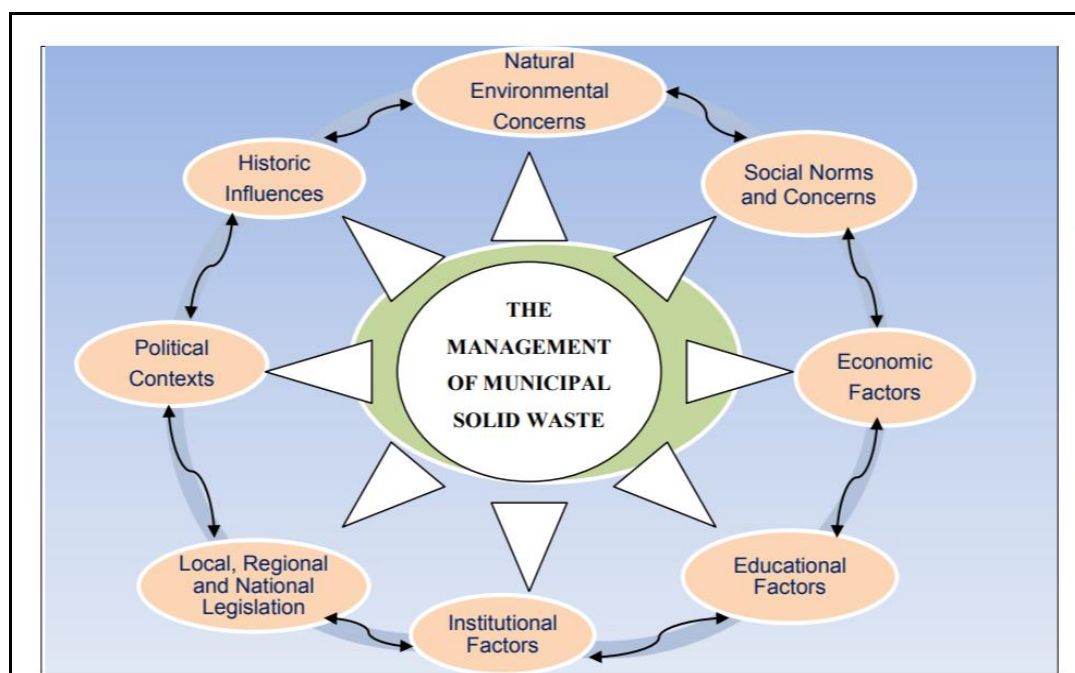
One of the reasons for increased waste production in South Africa is rural to urban migration (Nkosi, 2014). This also means that with the increasing population, there is increased demand for energy; which leads to an overload of existing systems (Makgae, 2011). However, the introduction of IWMP has led to the introduction of waste management methods that allow for the conversion of waste into energy that can be utilized within the household. Some of the processes involved here are bio-digestion, land fill gas to energy, gasification, and pyrolysis, which leads to the utilization of waste to produce usable energy (SACN, 2014). However, this is currently not being implemented, but it is an initiative that municipalities should consider in their attempt to reduce landfilling.

Waste management awareness is key in realizing the benefits of IWMP. Much of the poor waste management practices are due to behaviour and the lack of awareness of individuals, but with IWMP, citizens gain awareness of their role in proper waste management such as minimizing strategies, re-using, and recycling of some items, which will eventually lead to a change in attitudes and perception regarding waste management practices (Anderson *et al.*, 2013).

## **2.9 Factors affecting the implementation of IWMP in South Africa**

Alberts (2014) states that problems facing waste management in South Africa are waste collection backlogs, deteriorating waste equipment, population growth and lack of landfill space. These problems are amongst other problems that affect waste management in South

Africa. Naidoo (2009) identified eight factors affecting waste management in South Africa. For the purpose of this section, some of the factors will be drawn from Figure 7 indicating factors influencing municipal waste management in relation to IWMP implementation. The main issues that need to be addressed in relation to IWMP implementation include lack of capacity (qualified and experienced waste management staff), lack of planning and lack of adequate budgeting for both capital and operational expenditure.



**Figure 7: Factors influencing municipal waste management (Naidoo, 2009)**

### **2.9.1 Capital/Budget**

Capital investment into waste management sector is necessary for proper implementation of waste management systems and sustainability of waste management services provided. While numerous efforts have been made to ensure that the development of IWMP is smooth, challenges are inevitable. The main challenge is the cost of implementing IWMP and waste management system (SACN, 2014). This is one of the most common discouraging factors for adopting IWMP in developing countries (Nahman and Godfrey, 2009). Simatele *et al.* (2017) state that although the initial costs might be exorbitant, the system promises to reduce waste management costs in the long run.

The availability of funds to meet the significant once-off implementation cost of the system is a problem that affects the overall implementation of IWMP (SACN, 2014; Nahman and Godfrey, 2009). The waste management carried out by local municipalities is largely underfunded by the national government (DEAT, 2012). However, since the introduction of the NEM:WA, the funding for waste management has increased gradually (Fakoya, 2014).

Organizations such as UNEP have played a large role in helping the government fund this system due to the significant benefits to the environment and the national health of individuals (Nkosi, 2014; Chisadza, 2015).

### **2.9.2 Competency**

Many municipal workers are largely unqualified or not competent for any of their roles, due to lack of training. Incompetency makes the control and governing role of waste management system and landfills problematic as many of the workers are employed improperly instead of the qualified candidates (Fakoya, 2014). The local authority is unreliable to conduct minimization and avoidance campaigns from the point of waste generation, as they are challenged in performing their waste management duties particularly in waste collection services (Simatele *et al.*, 2017). Lack of competent resources does affect the performance of the municipalities and their functions. Naidoo (2009) states that there is still a backlog of waste management service delivery and most communities in the metros and districts experience high backlogs. This is also supported by Fakoya (2014) who states that incompetency of the municipality decreases the success of waste management programs implemented.

### **2.9.3 Organizational Capacity**

The IWM system relies heavily on the local government for provision of waste management services, but inadequate organizational capacity of municipalities leads to poor waste management and poor implementation of IWMP (Fakoya, 2014). Lack of adequate organizational capacity has the potential to impact on the development and implementation of the IWMP and overall waste management of the municipalities (Fakoya, 2014). Experienced and competent resources are critical for the implementation of IWMP, as some aspects of waste management are specialized and require specific skills (Karani and Jewasikiewit, 2007). Organizational capacity requires more than just providing and training resources; it needs more capacity building, and should introduce new technology, resources with an understanding of the administrative system for waste management and associated activities, and financial support. According to SACN (2014) metropolitan municipalities are making efforts to allocate a reasonable budget, as well as qualified and competent resources to implement waste management and other related functions.

### **2.9.4 Public Awareness**

Lack of awareness in waste management results in illegal dumping and littering. This problem is often evident in areas where there is a lack of awareness. The perceptions and cultures of the people in South Africa affect the implementation of the IWMP. The notion of

reuse, recycle, and reduce is fairly new to developing countries, which means that most people will be unwilling to reuse and recycle (Anderson *et al.*, 2013). In the majority of communities lack the knowledge to carry out the minimization and avoidance strategy and are unaware of the enormous environmental conservation burden the nation is facing (Anderson *et al.*, 2013).

One important aspect of IWMP is that municipalities run a campaign to educate people on the new waste management initiatives, and also sensitize the public to recycle, re-use, and minimize waste. Such a program would significantly reduce ignorance in citizens regarding their role in environmental management, and proper waste management. Therefore, the IWMP is a great option, as it promises to lead to better waste management methods, while also educating people on their role in relation to waste generation, reduction, separation, and collection (Anderson *et al.*, 2013).

#### **2.9.5 Legal framework**

There are a number of legal statutes that support waste management and IWMP as discussed in section 2.4, thus making legal framework a key factor to the development and implementation of IWMP (Muswema, 2012). Although a legal framework for waste management is available, there are gaps in the legislation that affect the implementation of IWMP. In many cases the municipal authority issues tenders to various contractors and businesses to manage the collection, transportation, treatment and disposal of waste, including management of landfills. The contractors, as well as other government affiliated bodies, can use these gaps to avoid the implementation of IWMP. Therefore, the presence of a supportive legal framework to IWMP is important (Muswema, 2012).

The South African government has established a legal requirement for IWMP (as discussed in section 2.4.4). However, the main responsibility lies with the local authority in ensuring compliance with the requirements of waste management, particularly IWMP. While legislation is developed at a national level, it ultimately affects how the local government makes decisions in relation to waste management.

#### **2.9.6 Political Influence**

Politics influence day to day function of the municipalities. Local government, particularly municipalities, experience pressure from various political parties (Naidoo, 2009). Environmental issues are often not considered significant in the political party manifestos. Municipal councils are elected to represent the political party and will often have a specific mandate to execute which might not have environmental issues as a priority. Muswema

(2012) is of a view that depending on when the IWMP is developed, a change of municipal council will most likely have an impact on the implementation of IWMP. The new municipal council will require workshop on IWMP to get a buy-in and allow for continuity from the old council to the new one (Muswema, 2012).

There are studies that have examined the problems associated with integrated waste management and implementation of IWMP in South Africa. Sentime (2014) assessed the impact of waste management and collection legislation; Godfrey and Oelofse (2017) looked at the historical review of waste management and recycling in South Africa; Municipal solid waste management was analysed by Naidoo (2009) using Msunduzi municipality as a case study; Muswema (2012) presented a paper titled Wrestling with IWMP implementation: case study challenges and lessons learnt. However, there are limited studies that have evaluated the quality of the developed IWMP specifically for municipalities in South Africa. The next discussion will be on the quality review methodology.

#### **2.10 Methods of assessing EIA reports quality**

According to Jalava *et al.*, (2010) the practice of reviewing the EIA reports is widely adopted across the globe. There are different ways of reviewing the reports such as the quality review checklist. In Canada, the reviewing commission review EIA statements and also do quality checks. The quality of the EIA reports can be determined using a review methodology characterized by a set of criteria used to determine the quality (Wood, 1999) and the individual's perspective is important during the review process (Glasson *et al.*, 2005). There are different review methods that can be used to assess the quality of the EIA reports: the European Commission Guideline, the Oxford- package and the Lee and Colley review package. The methods differ based to the number of levels or tiers. The Lee and Colley review package has four levels while the other two has three levels (Talime, 2010; Thorpe, 2014).

#### **2.11 EIA report quality review in South Africa**

According to Talime (2010:10) effectiveness is characterised by four aspects: “the quality of reports, effectiveness on decision-making, the effectiveness of prediction and management of the impacts and monitoring and post-audit”. The quality of reports is one of the aspects to assess to determine effectiveness, therefore the quality of reports should be of acceptable standard. Retief (2008:124) is of the view that a good report will improve the likelihood of effectiveness and it is assumed it contributes to better decision-making and therefore can enhance effectiveness. The quality of the EIA report is an important aspect because the

information in the report reflects the quality of the technical and scientific inputs in the EIA process (Pinho *et al.*, 2007; Talime, 2010).

There are different stakeholders that receive the EIA report, subject experts (government authorities) responsible for decision-making and non-experts /non-technical (public) (Talime, 2010). According to DEAT (2004) because the EIA report is received by different stakeholders (technical and non-technical), the report should therefore be accessible and written in a non-technical way and still serve its purpose of informing decision-makers. In South Africa, the EIA report is reviewed by Interest and Affected parties before making a decision of granting or not granting the environmental authorisation (van Heerden, 2010). Therefore the quality of the EIA report becomes a critical aspect to be assessed as it is an important function of an EIA process. Toro *et al.*, (2010) state that the evaluation of the EIA system enhances the EIA effectiveness and quality. The focus on the EIA quality review has been reviewing the quality against the procedure and regulations which is contrary to the Lee and Colley review package which focused on best practice (Sandham and Pretorius, 2008).

The Lee and Colley review package has been adapted to evaluate the EIA reports for various projects, for example projects with the potential of affecting wetlands (Sandham *et al.*, 2008), projects in the explosive industry (van Der Vyver, 2008), and EIA reports for filling stations (Kruger, 2012). This work was extended with quality review of EMPr in the mining sector using the same methodology (Joubert, 2015). The quality of EIA reports in South Africa was found to be similar to other countries, however there were minor omissions or lack of detailed review (Sandham *et al.*, 2008). The quality review of EIA reports for the explosive industry revealed that the EIA reports reviewed under the 2006 EIA regime was of a good quality (van der Vyver, 2008). The review of EIA reports for filling stations by Kruger (2012) found that the of EIA reports for filling stations in South Africa were satisfactory and was comparable with international studies. While the review of EMPr in the mining sector was of acceptable standard, there was an observation that there was a lack of mining technical knowledge from Environmental Assessment Practitioners which reflected in the quality of EMPr (Joubert, 2015).

The above mentioned information is an indication that there is extensive research conducted on the quality of EIA reports. The Lee and Colley review package was adopted and in some instances it was designed to suit a particular study. The research indicated that the quality of the EIA reports should be of acceptable standard as it affects the effectiveness of the EIA

process or system. Therefore, a review package methodology will be adopted to assess the quality of the IWMPs of the metropolitan municipalities of South Africa.

## **CHAPTER 3: RESEARCH METHODOLOGY**

### **3.1 Introduction**

The objectives of the study as stated in Chapter One are to: develop and adapt a review package to review the quality of sampled IWMPs from eight metropolitan municipalities in South Africa and to analyse and interpret the results and draw conclusions regarding the quality of the IWMPs in the metropolitan municipalities in South Africa. To achieve the stated objectives, the study adopted a Lee and Colley review package methodology. A similar approach of developing a review package was followed. A review was conducted in the context of South African waste management legislation (NEM: WA) requirements such as: the Guideline for the Development of IWMPs (DEA, 2012).

### **3.2 Research Design**

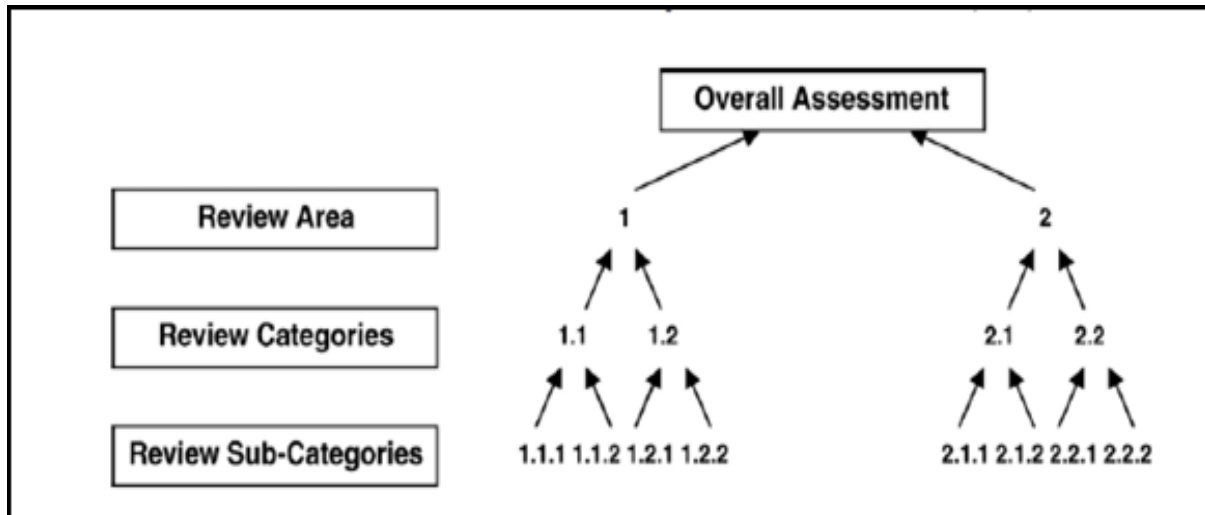
The Lee and Colley review package was adopted and used to design a review package for IWMP. The review areas of the IWMP review checklist are similar to those used by Lee and Colley (1999) to review EIA reports. The process of developing the review areas, categories and sub-categories will be discussed after discussing the Lee and Colley methodology.

#### **3.2.1 Lee and Colley Review Package**

The Lee and Colley review package is normally used in developing and developed countries like UK, Belgium, Denmark, and South Africa (Sandham et al., 2010; Mounir, 2014). Reviewers preferred Lee and Colley review package because it saves time and the EIA process is known to many (Sandham and Pretorius, 2008) and the Lee and Colley is simple and easy to follow when reviewing (Lee and George, 2000). The Lee and Colley is structured in a pyramid or hierarchy form (Figure 8) with four review area topics which are: “project description, key impacts identification, alternatives, mitigation and communication” (Sandham et al., 2013). The process of reviewing always commences from the bottom and proceed upwards to the categories then to Review areas and ultimately the determination of the overall assessment quality.

