

**Assessment of the waste management practices at Transnet National Ports Authority,
Port of Richards Bay**

by

NEAL CRAIG NAIDOO

Submitted in accordance with the requirements
for the degree of

MASTER OF SCIENCE

in the subject

ENVIRONMENTAL MANAGMENT

at the

UNIVERSITY OF SOUTH AFRICA

SUPERVISOR: MRS A BINDOFF
CO-SUPERVISOR: PROF M TEKERE

MAY 2015

I declare that **ASSESSMENT OF THE WASTE MANAGEMENT PRACTICES AT TRANSNET NATIONAL PORTS AUTHORITY, PORT OF RICHARDS BAY** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

SIGNATURE

(Mr NC Naidoo)

DATE

ACKNOWLEDGEMENTS

Special thanks to my supervisors, Mrs Anne Bindoff and Prof Memory Tekere, who despite their busy schedules was able to provide me with valuable support and guidance.

Thanks to all the staff of Transnet National Ports Authority, Port of Richards Bay who helped during the course of the research.

Many thanks to my parents for their encouragement and support over the years and for always being there for me.

Finally, thanks to Transnet National Ports Authority for sponsoring my MSc course.

ABSTRACT

Based on literature review, statistics of waste management at ports in South Africa is hard to come by. The research critically assessed the current waste management practices at Transnet National Ports Authority. Transnet National Ports Authority, Port of Richards Bay (TNPA RCB) was used as a case study to examine the different types and quantities of waste produced, analysing the current waste management model as well as determining TNPA RCB compliance to pertinent waste legislation.

A 10 day waste audit was conducted to obtain quantitative data and to identify the different types of waste generated. The baseline data resulting from the waste audit conducted for the first time since the establishment of the TNPA RCB, found 402 kg of general waste generated, 74 kg of this total is segregated for recycling and the remaining 328 kg is landfilled. The overall conclusion gained during compliance audit was that the TNPA RCB was partly compliant with pertinent waste legislation and obligations.

Furthermore, questionnaires about waste were sent to staff members working in offices to get an overview of how they deal with current waste management. A number of barriers to sustainable waste management were identified, including: lack of knowledge and awareness; constraints on facilities and human resources; culture that resists change and contamination. To overcome these, there needs to be education, as well as co-operation between top management, staff and waste service providers to help implement new strategies. The primary conclusions from this dissertation are that there are opportunities to divert waste streams from landfill and to attain a sustainable waste management system at TNPA RCB.

Key concepts: Waste management, ports, South Africa, recycling, legislation.

Table of Contents

CHAPTER 1	1
ORIENTATION TO THE STUDY	1
1.1 INTRODUCTION	1
1.2 BACKGROUND OF THE STUDY	3
1.3 STATEMENT OF THE PROBLEM	4
1.4 PURPOSE OF THE STUDY	5
1.5 RESEARCH OBJECTIVES	5
1.6 RESEARCH QUESTIONS	5
1.7 SIGNIFICANCE OF THE STUDY.....	5
CHAPTER 2	7
LITERATURE REVIEW	7
2.1 INTRODUCTION	7
2.2 THE WASTE HIERARCHY	7
2.2.1 INTRODUCTION	7
2.2.2 WASTE PREVENTION.....	8
2.2.3 REUSE.....	9
2.2.4 RECYCLE	9
2.2.5 RECOVERY	10
2.2.6 WASTE TREATMENT AND DISPOSAL.....	10
2.3 WASTE MANAGEMENT IN SOUTH AFRICA.....	11
2.3.1 HISTORY OF SOUTH AFRICAN WASTE LEGISLATION, POLICY AND STRATEGY FRAMEWORKS	11
2.3.2 CURRENT STATE OF WASTE MANAGEMENT.....	13
2.4 LEGISLATION AND LEGAL REQUIREMENTS PERTINENT TO WASTE MANAGEMENT AT PORTS IN SOUTH AFRICA.....	15
2.4.1 Introduction.....	15
2.4.2 Constitution of South Africa Act, 108 of 1996.....	15
2.4.3 The Environment Conservation Act, 73 of 1989 (ECA)	16
2.4.4 The National Environmental Management Act, 107 of 1998 (NEMA).	16
2.4.4 The National Environmental Management: Waste Act, 59 of 2008 (NEM: WA) .16	