The review areas are the key criteria for evaluating. Each review area consists of sub-categories at the bottom of the hierarchy with more than two digits; categories on the second level with two digits and the review areas on the third level with one digit (Figure 8). During the assessment, the reviewer will start from the lowest level which is sub-category indicated by numeric value 1.1.1 or 2.1.1 and entails the simple criteria related to a specific task and procedure (Lee et al., 1999). Once the lowest level is completed the reviewer will then move

to the next level which is category represented by numeric value 1.1 or 2.1 informed by the assessment out of the sub-category. From category the review progresses to another level which is the review area, presented by numeric value 1 or 2 until the overall assessment is completed (Lee *et al.*, 1999).



**Figure 8: Lee and Colley, EIR review package hierarchy (Sandham *et al.*, 2008)**

The overall assessment grade is awarded and that completes the assessment. By using the assessment grade the review is able to award an assessment grade depending on their satisfaction (Sandham *et al.*, 2013). Table 2 shows the assessment grade. Joubert (2015) also suggests that the more satisfied the reviewer is the better the scoring in terms of quality will be. The assessment grades can be summarised as A, B and C grades being satisfactory meaning the reviewer is satisfied with the task performed. If the task is poorly performed the reviewer will award D, E and F grades.

**Table 2: List of assessment grades (Lee et al., 1999)**

| <u>Symbol</u> | <u>Explanation</u>                                                                                                     |
|---------------|------------------------------------------------------------------------------------------------------------------------|
| A             | Relevant tasks well performed, no important tasks left incomplete.                                                     |
| B             | Generally satisfactory and complete, only minor omissions and inadequacies.                                            |
| C             | Can be considered just satisfactory despite omissions and/or inadequacies.                                             |
| D             | Parts are well attempted but must, as a whole, be considered just unsatisfactory because of omissions or inadequacies. |
| E             | Not satisfactory, significant omissions or inadequacies.                                                               |
| F             | Very unsatisfactory, important task(s) poorly done or not attempted.                                                   |
| NA            | Not applicable. The Review Topic is not applicable or it is irrelevant in the context of this Statement.               |

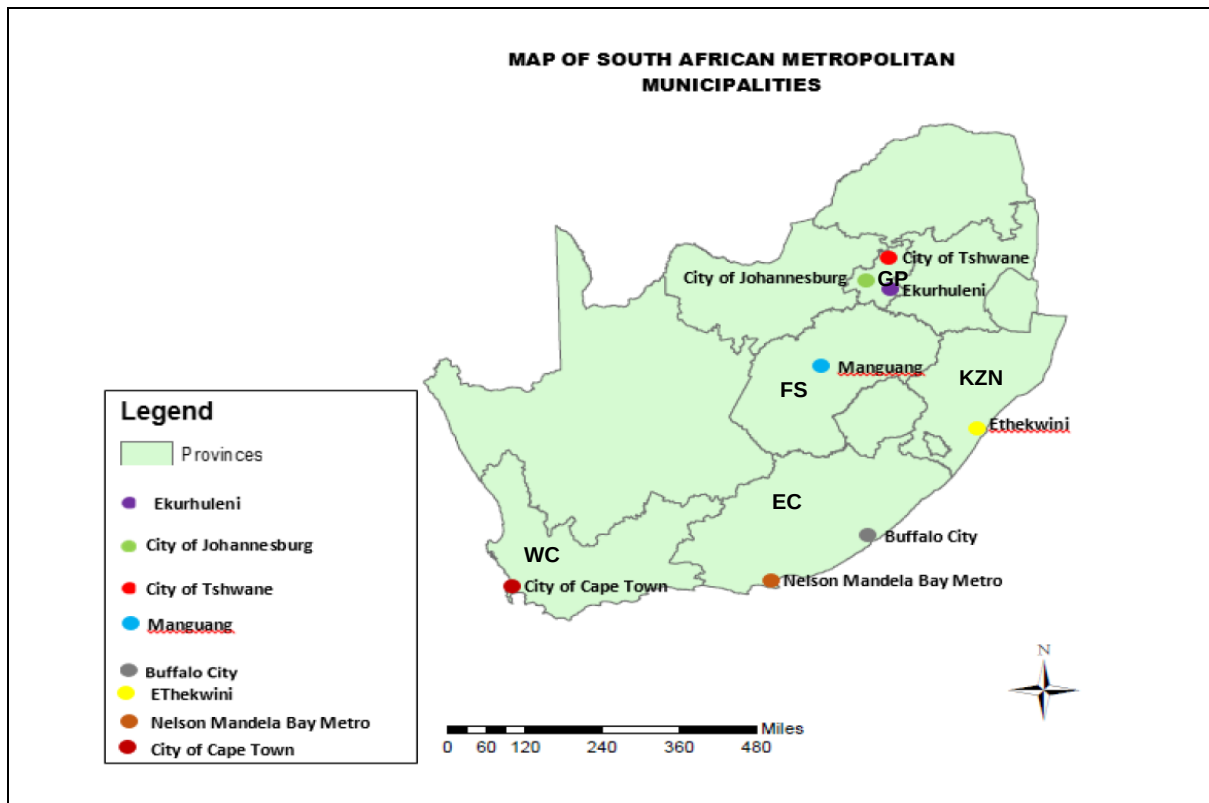
The Lee and Colley review process requires more than one review (Lee et al., 1999). Better results are achieved when the EIA reports quality review is conducted by at least two people (Peterson, 2010). The development of the IWMP review package for the metropolitan municipalities followed a similar approach as Lee and Colley.

### **3.2.2 Data Selection**

Municipalities are classified into three categories according to their jurisdiction: category A-metropolitan municipalities; category B-Local municipalities and category C-District municipalities (Moyo, 2015). The metropolitan municipality is defined by Section 155:1a of The Constitution as “municipality that executes all the functions of local government for a city, urban areas or centre of economic activity”.

Metropolitan municipalities are the largest and most densely populated compared to District municipalities and Local municipalities (Moyo, 2015). According to SACN (2013) commercial activities and industrial centres are common in metropolitan municipalities. Therefore, considering that metropolitan municipalities constitute of different cities, large population and commercial activities, IWMPs from metropolitan municipalities were considered for this study. Since the promulgation of the NEM:WA in 2008, municipalities are required to develop IWMPs and integrate the plans in the IDP to ensure alignment with other municipal basic services. Some of the metropolitan municipalities are already in their second or third generation of IWMP.

Data was extracted from a sample of IWMPs that were accessed from the public domain of the metropolitan municipalities. Only Ekurhuleni metropolitan municipality was contacted as the IWMP was not available on the website. A total of eight IWMPs of metropolitan municipalities located in different provinces in South Africa (Figure 9) were obtained for this study.



**Figure 9: Map showing Metropolitan Municipalities of South Africa ([www.salga.org.za](http://www.salga.org.za))**

Gauteng is the smallest of the nine provinces of South Africa and has the highest population as indicated in Table 3 below. The total waste tonnage of the metropolitan municipalities of Gauteng is higher compared to other provinces because Gauteng is made up of three metropolitan municipalities. The Western Cape has one metropolitan municipality which is the City of Cape Town and it is producing about 50% of the total tonnes of waste in the Western Cape. Buffalo City and Nelson Mandela Bay metropolitan municipalities are producing less waste combined compared to City of Cape Town. eThekweni metropolitan municipality has a population of 3.7m and is producing waste of about 1 752 800 tonnes. Mangaung metropolitan municipality has the smallest population and its waste contribution to the country's overall waste tonnes is less.

**Table 3: Sample of the IWMPs of the metropolitan municipalities in South Africa**

| Provinces           | Population | Waste quantity (tons) | Metropolitan Municipalities | Sample of IWMPs | Population | Waste quantity (tons) |
|---------------------|------------|-----------------------|-----------------------------|-----------------|------------|-----------------------|
| Western Cape (WC)   | 6 621 103  | 7 702 280             | City of Cape Town           | 7IWMP-2017      | 4 949 000  | 3 713 700             |
| Free State (FS)     | 2 954 348  | 4 572 337             | Mangaung                    | 3IWMP-2014      | 787 803    | 322 811               |
| Kwazulu-Natal (KZN) | 11 384 722 | 8 090 722             | eThekwin                    | 5IWMP-2016      | 3 662 000  | 8 090 722             |
| Eastern Cape (EC)   | 6 522 734  | 4 299 035             | Buffalo                     | 2IWMP-2012      | 810 500    | 1 577.6               |
|                     |            |                       | Nelson Mandela Bay          | 6IWMP-2016      | 1 263 000  | 793 501.2             |
| Gauteng (GP)        | 14 710 040 | 8 703 068             | City of Tshwane             | 4IWMP-2014      | 3 725 000  | 1 422 943.3           |
|                     |            |                       | Erkurlhuleni                | 8IWMP-2018      | 3 379 000  | 3 669 384.9           |
|                     |            |                       | City of Johannesburg        | 1IWMP-2011      | 4 949 000  | 2 035 015             |
| Limpopo (LP)        | 5 797 300  | 6 802 722             | -                           | -               | -          | -                     |
| Mpumalanga (MP)     | 4 523 900  | 31 096 624            | -                           | -               | -          | -                     |
| North-West (NW)     | 3 979 000  | 8 177 693             | -                           | -               | -          | -                     |
| Northern Cape (NC)  | 1 225 600  | 45 485                | -                           | -               | -          | -                     |

No IWMPs were obtained from District municipalities and Local municipalities due to the study only focusing on the IWMPs produced by the metropolitan municipalities with an objective to review their quality. The results of the review are discussed in the next section.

### **3.2.3 IWMP review package**

The requirements of the NEM:WA (Act No. 59 of 2008) and the Guideline were combined to come up with review topics: Situational analysis, implementation of the Waste Act, identify, evaluate and select alternatives, Communication and Stakeholder participation, implementation instrument and Funding mechanism. These review areas are similar to the four main review areas of the Lee and Colley review package stated above.

The categories and sub-categories of the IWMP review package were informed by the Guideline as the Guideline gives a detailed description of the IWMP and specific requirements on how to compile and implement the IWMP. Therefore, the categories and sub-categories were designed to suit the guideline requirements. The IWMP review package consists of 10 review areas; 32 categories and 38 sub-categories. The assessment exercise started at the lowest level which is the sub-category followed by the next level which is the categories. The assessment outcome of the categories informed the review areas and the assessment was completed by awarding overall assessment of the plan.

The review exercise followed the Lee and Colley method of assessing and awarding assessment grade. Table 4 shows the description of the assessment grades. The outcome of the assessment is symbolized by a grade allocation, in which A- Well Performed, B-Satisfactory, C-Just satisfactory, D- Not Satisfactory, E-Poorly performed, and F- Not attempted or Not applicable. The results of the assessment are recorded on Appendix C as raw data. A performance grade of A is awarded where the municipality has performed the task beyond what is required and targets were set and met. Satisfactory performance is when the municipality has performed the task but did not go beyond what was required. Just satisfactory is awarded when the municipality conduct the task with omission or has provided insufficient information which when assessment does not necessarily hinder the municipality from performing but performance could be enhanced provided there were no omission. Where the plan indicates significant omission or insufficient information and the municipality just fairly attempted to conduct the task that performance is graded as not satisfactory. Where there was not effort in conducting the task or the plan will indicate that the municipality has intentions to implement or conduct a task the performance will be rated poorly performed. While task not performed is when the municipality will indicate in the plan that nothing was done at all.

The requirements of Chapter 13 (section 12 & 13) of NEM: WA were adopted in designing a review package as indicated in Table 5, the review package was also informed by the guideline as indicated earlier. The review package thus indicate a link between the regulation requirements and how the review package will be used to assess if the requirements were met in the IWMPs.

**Table 4: List of assessment symbol/grade (Lee and Colley review package, 1999)**

| Rating<br>Symbol | Description                                                                   |
|------------------|-------------------------------------------------------------------------------|
| A                | Well performed                                                                |
| B                | Satisfactory                                                                  |
| C                | Just satisfactory performanc - Minor omissions/ insufficient information      |
| D                | Not satisfactory-Insufficient information provided, but task fairly attempted |
| E                | Poorly Performance- Not satisfactory, inadequately attempted                  |
| F                | task not performed/ not applicable                                            |

**Table 5: Summarised Review Package**

| No.       | Review areas<br>Review Categories<br>Sub-categories                                                              | No.       | Review areas<br>Review Categories<br>Sub-categories   |
|-----------|------------------------------------------------------------------------------------------------------------------|-----------|-------------------------------------------------------|
| <b>1</b>  | <b>Situation analysis</b>                                                                                        | 6.1       | Roles and Responsibilities                            |
| 1.1       | Goals of IWMP defined                                                                                            | 6.2       | Waste generation                                      |
| 1.2       | Description of geographical area of municipalities                                                               | 6.3       | Waste consumption                                     |
| 1.3       | Description of Socio-economic analysis                                                                           | 6.4       | Collection & Disposal                                 |
| 1.3.1     | Demographics                                                                                                     | 6.5       | Waste minimisation                                    |
| 1.3.2     | Socio-economic status                                                                                            | <b>7</b>  | <b>Gap analysis and challenges</b>                    |
| 1.4       | Waste quantities and types                                                                                       | 7.1       | Pressures and challenges                              |
| 1.4.1     | Current domestic waste generation per capita                                                                     | 7.1.1     | Waste minimisation, recycling, re-use & recovery      |
| 1.4.2     | Estimating future waste generation rates and quantities                                                          | 7.1.2     | Compliance and enforcement                            |
| 1.4.3     | Waste status (information, collection methods)                                                                   | 7.1.3     | Integrated planning                                   |
| 1.4.4     | Reporting of waste data to SAWIS                                                                                 | 7.1.4     | Waste data capture and management                     |
| 1.4.5     | Financing of waste management                                                                                    | 7.1.5     | Waste treatment and disposal                          |
| 1.4.6     | Organisation structure (current & future resources)                                                              |           |                                                       |
| <b>2</b>  | <b>Implementation of chapter 3 of Waste Act</b>                                                                  | 7.1.6     | Awareness raising and building capacity               |
| 2.1       | Description of waste management objectives (goals, targets & indicators)                                         | 7.1.7     | Waste service Delivery                                |
| 2.2.      | Identify and address impacts of poor waste management practices on the health and the environment                | 7.1.8     | Illegal dumping                                       |
| 2.3       | Provision of implementation of waste minimisation, re-cycle, re-cycling and the recovery targets and initiatives | 7.1.8     | Future needs determined                               |
| 2.4       | Address delivery of waste management services to the residential premises                                        | <b>8</b>  | <b>Environmental communication &amp; consultation</b> |
| 2.5       | Implement any relevant South African obligation to international agreements                                      | 8.1       | Examples of successful implementation                 |
| 2.6       | Give effect to best waste management practices                                                                   | 8.2       | Benchmarking                                          |
| <b>3</b>  | <b>Alternatives</b>                                                                                              | 8.3       | Public awareness                                      |
| 3.1       | Identify and evaluate alternatives                                                                               | <b>9</b>  | <b>Roles and Responsibilities</b>                     |
| 3.2       | Select preferred alternatives                                                                                    | 9.1       | Municipality's responsibilities                       |
| <b>4.</b> | <b>Communication and stakeholder participation</b>                                                               | 9.1.1     | Municipal manager                                     |
| 4.1       | Consultation process                                                                                             | 9.1.2     | Waste management officer                              |
| 4.2       | Stakeholder participation                                                                                        | 9.1.3     | Environmental Management Department                   |
| 4.3       | Awareness campaign and communication                                                                             | 9.1.4     | Waste management Directorate                          |
| 4.3.1     | Ward committee meeting                                                                                           | 9.1.5     | Infrastructure and service department                 |
| 4.3.2     | Waste management forum meetings                                                                                  | 9.2       | Stakeholder responsibilities                          |
| 4.3.3     | Workshops with I&AP                                                                                              | <b>10</b> | <b>Reporting, Monitoring and Review</b>               |
| 4.3.4     | Publishing of information about IWMP process                                                                     | 10.1      | Reporting                                             |
| <b>5</b>  | <b>Implementation instruments</b>                                                                                | 10.2      | Monitoring                                            |
| 5.1       | Partnership identified                                                                                           | 10.2.1    | Strategic issues                                      |
| 5.1.1     | Public-participation partnership                                                                                 | 10.2.2    | Performance                                           |
| 5.1.2     | Public-private partnership                                                                                       | 10.2.3    | Public Accountability                                 |
| 5.1.3     | NGO/Community based organisation                                                                                 | 10.2.4    | Communication and public participation                |
| 5.2       | Legislative Instruments (Development and enforcement of By-Laws)                                                 | 10.2.5    | Financial plan                                        |
| 5.3       | Funding mechanisms                                                                                               | 10.2.6    | Waste management implementation programme             |
| 5.3.1     | Funding mechanisms for recycling                                                                                 | 10.3      | Review of IWMPs                                       |
| 5.3.2     | Funding mechanisms for waste collection and transportation                                                       |           |                                                       |
| 5.3.3     | Funding mechanisms for waste disposal                                                                            |           |                                                       |
| 5.3       | Implementation plan (summary of an IWMP)                                                                         |           |                                                       |
| <b>6</b>  | <b>Waste management systems of the municipalities</b>                                                            |           |                                                       |

This section discussed the research methodology. The Lee and Colley review methodology was adopted in designing the review package for the IWMP samples for the metropolitan municipalities. The assessment outcome of each IWMP reviewed was recorded and the results will be presented and discussed in the next chapter.

#### **3.2.4 Limitations**

The information provided in the IWMPs was not verified against the SAWIC and other related documents such as IDP of that particular metropolitan municipality. The verification of information was out of the scope of study. The unavailability of the previous revision of the IWMP was a limitation, as old revision could not be reviewed to give a clear picture of where the municipality started and the progress.

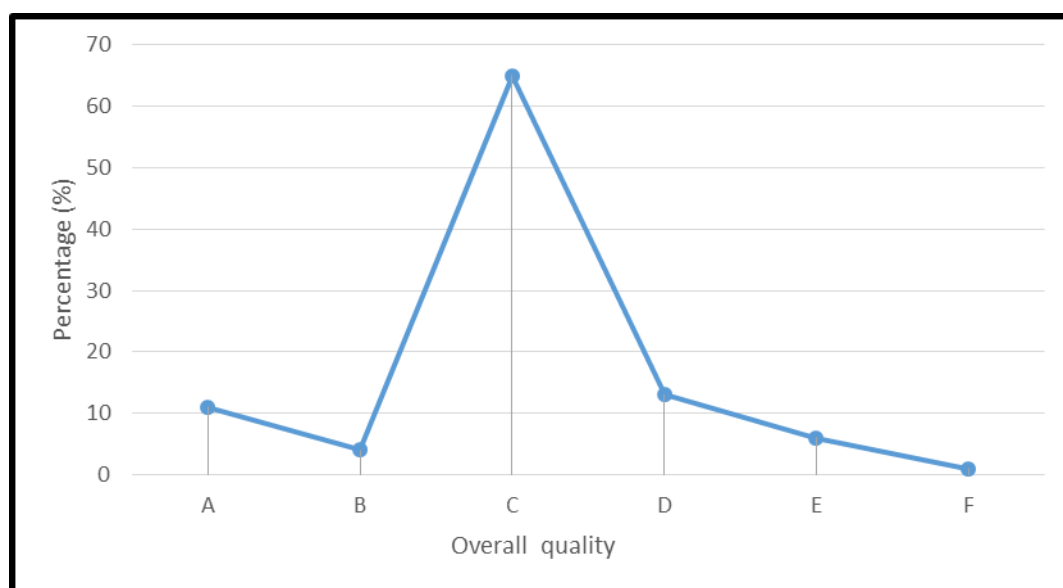
## CHAPTER 4: RESEARCH RESULTS AND ANALYSIS

### 4.1 Introduction

Chapter 4 of the study provides results interpretation and analysis of eight Integrated Waste Management Plans (IWMPs) for metropolitan municipalities in South Africa that were reviewed. Each Review Area was awarded a grade and the results were recorded in sheet (Annexure A) while the calculated percentage of the Review Areas is recorded in Table 4-1. The assessment grades are: A- well performed; B- satisfactory; C- just satisfactory; D-not satisfactory; E- poorly performed and F- not attempted/not applicable. The assessment grades were further grouped into the following categories: A-B which indicate the strength, E-F which is the weakness while A-C and C-D just satisfactory.

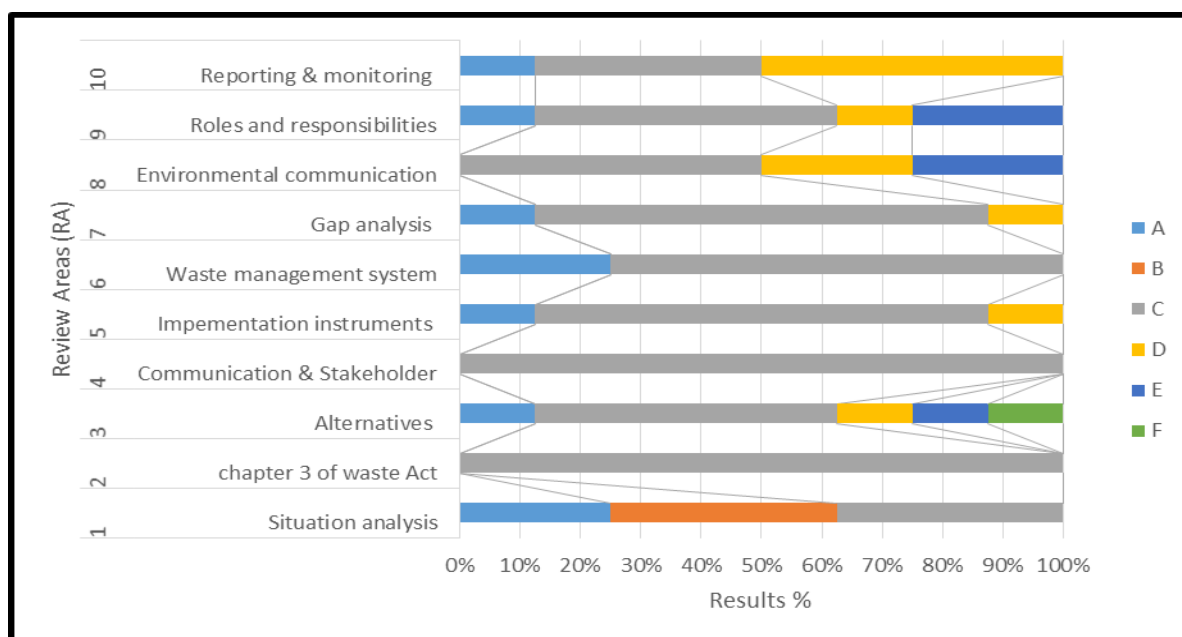
### 4.2 Overall quality of IWMPs reviewed

The overall quality of sampled eight IWMPs is depicted in Figure 10. The review showed that 14% of the IWMPs performed well (scoring A-B), while 80% of the IWMPs were found to be satisfactory grade (A-C). A total of 76.5% were just satisfactory (C-D) while 7.4% of the IWMPs were unsatisfactory scoring E-F. A summary of the overall grades is presented in Table 6. Overall quality review of IWMPs produced for municipalities was satisfactory.



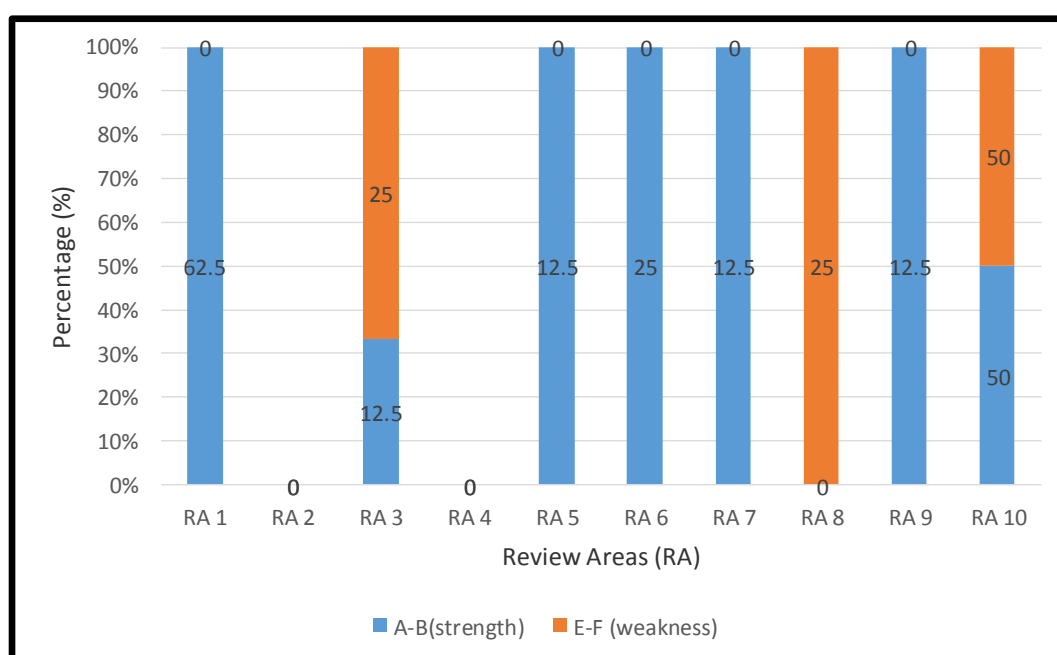
**Figure 10: Overall quality of reviewed IWMPs**

Summary of quality of Review Areas is presented in Figure 11. Most of the Review Areas were found satisfactory (A-C). There were other Review Areas that were found not satisfactory because of significant omissions scoring 25 % of E-F which indicated weakness of the plan, while Review Area 3 scored grade F for not attempting the task at all.



**Figure 11: Summary of Review Area grades**

Figure 12 shows comparison results between Review Areas that showed strength scoring A-B and weakness scoring E-F. Review Areas 1 scored 62.5 % of A-B thus situational analysis task was well performed. Review Area 8 and 10 did not perform well scoring 25% of E-F thus task poorly performed with major omissions or task not attempted at all. This is due to poor presentation of environmental communication and consultation and reporting, monitoring and reporting. The municipalities failed to perform the task as per the Guideline and the Waste Act requirements. Municipalities struggling to monitor and report on their performance with regard to meeting targets set in the IWMPs. The municipalities cannot account to the overall performance of waste management system hence those Review Areas showed weaknesses in that regard.



**Figure 12: Comparison between A-B and E-F**

**Table 6: Overview of the results of quality review of a sample of eight IWMPs**

| Overview of Review categories quality review grades |                                       | A | B | C   | D | E | F | A-C (%) | A-B (%) | C-D (%) | E-F (%) |
|-----------------------------------------------------|---------------------------------------|---|---|-----|---|---|---|---------|---------|---------|---------|
| 1.1                                                 | Goals of IWMP defined                 | 6 | 1 | 1   | 0 | 0 | 0 | 87,5    | 87.5    | 12.5    | 0       |
| 1.2                                                 | Geographical area of municipality     | 4 | 1 | 2   | 0 | 1 | 0 | 87.5    | 62.5    | 25      | 12.5    |
| 1.3                                                 | Socio-economic status                 | 4 | 2 | 2   | 0 | 0 | 0 | 100     | 75      | 25      | 0       |
| 1.4                                                 | Waste quantities and types            | 2 | 2 | 4   | 0 | 0 | 0 | 100     | 50      | 50      | 0       |
| 2.1                                                 | Waste management objectives           | 3 | 0 | 4   | 0 | 0 | 1 | 87.5    | 37.5    | 50      | 12.5    |
| 2.2                                                 | Waste impacts                         | 0 | 0 | 4   | 2 | 1 | 1 | 50      | 0       | 75      | 25      |
| 2.3                                                 | Waste management initiatives          | 0 | 0 | 7   | 0 | 0 | 1 | 87.5    | 0       | 87.5    | 12.5    |
| 2.4                                                 | Waste management services             | 0 | 0 | 8   | 0 | 0 | 0 | 100     | 0       | 100     | 0       |
| 2.5                                                 | International agreements              | 0 | 0 | 100 | 0 | 0 | 0 | 100     | 0       | 100     | 0       |
| 2.6                                                 | Best practices                        | 0 | 0 | 6   | 0 | 1 | 1 | 75      | 0       | 75      | 25      |
| 3.1                                                 | Identify Alternatives                 | 1 | 0 | 4   | 1 | 1 | 1 | 62.5    | 12.5    | 62.5    | 25      |
| 3.2                                                 | Select alternatives                   | 1 | 0 | 3   | 2 | 1 | 1 | 50      | 12.5    | 62.5    | 25      |
| 4.1                                                 | Consultation process                  | 0 | 0 | 7   | 1 | 0 | 0 | 87.5    | 0       | 12.5    | 0       |
| 4.2                                                 | Stakeholder participation             | 0 | 0 | 7   | 1 | 0 | 0 | 87.5    | 0       | 12.5    | 0       |
| 4.3                                                 | Awareness & communication             | 0 | 1 | 6   | 1 | 0 | 0 | 87.5    | 12.5    | 87.5    | 0       |
| 5.1                                                 | Partnership                           | 1 | 0 | 6   | 1 | 0 | 0 | 87.5    | 12.5    | 87.5    | 0       |
| 5.2                                                 | Legislative instruments               | 2 | 0 | 6   | 0 | 0 | 0 | 100     | 25      | 75      | 0       |
| 5.3                                                 | Funding mechanisms                    | 1 | 1 | 4   | 2 | 0 | 0 | 75      | 25      | 75      | 0       |
| 5.4                                                 | Implementation plan                   | 1 | 1 | 2   | 1 | 3 | 0 | 50      | 25      | 37.5    | 0       |
| 6.1                                                 | Roles and Responsibilities            | 2 | 0 | 6   | 0 | 0 | 0 | 100     | 25      | 75      | 0       |
| 6.2                                                 | Waste generation                      | 2 | 0 | 6   | 0 | 0 | 0 | 100     | 25      | 75      | 0       |
| 6.3                                                 | Waste consumption                     | 2 | 0 | 5   | 0 | 1 | 0 | 87.5    | 25      | 75      | 12.5    |
| 6.4                                                 | Collection & Disposal                 | 2 | 0 | 6   | 0 | 0 | 0 | 100     | 25      | 75      | 0       |
| 6.5                                                 | Waste minimisation                    | 2 | 0 | 6   | 0 | 0 | 0 | 100     | 25      | 75      | 0       |
| 7.1                                                 | Pressures and challenges              | 1 | 0 | 7   | 0 | 0 | 0 | 100     | 12.5    | 87.5    | 0       |
| 8.1                                                 | Examples of successful implementation | 0 | 0 | 4   | 2 | 2 | 0 | 50      | 0       | 75      | 25      |
| 8.2                                                 | Benchmarking                          | 0 | 0 | 1   | 1 | 5 | 1 | 12.5    | 0       | 25      | 75      |
| 8.3                                                 | Public awareness                      | 0 | 0 | 7   | 1 | 0 | 0 | 87.5    | 0       | 100     | 0       |
| 9.1                                                 | Municipality's responsibilities       | 1 | 0 | 5   | 0 | 1 | 1 | 75      | 12.5    | 12.5    | 25      |
| 9.2                                                 | Stakeholder responsibilities          | 1 | 0 | 5   | 1 | 1 | 1 | 75      | 12.5    | 75      | 25      |
| 10.1                                                | Reporting                             | 1 | 0 | 3   | 4 | 0 | 0 | 50      | 12.5    | 87.5    | 0       |
| 10.2                                                | Monitoring                            | 1 | 0 | 2   | 4 | 1 | 0 | 37.5    | 12.5    | 75      | 12.5    |
| 10.3                                                | Review of IWMPs                       | 2 | 0 | 5   | 1 | 0 | 0 | 87.5    | 25      | 75      | 0       |
| Overview of Review Area grades                      |                                       |   |   |     |   |   |   |         |         |         |         |
| 1                                                   | Situation analysis                    | 2 | 3 | 3   | 0 | 0 | 0 | 100     | 62.5    | 37.5    | 0       |
| 2                                                   | Chapter 3 of Waste Act                | 0 | 0 | 8   | 0 | 0 | 0 | 100     | 0       | 100     | 0       |
| 3                                                   | Alternatives                          | 1 | 0 | 4   | 1 | 1 | 1 | 62.5    | 12.5    | 62.5    | 25      |
| 4                                                   | Communication & stakeholder           | 0 | 0 | 8   | 0 | 0 | 0 | 100     | 0       | 100     | 0       |
| 5                                                   | Implementation instruments            | 1 | 0 | 6   | 1 | 0 | 0 | 87.5    | 12.5    | 87.5    | 0       |
| 6                                                   | Waste Management system               | 2 | 0 | 6   | 0 | 0 | 0 | 100     | 25      | 75      | 0       |
| 7                                                   | Gap analysis                          | 1 | 0 | 6   | 1 | 0 | 0 | 87.5    | 12.5    | 87.5    | 0       |
| 8                                                   | Environmental communication           | 0 | 0 | 4   | 2 | 2 | 0 | 50      | 0       | 75      | 25      |
| 9                                                   | Roles and responsibility              | 1 | 0 | 4   | 1 | 2 | 0 | 62.5    | 12.5    | 62.5    | 25      |
| 10                                                  | Monitoring and Reporting              | 1 | 0 | 3   | 4 | 0 | 0 | 50      | 12.5    | 87.5    | 0       |

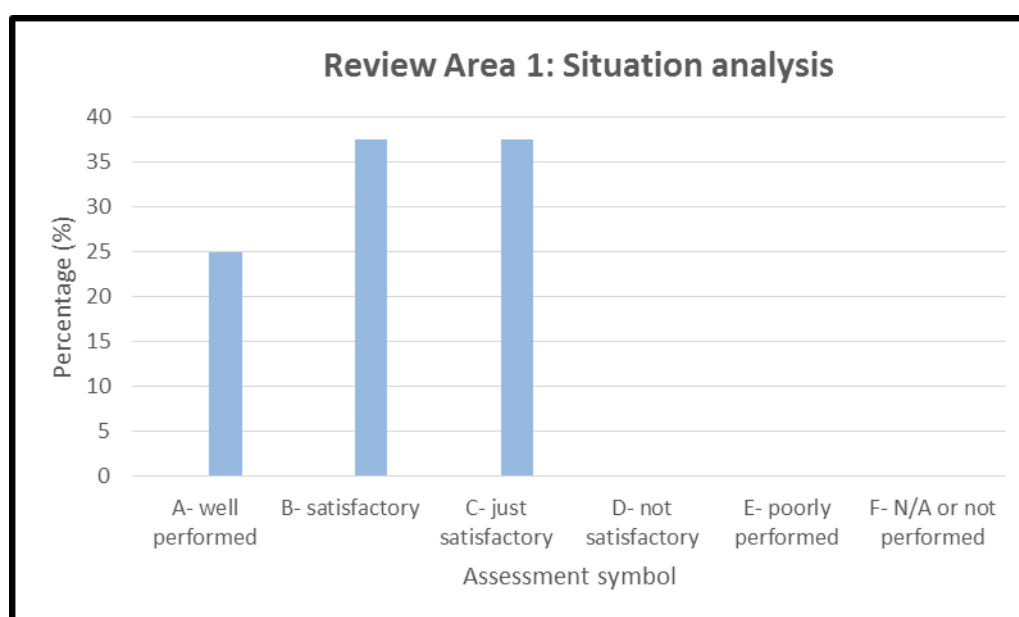
|                |   |   |    |    |   |   |    |    |      |     |
|----------------|---|---|----|----|---|---|----|----|------|-----|
| Overall grades | 9 | 2 | 52 | 10 | 5 | 1 | 80 | 14 | 76.5 | 7.4 |
|----------------|---|---|----|----|---|---|----|----|------|-----|

### 4.3 Review Areas results

This section will discuss the results of each Review Area, categories and sub-categories of the IWMPs.