2.4.4.1 General Duty of TNPA	16
2.4.4.2 Reduction, Re-use, Recycling and Recovery of Waste	17
2.4.4.3 Guiding Principles	17
2.4.4.4 Waste Management Activities	18
2.4.4.5 Storage, Collection and Transportation of Waste	18
2.4.4.6 Contaminated Land.....	19
2.4.4.7 Waste Management Licences	19
2.4.4.8 Compliance and Enforcement.....	20
2.4.4.9 Regulations and Standards	20
2.4.4.10 Phasing out of PCBs and Asbestos containing material	21
2.4.5 National Environmental Management: Waste Amendment Act, 26 of 2014 (NEM: WAA).....	21
2.4.6 The National Water Act, 36 of 1998 (NWA).....	22
2.4.7 National Environmental Management: Integrated Coastal Management Act, 24 of 2008 (NEM: ICMA)	22
2.4.8 National Ports Act, 12 of 2005 (NPA)	23
2.4.9 The Port Rules.....	24
2.4.10 MARPOL Convention	29
2.4.11 The Basel Convention.....	30
2.4.12 The London Convention	31
2.4.13 The Stockholm Convention	32
2.4.14 Montreal Protocol on Substances that Deplete the Ozone Layer under the Convention.....	32
2.4.15 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade.....	33
2.4.16 The Minamata Convention on Mercury.....	33
2.4.17 Ballast Water Management Convention (BWM)	33
2.4.18 TNPA Waste Management Strategy	33
2.5 IMPACTS OF WASTE ON THE RECEIVING ENVIRONMENT AT PORTS	35
2.5.1 Effects of general waste on the marine environment.....	36
2.5.2 Effects of oily waste on the marine environment	37
2.5.3 Effects of sewage waste on the marine environment.....	38
2.5.4 Effects of ballast water on the marine environment	38
2.5.5 Effects of galley waste on the marine environment.....	39

2.6 WASTE MANAGEMENT ROLES AND RESPONSIBILITIES AT PORTS IN SOUTH AFRICA.....	40
• Transnet National Ports Authority	40
• Tenants	41
2.7 PORT OF RICHARDS BAY.....	42
• Short-term developments	44
• Medium-term layout.....	44
• Long-term layout.....	44
CHAPTER 3	46
RESEARCH DESIGN AND METHODOLOGY	46
3.1 METHODOLOGY	46
3.2 REVIEW OF BACKGROUND INFORMATION ON WASTE MANAGEMENT AT SOUTH AFRICAN PORTS	48
3.2.1 SITE INVESTIGATION	48
3.2.2 AUDIT PROCESS.....	48
3.3 WASTE COMPLIANCE AUDIT	49
3.3.1 PRE-AUDIT ACTIVITIES	49
3.3.2 AUDIT ACTIVITIES	52
3.3.3 POST AUDIT ACTIVITIES	53
3.4 WASTE AUDIT	53
3.4.1 PRE-AUDIT ACTIVITIES	53
3.4.2 AUDIT ACTIVITIES	55
3.4.3 POST AUDIT ACTIVITIES	59
3.5 QUESTIONNAIRE SURVEY	59
3.5.1 DESIGNING THE QUESTIONNAIRE.....	59
3.5.2 SENDING THE QUESTIONNAIRE.....	60
3.5.3 ANALYSIS OF THE QUESTIONNAIRE.....	60
CHAPTER 4	61
RESULTS	61
4.1 CURRENT WASTE MANAGEMENT PRACTICES.....	61
4.1.1 COMMON ACTIVITIES AT TNPA RCB	61
4.1.2. MATERIALS USED IN OFFICE BASED AND ADMINISTRATIVE ACTIVITIES.....	62
4.1.3. MATERIALS USED IN MARINE BASED ACTIVITIES	63

4.1.4. MATERIALS USED INFRASTRUCTURE BASED ACTIVITIES.....	63
4.1.5. CURRENT WASTE MANAGEMENT PRACTICES.....	65
4.2 WASTE AUDIT	66
4.2.2 AREA ANALYSES.....	66
4.2.3 DIVERTING WASTE FROM LANDFILL.....	74
4.2.4 HAZARDOUS WASTE AUDIT.....	76
4.2.5 GALLEY WASTE.....	78
4.3 WASTE COMPLIANCE AUDIT	80
4.3.1 WASTE COMPLIANCE AUDIT FINDINGS.....	82
COMPLIANCE WITH INTERNATIONAL AGREEMENTS.....	82
COMPLIANCE WITH NATIONAL LEGISLATION	83
COMPLIANCE WITH NATIONAL PORTS AUTHORITY WASTE MANAGEMENT STRATEGY.....	87
COMPLIANCE WITH PORT OF RCB WASTE MANAGEMENT PLAN.....	92
COMPLIANCE OF PORT OF RCB WASTE MANAGEMENT PLAN WITH NEM: WA REQUIREMENTS	96
4.4 QUESTIONNAIRES TO STAFF AT TNPA RCB ON WASTE MANAGEMENT PRACTICES	97
4.4.1 BACKGROUND OF RESPONDENTS	97
4.4.2 CURRENT WASTE MANAGEMENT IN OFFICES AT TNPA RCB	97
4.4.3 IDENTIFICATION OF ENVIRONMENTAL CHAMPIONS	103
CHAPTER 5	104
DISCUSSION.....	104
5. DISCUSSION.....	104
5.1 CURRENT WASTE MANAGEMENT PRACTICES.....	104
5.2 WASTE AUDIT OUTCOMES	110
5.3 WASTE COMPLIANCE AUDIT	112
5.4 QUESTIONNAIRE OUTCOMES	114
5.4.1 STAFF PARTICIPATION	115
CHAPTER 6.....	116
CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS AND FURTHER	116
SUGGESTED RESEARCH	116
6.1 CONCLUSION.....	116
6.2 RECOMMENDATIONS.....	117