#### 4.3.1 Review Area 1: Situation Analysis

Situation analysis gives a description of the status quo of the waste management system of a municipality. Figure 13 below shows percentage allocation of Review Area 1 of the IWMPs. Looking at the objectives of situation analysis as described in the National Framework Guideline for Development of IWMPs (herein referred to as the Guideline). As indicated in Table 7, 62.5 % of the IWMPs performed well scoring A-B in Review Area 1. Under Category 1.1, most the IWMPs defined the goals scoring 100% A-C. A total of four IWMPs scored grade C under category 1.4 (waste quantities and types) and scored 100% of A-C (satisfactory) and 50% of A-B indicating task was well performed.



**Figure 13: Review grades for Review Area 1**

While the assessment of Sub-Review categories was satisfactory scoring A-C. There were few gaps that were identified in the Sub-Review categories 1.4.2 and 1.4.4. The Sub-Review categories scored E and F. The Sub-Review categories has 25% of E-F which showed the task was not well performed. The Guideline requires that the IWMPs estimate future waste generation rates and quantities for each socio-economic category for population, population distribution and commercial and industrial waste. There were municipalities that did not conduct the task of future projection well and insufficient information was provided hence Sub-Category scored E and 25% of E-F while the rest of the IWMPs were able to project future waste generation rate however the projection did not consider industrialization and other future economic development activities that

might stimulate population growth in the metropolitan municipalities hence scoring 50% of grade A-C

The Guideline requires that waste information be submitted to South African Waste Information System (SAWIS). The required waste information can be reported either by capturing information on SAWIS website or by manually submitting to provincial waste information officer who will then submit to SAWIS on behalf of the municipality. The review of sub-Review categories revealed that 37.5% of the plans were satisfactory (scoring A-C). Thus the plans indicated there is functional waste management information system and waste information is submitted to SAWIS regularly under Reporting of waste data to SAWIS Sub-Category. Only 12.5 % of the plans performed the task well scoring grade A-B. There were municipalities that indicated in the plans that currently there is no functional waste management information system or they are in the process of developing a waste management system thus scoring 25% of E-F there was one plan that indicated that the task was not attempted at all while the other one only stated the requirements from the Guideline meaning the information was not submitted to SAWIS thus scoring grade E and F. The municipalities did not attempt to report to SAWIS either by submitting waste information online or manually as required.

The IWMPs must indicate current and future organization structure according to the Guideline. The organizational structure must show human resource capacity available or required to implement waste management system or to deliver waste service delivery in the municipality. During the review of Sub-Category 1.4.6, 50% of the plans were found to have performed the task well (scored A-B) and 100% was satisfactory while the other 50% scored C-D meaning they are not satisfactory and can improve if more information such as enforcement and planning structures can be included in the organizational structure The IWMPs only focused on waste collection, recycling, infrastructure resources which are more operational functions.

**Table 7: Review grades of Review Area 1**

| RA<br>Cat<br>Sub-<br>cat | Results of RA 1                                         | A | B | C | D | E | F | A-<br>C<br>% | A-<br>B<br>% | C-<br>D<br>% | E-F<br>% |
|--------------------------|---------------------------------------------------------|---|---|---|---|---|---|--------------|--------------|--------------|----------|
| <b>1</b>                 | <b>Situation analysis</b>                               | 2 | 3 | 3 | 0 | 0 | 0 | 100          | 62.<br>5     | 37.<br>5     | 0        |
| 1.1                      | Goals of IWMP defined                                   | 6 | 1 | 1 | 0 | 0 | 0 | 100          | 87.<br>5     | 12.<br>5     | 0        |
| 1.2                      | Geographical area of municipality                       | 4 | 1 | 2 | 0 | 1 | 0 | 87.<br>5     | 62.<br>5     | 25           | 12.<br>5 |
| 1.3                      | Socio-economic status                                   | 4 | 2 | 2 | 0 | 0 | 0 | 100          | 75           | 25           | 0        |
| 1.3.1                    | Demographics                                            | 4 | 1 | 3 | 0 | 0 | 0 | 100          | 62.<br>5     | 32.<br>5     | 0        |
| 1.3.2                    | Socio-economic status                                   | 3 | 2 | 3 | 0 | 0 | 0 | 100          | 62.<br>5     | 32.<br>5     | 0        |
| 1.4                      | Waste quantities and types                              | 2 | 2 | 4 | 0 | 0 | 0 | 100          | 50           | 50           | 0        |
| 1.4.1                    | Current domestic waste generation per capita            | 3 | 1 | 4 | 0 | 0 | 0 | 100          | 50           | 50           | 0        |
| 1.4.2                    | Estimating future waste generation rates and quantities | 2 | 1 | 1 | 2 | 2 | 0 | 50           | 32.<br>5     | 32.<br>5     | 25       |
| 1.4.3                    | Waste status (information, collection methods)          | 2 | 2 | 3 | 0 | 1 | 0 | 87.<br>5     | 50           | 32.<br>5     | 12.<br>5 |
| 1.4.4                    | Reporting of waste data to SAWIS                        | 1 | 0 | 2 | 3 | 1 | 1 | 37.<br>5     | 12.<br>5     | 62.<br>5     | 25       |
| 1.4.5                    | Financing of waste management                           | 3 | 1 | 4 | 0 | 0 | 0 | 100          | 50           | 50           | 0        |
| 1.4.6                    | Organisation structure (current & future resources)     | 3 | 1 | 4 | 0 | 0 | 0 | 100          | 50           | 50           | 0        |

#### 4.3.2 Review Area 2: Implementation of Chapter 3 of Waste Act No. 59 of 2008

Table 8 shows the results of Review Area 2 grades. All the IWMPs reviewed scored A-C (satisfactory) and none were awarded as not satisfactory. The IWMPs were able to indicate how chapter 3 of Waste Act No. 59 of 2008 will be implemented. However, there were minor gaps that were identified in the Review categories of the IWMPs and will be discussed. Review Area 2 did not have any sub-Review categories only Review Areas and Review categories were assessed as indicated in Table 4-3 below.

**Table 8: Review grades of Review Area 2**

| RA<br>Cat<br>Sub-<br>cat | Results of RA 2               | A | B | C | D | E | F | A-C<br>% | A-<br>B<br>% | C-<br>D<br>% | E-F<br>% |
|--------------------------|-------------------------------|---|---|---|---|---|---|----------|--------------|--------------|----------|
| 2                        | <b>Chapter 3 of Waste Act</b> | 0 | 0 | 8 | 0 | 0 | 0 | 100      | 0            | 100          | 0        |
| 2.1                      | Waste management objectives   | 3 | 0 | 4 | 0 | 0 | 1 | 87.5     | 37.5         | 50           | 12.5     |
| 2.2.                     | Waste impacts                 | 0 | 0 | 4 | 2 | 1 | 1 | 50       | 0            | 75           | 25       |
| 2.3                      | Waste management initiatives  | 0 | 0 | 7 | 0 | 0 | 1 | 87.5     | 0            | 87.5         | 12.5     |
| 2.4                      | Waste management services     | 0 | 0 | 8 | 0 | 0 | 0 | 100      | 0            | 100          | 0        |
| 2.5                      | International agreements      | 0 | 0 | 8 | 0 | 0 | 0 | 100      | 0            | 100          | 0        |
| 2.6                      | Best practices                | 0 | 0 | 6 | 0 | 1 | 1 | 75       | 0            | 75           | 25       |

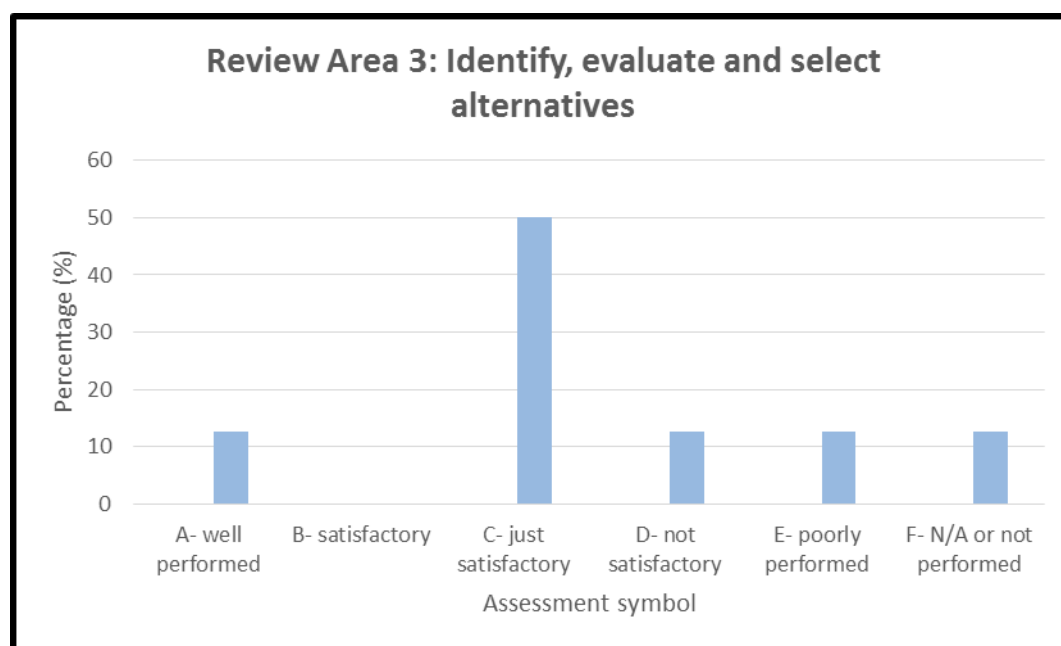
In Review Category 2.1 as described in Table 7, the waste management objectives were clearly addressed satisfactory (scoring 87.5%) while 12.5% were not satisfactory. Where the task was poorly performed the IWMPs failed to outline objectives, targets and indicators. In Category 2.2, 50% of IWMPs scored A-C (satisfactory). The IWMPs attempted to identify and address impacts of poor waste management practices on the health and the environment in the municipality. While 75% could have done better and 25 % either performed poorly or did not attempt the task to identify and address the impacts. Failure to attempt this task means the municipality did not do through research and could not provide required information in the IWMP. Category 2.3 review results showed that 87.5% of the IWMPs were able to identify waste management initiatives and none scored A-B of well performance. A total of 12.5% of the IWMPs did not perform well scoring E-F. Review Categories 2.4 and 2.5 were both satisfactory scoring 100% (A-C). While under Review Category 2.6, 25 % of the IWMPs did not perform well scoring E-F, the plans failed to describe how they will give effect to the best practice of the waste management and 75% were found to be satisfactory.

#### **4.2.3 Review Area 3: Identify, evaluate and select alternatives**

Table 9 shows that 62.5% of the IWMPs were satisfactory under Review Area 3 while 25% did not perform well. Only 12.5 % performed well scoring A-B and 62.5 % of the IWMPs attempted the task but omitted certain information which if provided they can score a better grade. Figure 14 shows the performance of Review Area 3 where 50% of the plans scored grade C (satisfactory).

**Table 9: Review grades of Review Area 3**

| RA<br>Cat<br>Sub-<br>cat | Results of RA 3                    | A | B | C | D | E | F | A-C<br>% | A-<br>B<br>% | C-<br>D<br>% | E-F<br>% |
|--------------------------|------------------------------------|---|---|---|---|---|---|----------|--------------|--------------|----------|
| <b>3</b>                 | <b>Alternatives</b>                | 1 | 0 | 4 | 1 | 1 | 1 | 62.5     | 12.5         | 62.5         | 25       |
| 3.1                      | Identify and evaluate alternatives | 1 | 0 | 4 | 1 | 1 | 1 | 62.5     | 12.5         | 62.5         | 25       |
| 3.2                      | Select preferred alternatives      | 1 | 0 | 3 | 2 | 1 | 1 | 50       | 12.5         | 62.5         | 25       |

**Figure 14: Review grades for Review Area 3**

The review of Review categories revealed that category 3.1 scored 62.5% (satisfactory) and category 3.2 scored 50% (satisfactory). Both Review categories scored 12.5% of A-B (task well performed) and 25% of poor performance (scoring E-F). According to the Guideline, the municipality is required to identify different alternatives that will be used to achieve targets as set in the IWMPs. The municipality must then assess and select the best alternative considering cost vs benefits (socio-ecological vs economical). There are different alternatives listed in the Guideline: legal requirements; resources/finance; human resource; and transportation. Some of the municipalities that identified alternatives only identified one alternative, where more than one alternatives were identified no preferred alternative was selected or where selection was done there was no certainty if the preferred alternative will be viable, thus most plans scored grade E for poor performance. Some of the municipalities did not attempt to identify alternatives and scored grade F. where alternatives were identified they were not linked to the goal/ target. Each goal/target requires a specific resource to be achieved i.e goal/ target x will require certain amount

of funds and human capacity to be achieved. Therefore, it is important that when conducting this task the municipality is focusing on achieving goals/targets as set in the IWMPs.

#### 4.3.4 Review Area 4: Communication and stakeholder participation

Table 10 shows that 100% of IWMPs were found satisfactory under Review area 4 with no grade awarded for poor performance and well performance. The IWMPs revealed that the municipalities attempted the task of communication and stakeholder participation.

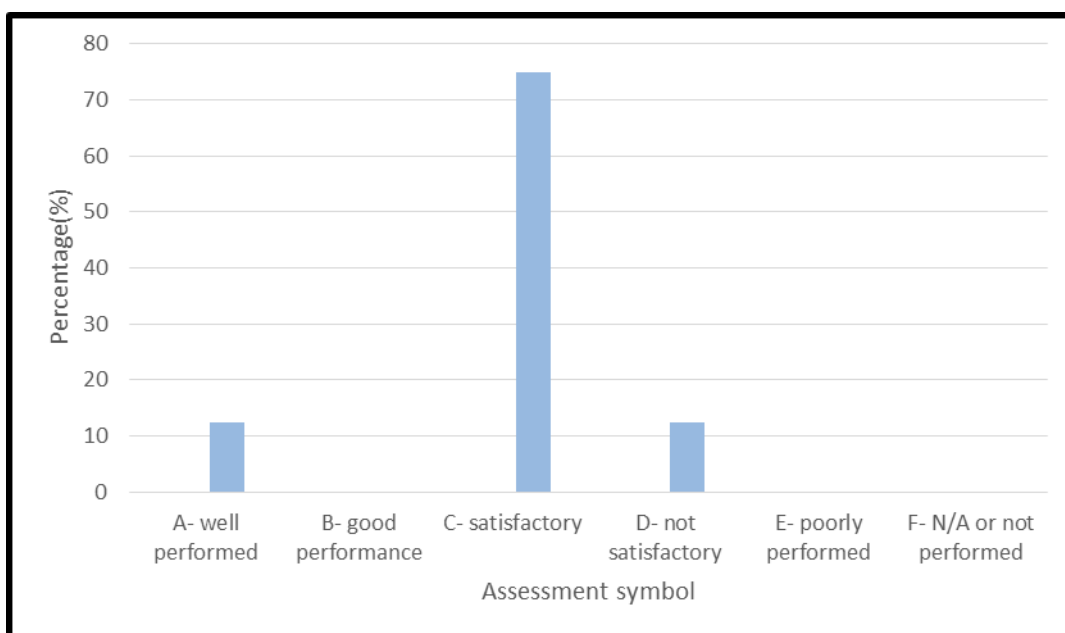
**Table 10: Review grades of Review Area 4**

| RA<br>Cat<br>Sub-<br>cat | Results of RA 4                              | A | B | C | D | E | F | A-C<br>% | A-<br>B<br>% | C-D<br>% | E-F<br>% |
|--------------------------|----------------------------------------------|---|---|---|---|---|---|----------|--------------|----------|----------|
| 4                        | <b>Communication &amp; stakeholder</b>       | 0 | 0 | 8 | 0 | 0 | 0 | 100      | 0            | 100      | 0        |
| 4.1                      | Consultation process                         | 0 | 0 | 7 | 1 | 0 | 0 | 87.5     | 0            | 100      | 0        |
| 4.2                      | Stakeholder participation                    | 0 | 0 | 7 | 1 | 0 | 0 | 87.5     | 0            | 100      | 0        |
| 4.3                      | Awareness campaign and communication         | 0 | 1 | 6 | 1 | 0 | 0 | 87.5     | 12.5         | 87.5     | 0        |
| 4.3.1                    | Ward committee meeting                       | 0 | 0 | 6 | 1 | 0 | 0 | 62.5     | 0            | 87.5     | 0        |
| 4.3.2                    | Waste management forum meetings              | 0 | 0 | 7 | 1 | 0 | 0 | 87.5     | 0            | 100      | 0        |
| 4.3.3                    | Workshops with I&AP                          | 0 | 0 | 7 | 1 | 0 | 0 | 87.5     | 0            | 100      | 0        |
| 4.3.4                    | Publishing of information about IWMP process | 0 | 0 | 7 | 1 | 0 | 0 | 87.5     | 0            | 100      | 0        |

Looking at the Review Categories results presented in Table 10 the performance of the Review categories was satisfactory scoring 87.5 %. Only 12.5% performed the task well scoring A-B and no poor performance of grade E-F was awarded. The Review of Sub- Categories showed that the performance of the plans was satisfactory scoring 87.5% however there were minor omissions resulting in Sub-Category 4.3.2, 4.3.3 and 4.3.4 scoring C-D. The omissions are attributed to the plans indicating that some of municipalities did not have awareness programs designed to keep stakeholders abreast on the issues concerning development and implementation of the IWMP, thus not allowing all stakeholders the opportunity to contribute to the development of the IWMP. There are various platforms (ward committee meeting, waste management forums and workshops with I&AP) suggested in the Guideline that can be utilized to raise awareness. During the review it was evident that these platforms are not utilized properly hence a grade of D. Certain IWMPs were published without consultation process as the process had not taken place during the publishing of the IWMP. In other IWMPs the municipalities admit that communication and stakeholder participation was identified as a problem which the municipality is working on addressing.

#### 4.3.5 Review Area 5: Implementation instruments

The performance of the Review Area 5 was satisfactory scoring 87.5% as indicated on Table 11. There were plans that performed well scoring 12.5% and 87.5% that was not satisfactory. Figure 15 depicts the results of grades awarded for Review Area 5 with most plans scoring 75% (C satisfactory). The IWMPs were able to identify different implementation instruments such as partnership; legal framework and funding mechanism that can be used to implement IWMPs and also to give effect to the municipal waste management system as a whole. The minor omissions resulting in some plans scoring D (not satisfactory) was due to the plans only identifying one implementation instrument which is currently not effective thus requiring further investigation. The investigation of such instruments could have been done prior to publishing of the IWMP as the plan is reviewed annually. No poor performance grade was awarded.



**Figure 15: Review Area 5: implementation instruments**

The performance of the Review Categories (Legislative instruments) was satisfactory (A-C) and 25% of the plans performed well under the Review categories (Implementation plan) while 37.5% did not perform well. The IWMPs did not list any existing or potential partnership. The funding mechanism identified was not for the entire municipal waste management system scoring C-D. Some of the identified implementation instruments are not working and requires investigation as no benefits are realized. Lastly most plans failed to include an implementation plan, although the Guideline has provided a template of how a summary of the implementation plan should be captured in the IWMP. Most of the Sub-Category scored 87.5% (A-C) thus they were found satisfactory and no poor performance grade was awarded. There were minor omissions that resulted in 100% of the plan scoring C-D in sub-category 5.1.3. Most of the IWMPs did not consider community based partnership with NGOs which the municipality can use to raise

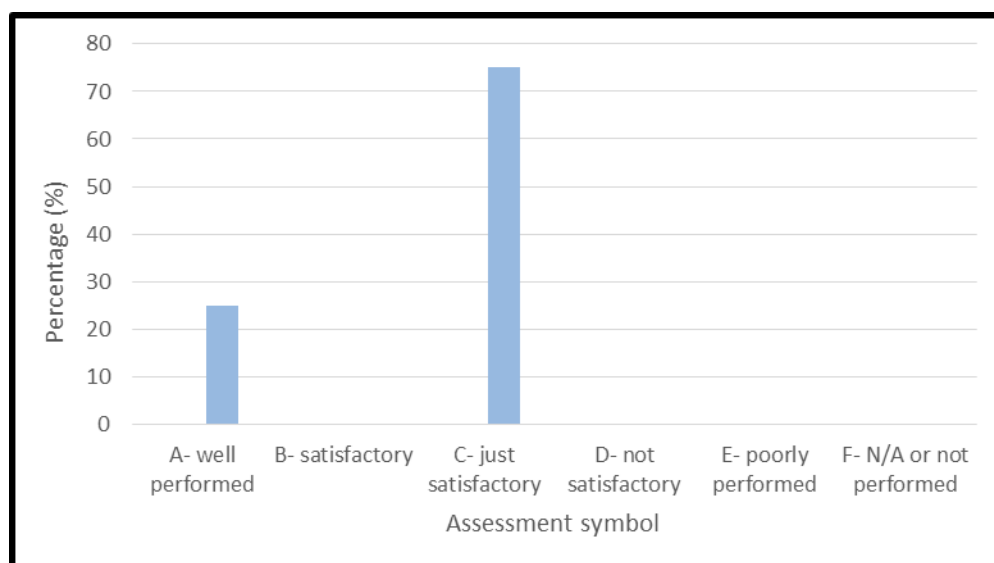
awareness and educational awareness programs instead of only focusing on public-private partnership.

**Table 11: Review grades of Review Area 5**

| RA<br>Cat<br>Sub-<br>cat | Results of RA 5                                                  | A | B | C | D | E | F | A-C<br>% | A-<br>B<br>% | C-<br>D<br>% | E-F<br>% |
|--------------------------|------------------------------------------------------------------|---|---|---|---|---|---|----------|--------------|--------------|----------|
| <b>5</b>                 | <b>Implementation instruments</b>                                | 1 | 0 | 6 | 1 | 0 | 0 | 87.5     | 12.5         | 87.5         | 0        |
| 5.1                      | Partnership                                                      | 1 | 0 | 6 | 1 | 0 | 0 | 87.5     | 12.5         | 87.5         | 0        |
| 5.1.1                    | Public-participation partnership                                 | 1 | 0 | 6 | 1 | 0 | 0 | 87.5     | 12.5         | 87.5         | 0        |
| 5.1.2                    | Public-private partnership                                       | 1 | 0 | 6 | 1 | 0 | 0 | 87.5     | 12.5         | 87.5         | 0        |
| 5.1.3                    | NGO/Community based organisation                                 | 0 | 0 | 6 | 2 | 0 | 0 | 75       | 0            | 100          | 0        |
| 5.2                      | Legislative Instruments (Development and enforcement of By-Laws) | 2 | 0 | 6 | 0 | 0 | 0 | 100      | 25           | 75           | 0        |
| 5.3                      | Funding mechanisms                                               | 1 | 1 | 4 | 2 | 0 | 0 | 75       | 25           | 75           | 0        |
| 5.3.1                    | Funding mechanisms for recycling                                 | 1 | 1 | 4 | 2 | 0 | 0 | 75       | 25           | 75           | 0        |
| 5.3.2                    | Funding mechanisms for waste collection and transportation       | 1 | 1 | 4 | 2 | 0 | 0 | 75       | 25           | 75           | 0        |
| 5.3.3                    | Funding mechanisms for waste disposal                            | 1 | 1 | 4 | 2 | 0 | 0 | 75       | 25           | 75           | 0        |
| 5.4                      | Implementation plan (summary of an IWMP)                         | 1 | 1 | 2 | 1 | 3 | 0 | 50       | 25           | 37.5         | 37.5     |

#### 4.3.6 Review Area 6: Waste management system of the municipality

Results of Review Area 6 which deals with the waste management system of the municipality are presented in Table 12 while Figure 16 depicts the performance grade awarded of Review Area 6. The IWMPs were found to be satisfactory (scoring A-C) and 25% of the plans performed well scoring (A-B) under Review Area 6, with most plans scored 100%. No poor performance grade was awarded for this Review Area.



## Figure 16: Review Area 6- Waste management system of the municipality

Figure 16 depicts the review results of Review Categories of Review Area 6. The review revealed that 25% scored A (well performed), while no grade B was awarded. Roles and responsibilities, waste generation, collection and disposal and waste minimization scored grade C and were found satisfactory scoring 100% (A-C). However, waste consumption scored E because the municipality failed to give details regarding waste consumption. Where the key role players were identified with minor omissions the plans scored C-D and there was 75% of the plans that did not identify key role players for implementing the waste management system.

**Table 12: Review grades of Review Area 6**

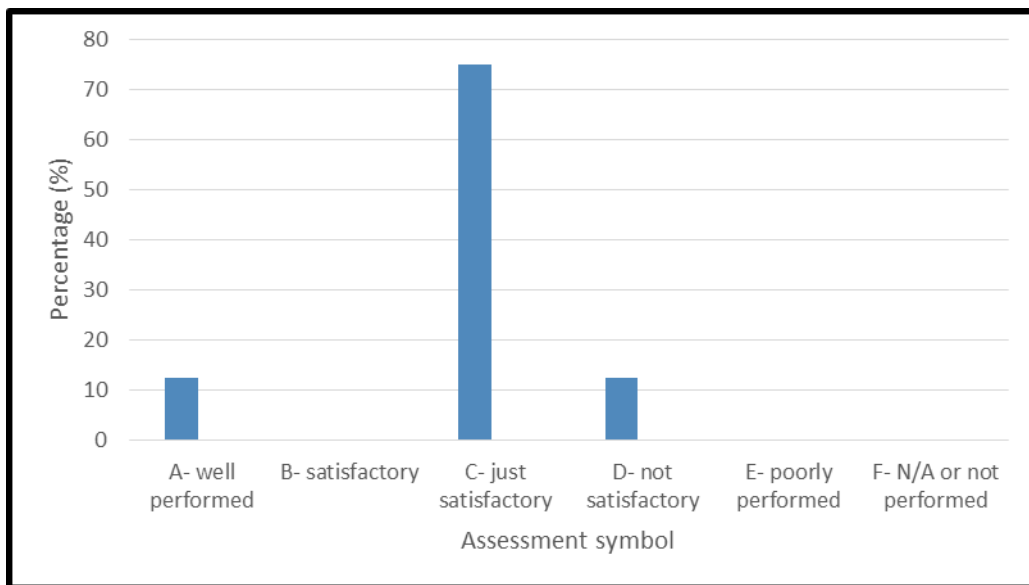
| RA<br>Cat<br>Sub-<br>cat | Results of RA 6            | A | B | C | D | E | F | A-C<br>% | A-B<br>% | C-D<br>% | E-F<br>% |
|--------------------------|----------------------------|---|---|---|---|---|---|----------|----------|----------|----------|
| 6                        | Waste management system    | 2 | 0 | 6 | 0 | 0 | 0 | 100      | 25       | 75       | 0        |
| 6.1                      | Roles and Responsibilities | 2 | 0 | 6 | 0 | 0 | 0 | 100      | 25       | 75       | 0        |
| 6.2                      | Waste generation           | 2 | 0 | 6 | 0 | 0 | 0 | 100      | 25       | 75       | 0        |
| 6.3                      | Waste consumption          | 2 | 0 | 5 | 0 | 1 | 0 | 87.5     | 25       | 75       | 12.5     |
| 6.4                      | Collection & Disposal      | 2 | 0 | 6 | 0 | 0 | 0 | 100      | 25       | 75       | 0        |
| 6.5                      | Waste minimisation         | 2 | 0 | 6 | 0 | 0 | 0 | 100      | 25       | 75       | 0        |

### 4.3.7 Review Area 7: Gaps analysis

The review results of Review Area 7 (gap analysis) and review Categories are presented in Figure 17 and Table 13. The results showed that 12.5% of the reviewed IWMPs scored A-B the task was well performed and 87.5% was satisfactory (A-C). No poor performance was awarded for and 87.5% was just (C-D). A total of seven reports scored grade C (satisfactory) while no unsatisfactory or poor performance grade awarded. The review of Review categories indicated that 12.5% of the plans performed well scoring A-B while 87.5% of the plans were satisfactory scoring C. The significant omissions can be attributed to the municipalities failing to capture problems in the IWMPs that they are currently facing with regard to waste management thus is resulted in Sub-Category (waste data capture and management) scoring F and compliance and enforcement scoring E (poorly performed). Other plans (12.5%) do not have the current status of compliance and enforcement in the municipality. Another significant omission under compliance and enforcement was that most of the municipalities are failing to enforce compliance as a result the IWMPs only indicate that compliance and enforcement is a challenge but does not state how it is

currently affecting the implementation of the IWMP. It was also evident during the review that municipalities are failing to achieve compliance and enforcement due to lack of resources.

A number of plans (87.5%) did not identify future needs with regard to waste management. Most of the IWMPs (75%) have identified illegal dumping as a problem in townships and informal settlements and is contributing to poor waste management but the IWMPs does not detail solutions to this problem.



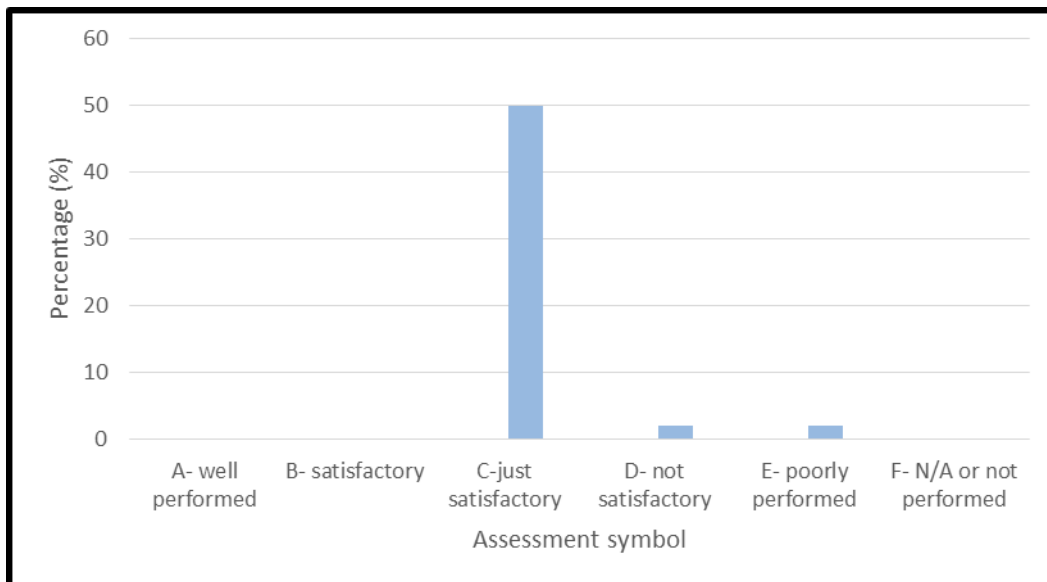
**Figure 17: Review Area 7- Gap analysis**

**Table 13: Review grades of Review Area 7**

| RA<br>Cat<br>Sub-<br>cat | Results of RA 7                                     | A | B | C | D | E | F | A-C<br>% | A-B<br>% | C-D<br>% | E-<br>F<br>% |
|--------------------------|-----------------------------------------------------|---|---|---|---|---|---|----------|----------|----------|--------------|
| 7                        | Gap analysis                                        | 1 | 0 | 6 | 1 | 0 | 0 | 87.5     | 12.5     | 87.5     | 0            |
| 7.1                      | Pressures and challenges                            | 1 | 0 | 7 | 0 | 0 | 0 | 100      | 12.5     | 87.5     | 0            |
| 7.1.1                    | Waste minimisation,<br>recycling, re-use & recovery | 1 | 0 | 6 | 1 | 0 | 0 | 87.5     | 12.5     | 87.5     | 0            |
| 7.1.2                    | Compliance and enforcement                          | 2 | 0 | 4 | 1 | 1 | 0 | 75       | 25       | 62.5     | 12.5         |
| 7.1.3                    | Integrated planning                                 | 2 | 0 | 5 | 1 | 0 | 0 | 87.5     | 25       | 75       | 0            |
| 7.1.4                    | Waste data capture and<br>management                | 2 | 1 | 4 | 0 | 0 | 1 | 87.5     | 32.5     | 50       | 0            |
| 7.1.5                    | Waste treatment and<br>disposal                     | 2 | 0 | 6 | 0 | 0 | 0 | 100      | 25       | 75       | 0            |
| 7.1.6                    | Awareness raising and<br>building capacity          | 0 | 0 | 7 | 1 | 0 | 0 | 87.5     | 0        | 100      | 0            |
| 7.1.7                    | Waste service Delivery                              | 0 | 0 | 8 | 0 | 0 | 0 | 100      | 0        | 100      | 0            |
| 7.1.8                    | Illegal dumping                                     | 2 | 0 | 6 | 0 | 0 | 0 | 100      | 25       | 0        | 0            |
| 7.1.9                    | Future needs                                        | 1 | 0 | 3 | 4 | 0 | 0 | 50       | 12.5     | 87.5     | 0            |

#### 4.3.8 Review Area 8: Environmental communication and consultation

Figure 18 shows the results of assessment of Review Area 8 according to grades allocated in Table 14. The review showed that 50% of the IWMPs were satisfactory (scoring C) with minor omissions. The results revealed that 25% of the reviewed IWMPs were not satisfactory (scoring D) while the other 25% scored E (task poorly performed) with major omissions that defeats the purpose of attempting the task. Most municipalities struggled with this task of environmental communication and consultation.



**Figure 18: Review grades for Review Area 8**

Review Area 8 had three Review Categories which were reviewed and results were presented in Figure 18. The review showed that 50% of the IWMPs were satisfactory (scoring A-C) with minor omissions while 25% of the plans poorly performed and no well performed grade was awarded. Most plans (75%) performed poorly under category 8.2 (Benchmarking marking) scoring E and F. The significant omissions were due to the municipalities failing to do Benchmarking and not sharing or learning from each other. Some of the IWMPs (25%) did not have any information regarding successful implementation of the waste management initiatives and the IWMP. Public awareness is important in implementing IWMP, and requires communication actions from the municipalities to raise awareness about integrated waste management. There were many plans (100%) that were just satisfactory (C-D) this was due to lack of evidence, where there was communication between the public, government department and industries there was no evidence in the IWMPs.

**Table 14: Review grades of Review Area**

| RA<br>Cat<br>Sub-<br>cat | Results of RA 8                       | A | B | C | D | E | F | A-C<br>% | A-B<br>% | C-D<br>% | E-F<br>% |
|--------------------------|---------------------------------------|---|---|---|---|---|---|----------|----------|----------|----------|
| 8                        | Environmental communication           | 0 | 0 | 4 | 2 | 2 | 0 | 50       | 0        | 75       | 25       |
| 8.1                      | Examples of successful implementation | 0 | 0 | 4 | 2 | 2 | 0 | 50       | 0        | 75       | 25       |
| 8.2                      | Benchmarking                          | 0 | 0 | 1 | 1 | 5 | 1 | 12.5     | 0        | 25       | 75       |
| 8.3                      | Public awareness                      | 0 | 0 | 7 | 1 | 0 | 0 | 87.5     | 0        | 100      | 0        |

#### 4.3.9 Review Area 9: Roles and responsibilities

Figure 19 shows the results of Review Area 9 which deals with roles and responsibilities. The review showed that 12.5% of the reviewed IWMPs performed well (A-B) and 25% performed poorly (E-F) while 62.5 % of the plans were satisfactory scoring A-C. There was 62.5% of the plans that were just satisfactory (C-D). The significant omission is attributed to the municipality failing to identify additional resources that will be required as per the waste license requirements particularly at the waste disposal facility.

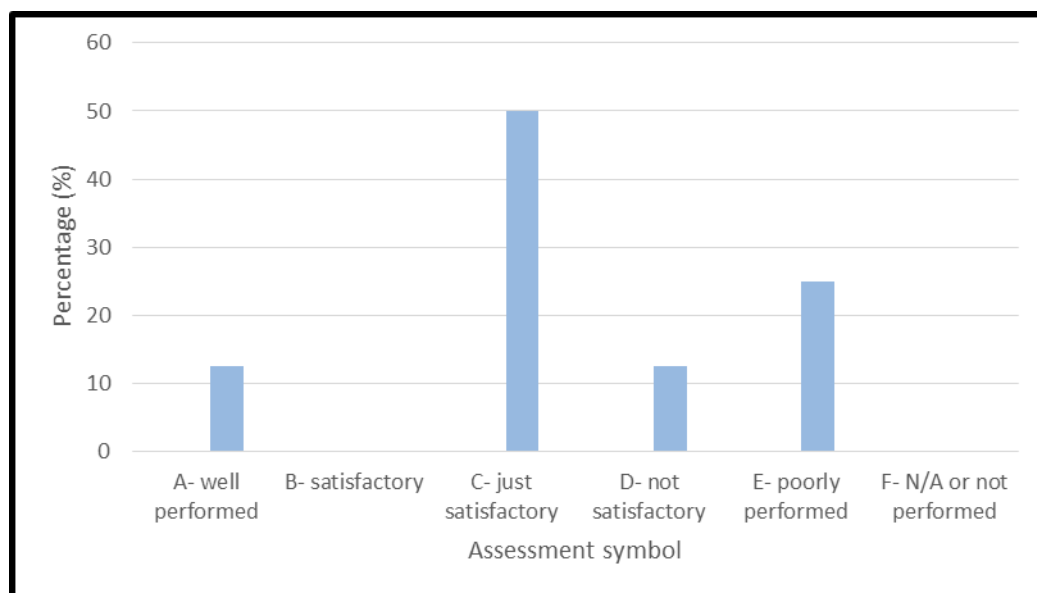
**Figure 19: Review grades for Review Area 9**

Table 15 shows the results of Review Categories and Sub-Categories of the Review Area 9. Category 9.1 and 9.2 indicate that 12.5% of the plans that performed well (A-B) and 25% that poorly performed scoring E-F. There was no clear indication of the role of the stakeholders thus 50% of the plans scored A-C. Some of the IWMPs (75%) only identified waste management officer and did not consider other resources thus scoring 25% under sub-category 9.1.2. Where staff

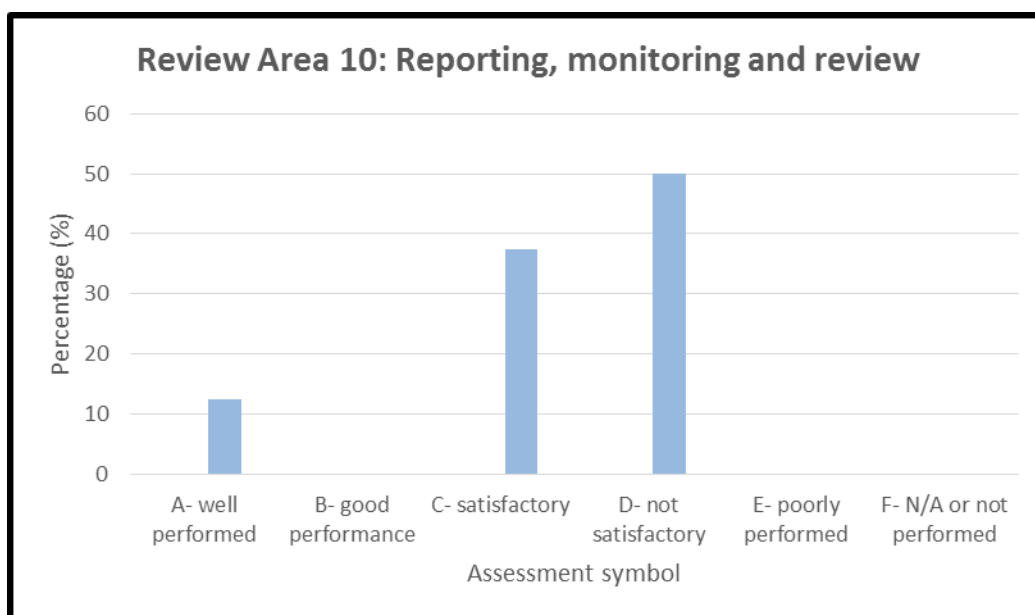
shortage was identified as an issue, the municipality did not identify additional resources to solve the problem of staff shortage.

**Table 15: Review grades of Review Area 9**

| RA<br>Cat<br>Sub-<br>cat | Results of RA 9                          | A | B | C | D | E | F | A-C<br>% | A-<br>B<br>% | C-<br>D<br>% | E-F<br>% |
|--------------------------|------------------------------------------|---|---|---|---|---|---|----------|--------------|--------------|----------|
| <b>9</b>                 | <b>Roles and Responsibilities</b>        | 1 | 0 | 4 | 1 | 2 | 0 | 62.5     | 12.5         | 62.5         | 25       |
| 9.1                      | Municipality's responsibilities          | 1 | 0 | 5 | 1 | 1 | 1 | 75       | 12.5         | 75           | 25       |
| 9.1.1                    | Municipal manager                        | 1 | 0 | 5 | 0 | 2 | 0 | 75       | 12.5         | 62.5         | 25       |
| 9.1.2                    | Waste management officer                 | 3 | 0 | 3 | 0 | 2 | 0 | 75       | 32.5         | 32.5         | 25       |
| 9.1.3                    | Environmental Management<br>Department   | 1 | 0 | 3 | 1 | 1 | 1 | 50       | 12.5         | 50           | 25       |
| 9.1.4                    | Waste management Directorate             | 4 | 0 | 2 | 1 | 1 | 0 | 75       | 50           | 32.5         | 12.5     |
| 9.1.5                    | Infrastructure and service<br>department | 2 | 0 | 3 | 2 | 0 | 1 | 62.5     | 25           | 62.5         | 12.5     |
| 9.2                      | Stakeholder responsibilities             | 1 | 0 | 3 | 4 | 0 | 0 | 50       | 12.5         | 87.5         | 0        |

#### **4.3.10 Review Area 10: Reporting, monitoring and review**

Figure 20 shows results of Review Area 10, where 12.5% of the reviewed IWMPs scored A-B (well performed) and none was scored poor performance grade (E-F). Review Area 10 had 50% of the plans that were satisfactory and 87.5% that were just satisfactory (C-D). The omissions that resulted in other plans scoring D are due to reporting not done as stipulated in Section 13(3) of Waste Act 59 of 2008 which requires annual performance report. Annual report must be prepared and submitted to DEA.



**Figure 20: Review grades for Review Area 10**

Table 16 shows the percentage allocation of Review Categories and Sub-Categories results. Reporting, monitoring and review were satisfactory scoring C while 12.5% of the plans performed well (A-B) under those Review categories however there was poor performance (E-F) with 12.5% of the plans not performing well while 37.5% were satisfactory under monitoring.

The omissions are noted as follows: Strategic issues as set by the municipality in the IWMP requires monitoring and the IWMP failed to show monitoring of strategic issues under sub-category 10.2.1 with some plans scoring D (not satisfactory). Public accountability did not perform well (E) and no well performance grade (A) was awarded under this Sub-Category. Although public accountability is done there were instances where meetings with the public were not recorded. Some of the plans do not indicate how the public will be kept abreast about the objectives of the IWMP. In some instances, the municipality admits to not conducting public participation and not communicating with the public regarding the progress of IWMP implementation. Under category 10.3 (Review of the IWMPs) most of the IWMPs (12.5%) indicated that the plans are reviewed every 5 years and annually. While 50% of the plans are not being reviewed annually but only every five years. According to the Guideline, IWMP should be reviewed every 5 years in line with the IDP requirements and annual performance review which assist the municipality in ensuring that goals and targets are met.

**Table 16: Review grades of Review Area 10**

| RA<br>Cat<br>Sub-cat | Results of RA 10                          | A | B | C | D | E | F | A-C<br>% | A-B<br>% | C-D<br>% | E-F<br>% |
|----------------------|-------------------------------------------|---|---|---|---|---|---|----------|----------|----------|----------|
| 10                   | Reporting & Monitoring                    | 1 | 0 | 3 | 4 | 0 | 0 | 50       | 12.5     | 87.5     | 0        |
| 10.1                 | Reporting                                 | 1 | 0 | 3 | 4 | 0 | 0 | 50       | 12.5     | 87.5     | 0        |
| 10.2                 | Monitoring                                | 1 | 0 | 2 | 4 | 1 | 0 | 37.5     | 12.5     | 75       | 12.5     |
| 10.2.1               | Strategic issues                          | 2 | 0 | 2 | 4 | 0 | 0 | 50       | 25       | 75       | 0        |
| 10.2.2               | Performance                               | 1 | 0 | 3 | 4 | 0 | 0 | 50       | 12.5     | 87.5     | 0        |
| 10.2.3               | Public Accountability                     | 0 | 0 | 4 | 3 | 1 | 0 | 50       | 0        | 87.5     | 12.5     |
| 10.2.4               | Communication and public participation    | 0 | 0 | 6 | 2 | 0 | 0 | 75       | 0        | 100      | 0        |
| 10.2.5               | Financial plan                            | 1 | 0 | 5 | 2 | 0 | 0 | 75       | 12.5     | 87.5     | 0        |
| 10.2.6               | Waste management implementation programme | 1 | 0 | 5 | 2 | 0 | 0 | 75       | 12.5     | 87.5     | 0        |
| 10.3                 | Review of IWMPs                           | 1 | 0 | 3 | 4 | 0 | 0 | 50       | 12.5     | 87.5     | 0        |

#### 4.4 key findings of quality review of IWMPs

This section looks at the key findings from the research analysis that affected the quality of the IWMPs produced for metropolitan municipalities. Looking at all Review Areas, Review Categories and Sub- Categories there were areas of concern that deals more with the process of developing IWMPs which could have affected the quality of the IWMPs. If the quality of the IWMPs is not good, the effectiveness of the plan is therefore questioned. This is supported by Fuller (1999) who states that the quality of the EIA reports can be associated with the quality of the EIA process. Research in the quality of EIA reports has shown that there are various factors that influence the EIA process, aspects such public involvement, cost and impact analysis (Lee *et al*, 1999; Fuller, 1999). This view is not different from what the analysis of this research revealed. During the review of the IWMPs, it was evident that factors such as awareness and public accountability; organizational capacity; performance review; compliance and monitoring; stakeholder consultation, funding mechanism affected the quality of the IWMPs.

##### 4.4.1 Awareness and public accountability

Public awareness was identified in Chapter 2 as one of the factors affecting the implementation of the IWMP. IWMP is a tool that can also be used to raise public awareness in waste management (Anderson *et al.*, 2013). During the review, some of the municipalities identified public awareness as a problem which they are trying to address. The review showed that 87.5% of the plans were just satisfactory (C-D) while no well performance grade was awarded. The Guideline has recommended platforms that can used to raise awareness, platforms such as ward committee meetings, forums, workshops with various public groups and also publishing of IWMP in the local newspaper and local radio stations. The review revealed that 100% of the plans were not satisfactory (C-D) under Sub-Category 5.1.3 of Review Area. These platforms are crucial to

change attitude of the public towards waste management. Annual performance reports of IWMPs are not distributed to the public for discussion. Therefore, there is a lack of accountability (12.5%) from the municipality to the public regarding the implementation of the IWMP and the performance of the plans is not satisfactory (C-D).

#### **4.4.2 Organizational capacity**

According to Fakoya (2014) inadequate organizational capacity can result in poor development and implementation of IWMP. The municipalities are required to produce in the IWMP current organizational structure and future structure. The structure include management, planning, operation and enforcement. The municipality should ensure that there is sufficient human resource capacity. During the review, most of the IWMPs indicated that there is a shortage of resources. Although resource shortage was identified an issue in the IWMP, most of the municipalities did not have a solution or a plan in future to increase capacity, hence the 50% of the plans were not satisfactory scoring C-D under Sub-category 1.4.6 (Organizational structure). The Guideline support the earlier statement by Fakoya (2014) that successful implementation of IWMP is dependent on adequate organizational structure and availability of resources.

#### **4.4.3 Performance review (reporting, monitoring and review)**

During the review, reporting on implementation of the IWMP was not satisfactory (C-D) with 7.4% of the plans not attempting the task. Monitoring was poorly performed with 12.5% of the plans scoring E-F. Most (87.5%) of the plan's performance was not satisfactory (C-D). The Waste Act requires that the municipality produce annual performance reports in terms of section 46 of the Municipal System Act. The annual performance report must contain implementation of the IWMP and the performance of the municipality in meeting the targets and objectives. The required information is summarized in the Guideline as: the extent to which the plan was implemented; waste management initiatives, progress on waste management service delivery, level of compliance; non- compliance with IWMP by the municipality. During the review most of the IWMPs (87.5%) did not provide required information and did not give reason for not providing required information.

#### **4.4.4 Compliance and enforcement**

The municipality is required to comply with the IWMP, compliance is not only limited to the public or private sector. The Guideline requires that the municipality determine the extent to which it has complied with the requirements of the IWMP. During the review, it was evident that most of the municipalities (62.5%) did not indicate the extent to which they have complied with the IWMP. Some of the municipalities (25%) only indicated that compliance and enforcement could not be achieved due to lack of resources while 12.5% of the plans performed poorly.

#### **4.4.5 Communication and Stakeholder consultation**

DEAT (2000) identified stakeholders as key role players in successful development and implementation of IWMPs. Stakeholder consultation is therefore important during the process of developing the IWMPs to ensure that IWMPs of good quality is produced. Chapter 4 of the Municipal System Act requires that community/stakeholder participate during the development of the IWMP and the municipality should provide different platforms/mechanisms for this to be done. During the review it was evident that 100% of the plans were not satisfactory (C-D) and only 12.5% of the plans performing well a task of awareness and communication. Some of the municipalities have a database of stakeholders but only consulted government authorities, excluding businesses and industry associations; community based organization; recyclers and political leaders. Stakeholder consultation process is not detailed in most of the IWMPs, while other plans did capture issues raised during consultation. Some of the stakeholders were not given an opportunity to contribute to the development of the IWMP while other stakeholders did not review the draft. The Guideline requires that the IWMPs should have a summarized list of consulted stakeholders, input and issues raised during consultation. As part of the consultation process the municipality should give response to the issues raise prior to the publishing of the final IWMP. In one of the IWMPs the municipality indicated that the consultation process is still underway and required information will only be included once the consultation process is completed. Overall the stakeholder participation process was not satisfactory scoring C-D.

#### **4.4.6 Funding mechanism**

According to the Guideline sufficient funding is a pre-requisite for successful development and implementation of IWMP. Funding is required for planning; building organizational capacity; development and implementation of IWMP; compliance and enforcement; operation and maintenance cost and lastly development of waste management facilities. Therefore, the municipalities need to determine in the IWMP where they will be getting funds and also list different revenue collection mechanisms. The Guideline recommended different funding mechanisms such as recycling, waste collection and transportation, waste disposal.

During the review, 75% of the IWMPs indicated that appropriate funding mechanisms are yet to be established thus scoring C-D. While 75% were satisfactory (A-C) indicating that there is some sort of funding mechanism but it is not for the entire waste management system of the entire municipality. One municipality indicated in the IWMP that the available funding mechanism requires further investigation as it is currently not working. In chapter 2, cost of implementing IWMP was identified as a challenge that affect overall implementation of IWMP (Nahman and Godfrey, 2010).

The strength of the plans were: situational analysis; implementation of Chapter 3 of Waste Act; description of the waste management system and identification of the implementation instruments scoring A-C while the weakness of the reports scoring E-F were: extent to which the IWMP will be implemented; alternatives were not clearly identified or selected and environmental communication not done properly.

#### **4.5 Conclusion**

The chapter interpreted and analyzed the research results which were also presented in graphs and tables. Each Review Area's performance was graphically depicted with description. Omissions that resulted in Review Areas, Review categories and sub-Review categories were also discussed. The analysis did a comparison of all Review Area's performance, there were few Review Areas that were 100% satisfactory (scoring A-C), However there were other Review Areas that were not satisfactory scoring D-F with significant omissions.

### **CHAPTER 5: CONCLUSION AND RECOMMENDATION**

#### **5.1 Introduction**

The aim of this study was to determine the quality of the IWMPs developed for the metropolitan municipalities in South Africa. This was achieved through the following objectives: to develop a review package to review the quality of the IWMPs; to review the quality of a sampled IWMPs from eight metropolitan municipalities in South Africa; to analyse and interpret the results and draw conclusions regarding the quality of the IWMPs in the metropolitan municipalities in South Africa.

The literature study discussed waste management practices in developed and developing countries and the problems relating to waste management that the countries are experiencing. Problems commonly experienced in developing countries are insufficient funds/budget, lack of enforcement and appropriate infrastructure and technology and lack of partnership between formal and informal sectors. The informal sector is significantly contributing to waste management and therefore requires to be integrated in the main waste management system as it was in Brazil. South Africa can do lesson learnt of how informal sector was legitimized in Brazil. The importance of IWMP was also discussed and the factors affecting the implementation thereof. Having done the literature review the next section will show how the research aim and objectives were achieved and concludes with recommendations for municipalities to improve the quality of the IWMPs.

### **5.1 Objective 1- To develop and adapt a review package to review the quality of IWMPs**

Chapter 3 of the study addressed the first objective which was to develop a review package to review the quality of the IWMPs. This objective was achieved as a review checklist was developed using guidelines for the development of IWMP and Chapter 3 of Waste Act 59 of 2008. The checklist had ten review areas with review categories and sub-categories. A list of assessment symbols was adopted from the Lee and Colley review package. Symbols were further categorized into satisfactory (A-C) and not satisfactory (E-F). The review topics for this research are similar to those of the Lee and Colley review package.

### **5.2 Objective 2- To review the quality of IWMPs from eight metropolitan municipalities in South Africa**

Objective 2 of this study was addressed in chapter 4. The objective was to review sampled IWMPs from eight metropolitan municipalities in South Africa. The focus was only on metropolitan municipalities and did not consider IWMPs from District and Local municipalities. Metropolitan municipalities were considered because they are the largest and most densely populated and, are characterised by commercial and industrial activities. These activities contribute to the large quantities of waste that are generated in the municipalities.

The review as detailed in Chapter 4 revealed that the overall quality of the IWMP developed for metropolitan municipalities is satisfactory. 64% of the review areas were found to be satisfactory scoring C with minor omissions while other areas were not satisfactory with major omissions scoring D, E. only review area 3 scored F for not attempting the task at all.

The comparison between review areas scoring A-C and D-F showed that 79% of review areas scored A-C while 21% of review areas were not satisfactory scoring D-F. Significant omissions were due to poor presentation of environmental communication and consultation; monitoring, review and reporting. The tasks were not performed as per the requirements of the guideline and Chapter 3 of the Waste Act 59 of 2008. Municipalities failed to account on the overall performance of the waste management system in the IWMP. Most of the municipalities performed poorly in review area 10 particularly municipalities that are on their first generation of the IWMP.

### **5.3 Objective 3- To analyse and interpret the results and draw conclusions regarding the quality of IWMPs in the metropolitan municipalities in South Africa.**

Objective 3 was to analyse and interpret the results and draw conclusions regarding the quality of the IWMPs in the metropolitan municipalities in South Africa. Although the overall quality of the IWMPs was satisfactory, the analysis revealed that there were few key findings from the review worth noting. The key findings were factors that are considered to have potential to affect the quality of the IWMPs. Some of these factors are similar to those identified in Chapter 2 of this study

as factors affecting implementation of the IWMP. The analysis showed that factors such as awareness and public accountability; organizational capacity; performance review; compliance and monitoring; stakeholder consultation and funding mechanism affected the process of developing and the implementation of the IWMPs ultimately affecting the overall quality of the IWMPs produced by the municipalities.

The overall quality review indicated that 80% of the IWMPs that were developed for the metropolitan municipalities are satisfactory. Most plans were satisfactory scoring C. Only 14% of the plans performed well scoring A-B. Summary of Review Areas showed that there were Review Areas (RA3; RA8 and RA9) that did not perform well scoring E-F.

Under Review Area 1 most plans (62.5%) performed well scoring A-B. Situational analysis was analysed and all aspects concerning waste management were addressed. Although no plans were found to have poorly performed 37.5% of the plans were not satisfactory (C-D). Review Area 8 (Environmental communication) had 25% of the plans that did not perform well scoring E-F. Review area 9 (Roles and Responsibilities) and Review Area 3 (Alternatives) had 25% of the plans performing poorly (E-F). The three Review Areas showed weakness in that it had 25% of the plans scoring E-F. Review Area 3 scored F (task not attempted).

Most of the plans (87.5%) were found to be satisfactory under Review Area 4 scoring C and no poor performance was awarded. Goals of the IWMPs were clearly defined with 87.5% of the plans performing well scoring (A-B) and 75% described the socio-economic (Category 1.3) status scoring A-B and 87.5% of the plans were satisfactory (A-C) under Category 10.3 and 75% were not satisfactory was satisfactory (C-D).

#### **5.4 Concluding remarks**

The research concluded that increase in waste management is a major socio-economic and environmental issue which is exacerbated by population increase and different economic activities (commercial and industrial). To address this challenge, IWMP was introduced as a tool which gives analysis of the local municipality's waste management practice and further addresses the issues of non-compliances within the municipalities. Research showed that IWMPs provide cost effective, technical and environmental solutions to the waste management of each municipality. The overall quality of the reviewed IWMPs was satisfactory (C), however there were few areas of concern that were identified as weakness of the plans: Environmental Communication; Roles and Responsibilities and Alternatives had about 25% of the plans not performing well scoring (E-F). While Review Areas 1 (Situational analysis) had 62.5% of the plans performing well. To improve on the quality of IWMP, recommendations are made based on the key findings of the study.

## 5.5 Recommendations

The study concludes by providing recommendations that can improve the process of developing and implementing the IWMP which will ultimately improve the quality of the IWMP.

- Results of Review Area 4 showed that under Sub-category 4.3.2 (waste management forum meetings) and 4.3.3 (workshops with I&AP) 87.5% plans were not satisfactory scoring (C-D). This was due to the municipalities not having awareness campaigns to raise waste management initiatives awareness to the public. Furthermore, the plans also indicated that municipalities are not using provided platforms to engage the stakeholders hence 100% of the plans were not satisfactory (C-D) under Sub-category 4.3.3 scored C-D.

It is evident from the study that stakeholders are key role players in the development and implementation of the IWMPs. Therefore, it is critical that the municipality develop a database for internal and external stakeholders to be consulted throughout the process of developing the IWMP and be kept abreast with any development regarding IWMP. Therefore, it is recommended to improve the quality of the IWMPs municipalities should ensure that they are constantly raising awareness on waste management and IWMP is a tool that can be used to raise awareness. It is recommended that the municipalities use platforms such as ward committee meetings, workshops with various public groups and also publishing of IWMPs in the local media (newspaper/radio stations).

- Review Area 10 results indicated that 12.5% of the plans did not perform well scoring (E-F) for monitoring. The municipalities should have measures in place to monitor set targets and objectives and the overall performance of the municipalities in terms of implementing IWMPs. Municipalities should ensure that performance review in terms of monitoring, reporting and review is done annually and a performance report is produced. The performance report must contain information on the implementation of the IWMP and performance of the municipality in meeting the targets and objectives set in the IWMP.

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## **Appendix A: Review topics for the IWMP review package**

### **1. SITUATIONAL ANALYSIS**

- 1.1 The IWMP clearly set the goals and objectives of the IWMP
- 1.2 Description of geographical area within which the IWMP will be implemented (municipality's jurisdiction).
- 1.3 The description of socio-economic status
  - 1.3.1 The description of demographics should include gender, race, age, fertility, mortality and migration.
  - 1.3.2 Socio-economic status giving description of number of households distribution, poverty levels, education and employment status
  - 1.3.3 There should be description of Waste quantities and types in relation to the demographics
- 1.4.2 There should be estimation of future waste generation rates and quantities
- 1.4.3 Detailed waste status reflecting existing waste collection methods and recorded waste information
- 1.4.4 The waste information recorded either manually or using weighbridge should be submitted to SAWIS on a monthly basis either manually to the waste information officer to via SAWIC website.
- 1.4.5 There should be a financial recovery mechanism in place
- 1.4.6 The organizational structure should indicate current resources and also identify future resources and infrastructure required to provide waste management services

### **2. Implementation of chapter 3 of Waste Act**

- 2.1 Description of waste management objectives (goals, targets & indicators)
- 2.2 Identify and address impacts of poor waste management practices on the health and the environment
- 2.3 Provision of implementation of waste minimisation, re-cycle, re-cycling and the recovery targets and initiatives
- 2.4 Address delivery of waste management services to the residential premises
- 2.5 Implement any relevant South African obligation to international agreements
- 2.6 Give effect to best waste management practices

### **3. ALTERNATIVES**

- 3.1 Identify and evaluate different alternatives that can be used to achieve a desired waste management status and achieve set targets.

3.2 Select preferred alternatives that have socio-ecological and economic benefits and it should be clear if the alternative is intended for short term or long term. And what are the implication of failing to consider the alternative.

#### **4. COMMUNICATION AND STAKEHOLDER PARTICIPATION**

4.1 The consultation process as stipulated in the Municipal Systems Act should be followed.

4.2 Stakeholder participation - Were the stakeholders allowed opportunity to participate during the development of the IWMP.

4.3 Awareness campaign and communication – the IWM planning process followed the legislated public participation process. The awareness should be raised regarding the IWMP to keep stakeholders up to date with the development and implementation of the IWMP. Different platforms should be used for communication and stakeholder participation.

4.3.1 The municipalities should use community platforms such as the ward committee meeting to engage the stakeholders

4.3.2 The municipalities should schedule waste management forum to allow the stakeholders to participate in the IWM planning process

4.3.3 The municipalities should organize workshops with I&AP (tax associations, youth groups, religious groups, local community businesses and schools)

4.3.4 The local media platforms (newspaper, radio stations and community notice boards) should be used to publish information about IWMP process

#### **5. IMPLEMENTATION INSTRUMENTS**

5.1 Partnership- the municipalities should enter into partnership with different service providers to be able to provide waste management services to the local communities

5.1.1 The public-public partnership- there should be partnership between the District municipality and Local municipalities. The partnership is for the local authorities to work together to establish waste management facilities. The partnership will also assist where the local municipalities have limited capacity and is unable to provide waste services

5.1.2 Public-private partnership- municipalities should collaborate with private sector to get financial assistance on waste management services (separation at source, waste management facilities and waste management initiatives).

5.1.3 NGO/Community based organization- the community based organizations can assist the municipalities with conducting awareness and educational campaigns.

5.2 Legislative Instruments- By-Laws developed by the local municipalities aligned with the National and Provincial legislation. The purpose of the By-Laws is to regulate waste management in the municipalities. The IWMPs should indicate how By-laws will be enforced.

5.3 Funding mechanisms- Funding is important to implement IWMP. Funds are required for: municipal capacity building; funding is required. Therefore funding mechanism for different waste management options should be outlined.

5.3.1 Available funding mechanisms for recycling

5.3.2 Available funding mechanisms for waste collection and transportation

5.3.3 Available funding mechanisms for waste disposal

5.4 Implementation plan (summary of an IWMP) - the plan should detail how set targets and goals will be achieved and what resources will be required by the municipalities to implement the plan over the five years period. A summary of the entire IWMP is provided

## **6. WASTE MANAGEMENT SYSTEMS OF THE MUNICIPALITIES**

The existing waste management system should be described and the waste management options integrated into the system should also be discussed.

6.1 Roles and Responsibilities- key role plays identified (licensing and permitting department; infrastructure and service department; enforcement department; service providers and environment health department).

6.2 Waste generation- a detailed discussion on waste generation and how it influences the waste management system.

6.3 Waste consumption- information collected about waste consumption and waste disposed at the landfill over a five year period or depending on the timeframes set on the IWMP.

6.4 Collection & Disposal- total number waste centre facilities (Depos) and their strategic location. Total number of landfill sites and private sites; composting plant and incineration plant and a map showing location of each facility.

6.5 Waste minimization- waste minimization options and initiatives identified

## **7. GAP ANALYSIS AND CHALLENGES**

7.1 Description of pressures and challenges faced as a result of rapid population growth and increase of economic activities that result in high waste quantities.

7.1.1 Waste minimization, recycling, re-use & recovery- Explain the shortfall associated with waste management options.

7.1.2 Compliance and enforcement- describe problems associated enforcement and compliances

7.1.3 Integrated planning- the coordination of different departments working together to implement the waste management system and the IWMP. What is the shortfall for not doing integrated planning?

7.1.4 Waste data capture and management- is waste data (estimates and current) being captured correctly and kept safely and presented upon request. Reasons for not submitting waste data to SAWIS.

7.1.5 Waste treatment and disposal- waste treatment facilities and landfill sites that are not operational and not complying with the requirements. The landfill site that are reaching their full capacity and related problems discussed.

7.1.6 Awareness raising and building capacity- lack of awareness and capacity building problems and where municipalities are not able to raise awareness what are the hindrances.

7.1.7 Waste service Delivery- Lack of service delivery at informal areas discussed

7.1.8 Illegal dumping- problem of illegal dumping outlined and impacts of illegal dumping in municipal's waste management system and implementation of IWMP.

7.1.9 Future needs determined- how will the future needs of the community with regard to waste management affect the implementation of the IWMP with regard to funds, resources and service delivery. What problems do municipalities foresee in the future associated with waste management.

## **8. ENVIRONMENTAL COMMUNICATION & CONSULTATION**

8.1 Examples of successful implementation- the IWMP should give examples of where the IWMP was successfully implemented and those successful cases should be communicated by the government. Communication of examples will show how waste participants can contribute to the implementation of the IWMP

8.2 Benchmarking- the purpose of benchmarking is for information sharing amongst the municipalities. There should be lesson learned and good practice.

8.3 Public awareness- public buy-in is important for successful implementation of the IWMP. Public knowledge on waste management will also influence public buy-in.

## **9. ROLES AND RESPONSIBILITIES**

9.1 Municipality's responsibilities- there should be clear description of role and responsibilities of those responsible for waste management and implementation of the IWMP. The roles are determined as per the requirements of the Constitution, NEMWA and IWM policy.

9.1.1 Municipal manager- the municipal manager responsible for waste management within the municipality's jurisdiction.

9.1.2 Waste management officer- ensures that waste management service are provided and coordinate waste management activities.

9.1.3 Environmental Management Department- the department that is responsible for Waste Management Directorate and other sections such as enforcement and compliance

9.1.4 Waste management Directorate- responsible for strategic planning and policy formulation in the municipalities. Roles also include (waste Information management system; auditing; incidents management and reporting and ensures adherence to national and provincial requirements).

9.1.5 Infrastructure and service department- the department deals with waste management delivery service agencies (pikitung) that does service delivery (waste collection and disposal) on behalf of the municipalities.

9.2 Stakeholder responsibilities- the main stakeholders in waste management and implementation of the IWMP are: households and industries who are responsible for waste separation at a source and change of behaviour and consumption pattern that influence the waste production and quantities.

## **10. REPORTING, MONITORING AND REVIEW**

10.1 Reporting- the annual performance of the IWMP should be provided. The content should include: the extent of to which the IWMP was implemented; waste management initiatives; waste management delivery services and compliance of the IWMP to the applicable waste management standards; how the municipality performed in achieving the targets; any amendments to the plan

10.2 Monitoring- monitoring framework to which the plan will comply with is developed. The framework should include the following issues:

10.2.1 Strategic issues- indication of how short-term to medium-term goals will be achieved and objectives will be delivered.

10.2.2 Performance of the municipalities in relation to the IWMP targets and objectives.

10.2.3 Public accountability- did the municipalities show accountability to the public and was the public informed throughout the process.

10.2.4 Communication and public participation- the communication plan indicating how the stakeholders will be informed and how the feedback regarding the progress of the IWMP will be communicated.

10.2.5 Financial plan- annual budget allocation and medium-term finance and how funds were raised should be discussed.

10.2.6 Waste management implementation programme- the delivery milestones; target; activities undertaken; municipalities' responsibilities and schedules of projects related to IWMP implementation should be included in the programme.

10.3 Review of IWMPs- to measure successful implementation of the IWMP the plan should be reviewed. Therefore the IWMP should be reviewed every five years aligned with the IDP requirements. Annual performance reports can also be considered as a reviewing mechanism.

## Appendix B: Collation sheet

| RA<br>Categories<br>Sub-<br>categories | City of<br>Johannesburg_20<br>11 | Buffalo city_2012 | Mangaung_2014 | City of<br>Tswane_2014 | eThekwinini_2016 | Nelson Mandela<br>Bay_2016 | City of Cape<br>Town_2017 | Ekurhuleni_2018 |
|----------------------------------------|----------------------------------|-------------------|---------------|------------------------|------------------|----------------------------|---------------------------|-----------------|
| <b>1</b>                               |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.1                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.2                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.3                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.3.1                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.3.2                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.4                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.4.1                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.4.2                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.4.3                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.4.4                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.4.5                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 1.4.6                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| <b>2</b>                               |                                  |                   |               |                        |                  |                            |                           |                 |
| 2.1                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 2.2.                                   |                                  |                   |               |                        |                  |                            |                           |                 |
| 2.3                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 2.4                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 2.5                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 2.6                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| <b>3</b>                               |                                  |                   |               |                        |                  |                            |                           |                 |
| 3.1                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 3.2                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| <b>4.</b>                              |                                  |                   |               |                        |                  |                            |                           |                 |
| 4.1                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 4.2                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 4.3                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 4.3.1                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 4.3.2                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 4.3.3                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 4.3.4                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| <b>5</b>                               |                                  |                   |               |                        |                  |                            |                           |                 |
| 5.1                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| 5.1.1                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 5.1.2                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 5.1.3                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 5.2                                    |                                  |                   |               |                        |                  |                            |                           |                 |
| <b>5.3</b>                             |                                  |                   |               |                        |                  |                            |                           |                 |
| 5.4.1                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 5.4.2                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 5.4.3                                  |                                  |                   |               |                        |                  |                            |                           |                 |
| 5.5                                    |                                  |                   |               |                        |                  |                            |                           |                 |

|           |  |  |  |  |  |  |  |  |
|-----------|--|--|--|--|--|--|--|--|
| <b>6</b>  |  |  |  |  |  |  |  |  |
| 6.1       |  |  |  |  |  |  |  |  |
| 6.2       |  |  |  |  |  |  |  |  |
| 6.3       |  |  |  |  |  |  |  |  |
| 6.4       |  |  |  |  |  |  |  |  |
| 6.5       |  |  |  |  |  |  |  |  |
| <b>7</b>  |  |  |  |  |  |  |  |  |
| 7.1       |  |  |  |  |  |  |  |  |
| 7.1.1     |  |  |  |  |  |  |  |  |
| 7.1.2     |  |  |  |  |  |  |  |  |
| 7.1.3     |  |  |  |  |  |  |  |  |
| 7.1.4     |  |  |  |  |  |  |  |  |
| 7.1.5     |  |  |  |  |  |  |  |  |
| 7.1.6     |  |  |  |  |  |  |  |  |
| 7.1.7     |  |  |  |  |  |  |  |  |
| 7.1.8     |  |  |  |  |  |  |  |  |
| 7.1.9     |  |  |  |  |  |  |  |  |
| <b>8</b>  |  |  |  |  |  |  |  |  |
| 8.1       |  |  |  |  |  |  |  |  |
| 8.2       |  |  |  |  |  |  |  |  |
| 8.3       |  |  |  |  |  |  |  |  |
| <b>9</b>  |  |  |  |  |  |  |  |  |
| 9.1       |  |  |  |  |  |  |  |  |
| 9.1.1     |  |  |  |  |  |  |  |  |
| 9.1.2     |  |  |  |  |  |  |  |  |
| 9.1.3     |  |  |  |  |  |  |  |  |
| 9.1.4     |  |  |  |  |  |  |  |  |
| 9.1.5     |  |  |  |  |  |  |  |  |
| 9.2       |  |  |  |  |  |  |  |  |
| <b>10</b> |  |  |  |  |  |  |  |  |
| 10.1      |  |  |  |  |  |  |  |  |
| 10.2      |  |  |  |  |  |  |  |  |
| 10.2.1    |  |  |  |  |  |  |  |  |
| 10.2.2    |  |  |  |  |  |  |  |  |
| 10.2.3    |  |  |  |  |  |  |  |  |
| 10.2.4    |  |  |  |  |  |  |  |  |
| 10.2.5    |  |  |  |  |  |  |  |  |
| 10.2.6    |  |  |  |  |  |  |  |  |
| 10.3      |  |  |  |  |  |  |  |  |

## Appendix C: Raw Data for IWMP

| RA<br>Categories<br>Sub-<br>categories | City of<br>Johannesburg_20<br>11 | Buffalo city_2012 | Mangaung_2014 | City of<br>Tswane_2014 | eThekwin_2016 | Nelson Mandela<br>Bay_2016 | City of Cape<br>Town_2017 | Ekurhuleni_2018 |
|----------------------------------------|----------------------------------|-------------------|---------------|------------------------|---------------|----------------------------|---------------------------|-----------------|
| <b>1</b>                               | <b>C</b>                         | <b>C</b>          | <b>B</b>      | <b>C</b>               | <b>B</b>      | <b>B</b>                   | <b>A</b>                  | <b>A</b>        |
| 1.1                                    | C                                | A                 | B             | A                      | A             | A                          | A                         | A               |
| 1.2                                    | C                                | C                 | B             | A                      | A             | E                          | A                         | A               |
| 1.3                                    | C                                | C                 | B             | A                      |               | B                          | A                         | A               |
| 1.3.1                                  | C                                | C                 | C             | A                      | A             | B                          | A                         | A               |
| 1.3.2                                  | <b>C</b>                         | <b>C</b>          | <b>B</b>      | C                      | A             | B                          | A                         | A               |
| 1.4                                    | C                                | C                 | B             | C                      | B             | C                          | A                         | A               |
| 1.4.1                                  | C                                | C                 | A             | C                      | B             | C                          | A                         | A               |
| 1.4.2                                  | D                                | C                 | E             | E                      | B             | D                          | A                         | A               |
| 1.4.3                                  | E                                | C                 | B             | C                      | B             | C                          | A                         | A               |
| 1.4.4                                  | D                                | F                 | D             | E                      | D             | A                          | C                         | C               |
| 1.4.5                                  | C                                | B                 | A             | C                      | C             | C                          | A                         | A               |
| 1.4.6                                  | C                                | C                 | A             | A                      | B             | D                          | A                         | A               |
| <b>2</b>                               | <b>C</b>                         | <b>C</b>          | <b>C</b>      | <b>C</b>               | <b>C</b>      | <b>C</b>                   | <b>C</b>                  | <b>C</b>        |
| 2.1                                    | C                                | C                 | F             | A                      | A             | A                          | C                         | C               |
| 2.2.                                   | C                                | D                 | F             | E                      | C             | D                          | C                         | C               |
| 2.3                                    | E                                | C                 | C             | C                      | C             | C                          | C                         | C               |
| 2.4                                    | <b>C</b>                         | <b>C</b>          | <b>C</b>      | C                      | C             | <b>C</b>                   | C                         | C               |
| 2.5                                    | C                                | C                 | C             | C                      | C             | C                          | C                         | C               |
| 2.6                                    | C                                | C                 | C             | E                      | C             | D                          | C                         | C               |
| <b>3</b>                               | <b>C</b>                         | <b>C</b>          | <b>F</b>      | <b>C</b>               | <b>C</b>      | <b>D</b>                   | <b>E</b>                  | <b>A</b>        |
| 3.1                                    | <b>C</b>                         | <b>C</b>          | <b>F</b>      | <b>C</b>               | C             | <b>D</b>                   | E                         | A               |
| 3.2                                    | D                                | C                 | F             | C                      | C             | D                          | E                         | A               |
| <b>4.</b>                              | <b>C</b>                         | <b>C</b>          | <b>C</b>      | <b>C</b>               | <b>C</b>      | <b>C</b>                   | <b>C</b>                  | <b>C</b>        |
| 4.1                                    | C                                | D                 | C             | C                      | C             | C                          | C                         | C               |
| 4.2                                    | C                                | D                 | C             | C                      | C             | C                          | C                         | C               |
| 4.3                                    | C                                | B                 | C             | C                      | C             | C                          | C                         | C               |
| 4.3.1                                  | C                                | C                 | D             | C                      | F             | C                          | C                         | C               |
| 4.3.2                                  | C                                | C                 | D             | C                      | C             | C                          | C                         | C               |
| 4.3.3                                  | <b>C</b>                         | <b>C</b>          | <b>D</b>      | <b>C</b>               | C             | <b>C</b>                   | C                         | C               |
| 4.3.4                                  | C                                | C                 | C             | C                      | C             | C                          | C                         | C               |
| <b>5</b>                               | <b>D</b>                         | <b>A</b>          | <b>C</b>      | <b>C</b>               | <b>C</b>      | <b>C</b>                   | <b>C</b>                  | <b>C</b>        |
| 5.1                                    | D                                | A                 | C             | C                      | C             |                            | C                         | C               |
| 5.1.1                                  | D                                | A                 | C             | C                      | C             | C                          | C                         | C               |
| 5.1.2                                  | D                                | A                 | C             | C                      | C             | C                          | C                         | C               |
| 5.1.3                                  | D                                | D                 | C             | C                      | C             | C                          | C                         | C               |
| 5.2                                    | C                                | A                 | C             | C                      | C             | C                          | C                         | A               |
| <b>5.3</b>                             | C                                | C                 | C             | D                      | <b>A</b>      | D                          | C                         | B               |
| 5.4.1                                  | C                                | C                 | C             | D                      | A             | D                          | C                         | B               |
| 5.4.2                                  | C                                | C                 | C             | D                      | A             | D                          | C                         | B               |
| 5.4.3                                  | C                                | C                 | C             | D                      | A             | D                          | C                         | B               |

|           |          |          |          |          |          |          |          |          |
|-----------|----------|----------|----------|----------|----------|----------|----------|----------|
| 5.5       | D        | B        | E        | E        | A        | E        | C        | C        |
| <b>6</b>  | <b>A</b> | <b>C</b> | <b>C</b> | <b>C</b> | <b>A</b> | <b>C</b> | <b>C</b> | <b>C</b> |
| 6.1       | A        | C        | C        | C        | A        | C        | C        | C        |
| 6.2       | A        | C        | C        | C        | A        | C        | C        | C        |
| 6.3       | A        | C        | E        | C        | A        | C        | C        | C        |
| 6.4       | A        | C        | C        | C        | A        | C        | C        | C        |
| 6.5       | A        | C        | C        | C        | A        | C        | C        | C        |
| <b>7</b>  | <b>A</b> | <b>C</b> | <b>D</b> | <b>C</b> | <b>C</b> | <b>C</b> | <b>C</b> | <b>C</b> |
| 7.1       | A        | C        | C        | C        |          |          | C        | C        |
| 7.1.1     | A        | D        | C        | C        | C        | C        | C        | C        |
| 7.1.2     | A        | E        | D        | C        | C        | C        | A        | C        |
| 7.1.3     | A        | C        | C        | C        | C        | C        | A        | D        |
| 7.1.4     | A        | F        | C        | C        | C        | B        | A        | C        |
| 7.1.5     | A        | C        | C        | C        | C        | C        | A        | C        |
| 7.1.6     | C        | C        | D        | C        | C        | C        | C        | C        |
| 7.1.7     | C        | C        | C        | C        | C        | C        | C        | C        |
| 7.1.8     | C        | C        | C        | C        | A        | C        | A        | C        |
| 7.1.9     | A        | C        | D        | D        | C        | D        | D        | C        |
| <b>8</b>  | <b>C</b> | <b>D</b> | <b>E</b> | <b>D</b> | <b>C</b> | <b>C</b> | <b>E</b> | <b>C</b> |
| 8.1       | C        | D        | E        | D        | C        | C        | E        | C        |
| 8.2       | C        | D        | E        | E        | E        | F        | E        | E        |
| 8.3       | C        | C        | D        | C        | C        | C        | C        | C        |
| <b>9</b>  | <b>A</b> | <b>D</b> | <b>E</b> | <b>C</b> | <b>C</b> | <b>E</b> | <b>C</b> | <b>C</b> |
| 9.1       | A        | C        | F        | C        | C        | E        | C        | C        |
| 9.1.1     | A        | C        | E        | C        | C        | E        | C        | C        |
| 9.1.2     | A        | C        | E        | C        | C        | E        | A        | A        |
| 9.1.3     | A        | D        | F        | C        | C        | E        | D        | C        |
| 9.1.4     | A        | D        | A        | C        | C        | E        | A        | A        |
| 9.1.5     | A        | D        | F        | C        | C        | A        | D        | C        |
| 9.2       | A        | C        | C        | C        | C        | E        | D        | C        |
| <b>10</b> | <b>D</b> | <b>C</b> | <b>D</b> | <b>D</b> | <b>D</b> | <b>C</b> | <b>A</b> | <b>C</b> |
| 10.1      | D        | C        | D        | D        | D        | C        | A        | C        |
| 10.2      | D        | E        | D        | D        | D        | C        | A        | C        |
| 10.2.1    | D        | D        | D        | C        | D        | A        | A        | C        |
| 10.2.2    | D        | D        | C        | D        | D        | C        | A        | C        |
| 10.2.3    | D        | C        | D        | D        | E        | C        | C        | C        |
| 10.2.4    | D        | C        | C        | D        | C        | C        | C        | C        |
| 10.2.5    | D        | C        | C        | D        | C        | C        | A        | C        |
| 10.2.6    | D        | C        | D        | C        | C        | C        | C        | A        |
| 10.3      | D        | C        | C        | C        | A        | C        | A        | C        |