6.2.1 WASTE MANAGEMENT ISSUES AT TNPA RCB.....	117
6.2.2 WASTE REDUCTION RECOMMENDATIONS	119
6.2.3 WASTE REUSE RECOMMENDATIONS	120
6.2.4 WASTE RECYCLING RECOMMENDATIONS	120
6.3 LIMITATIONS AND FURTHER SUGGESTED RESEARCH.....	121
REFERENCES	122
APPENDIXES	130

LIST OF TABLES

Table 2.1: MARPOL Waste Annexes.

Table 2.2: Types of waste generated within ports

Table 3.1: Documents reviewed for the Waste Audit.

Table 3.2 Areas studied at TNPA RCB.

Table 4.1: Identified activities within TNPA RCB.

Table 4.2: Identified materials used within offices at TNPA RCB and their disposal.

Table 4.3: Identified waste generated by marine based activities at TNPA RCB and their management.

Table 4.4: Identified waste generated by infrastructure based activities at TNPA RCB.

Table 4.5: Current sustainability of waste management practices at TNPA Port of RCB.

Table 4.6: Composition of general waste weighed during the 10 day audit period.

Table 4.7: Estimated disposal costs from 2014 to 2020.

Table 4.8: Galley Waste cost breakdown for the 2013/14 financial year.

Table 4.9: Waste Compliance findings.

Table 5.1: Estimated Cost of implementing a Waste recycling programme for the Port of RCB.

Table 5.2: Average recyclable waste generated at TNPA RCB per year.

LIST OF FIGURES

Figure 2.1: Waste hierarchy.

Figure 2.2: Port of Richards Bay current layout (Source: RCB Planning department, 2012).

Figure 3.1 Research steps undertaken.

Figure 3.2 Audit Activities for the Port of RCB.

Figure 3.3: The Port of RCB operational areas that were inspected.

Figure 3.4: Setting up of waste receptacles for the waste audit.

Figure 3.5: Arial view of the port showing areas of study.

Figure 3.6: Waste collected in boxes.

Figure 4.1: Composition (%) of waste streams for the 10 day audit at Pioneer Centre.

Figure 4.2: Composition of waste streams (kg) for the 10 day audit at Mess (Dining area) and Ablution Pioneer.

Figure 4.3: Composition of waste streams (kg) for the 10 day audit at Bayvue Building.

Figure 4.4: Composition of waste streams (kg) for the 10 day audit at Osisweni building.

Figure 4.5: Composition of waste streams (kg) for the 10 day audit at IT Department.

Figure 4.6: Composition of waste streams (kg) for the 10 day audit at Clinic, Risk and Fire Department.

Figure 4.7: Composition of waste streams (kg) for the 10 day audit at Berthing Crew.

Figure 4.8: Composition of waste streams (kg) for the 10 day audit at Maritime House.

Figure 4.9: Composition of waste streams (kg) for the 10 day audit at Mess and Ablution Maritime.

Figure 4.10: Composition of waste streams (kg) for the 10 day audit at Diving Department.

Figure 4.11: Composition of waste streams (kg) for the 10 day audit at Tugboats.

Figure 4.12: Composition of waste streams (kg) for the 10 day audit at Port Control.

Figure 4.13: Top five areas for food wastes (kg / Day) produced at TNPA RCB.

Figure 4.14: Top five sources of waste papers at TNPA RCB.

Figure 4.15: Top five areas where recyclable plastic waste is produced at TNPA RCB.

Figure 4.16: Composition of industrial waste produced by TNPA RCB from February 2013 to February 2014.

Figure 4.17: Total tonnage of hazardous/industrial produced for 2011 to 2014 financial years. (Source: TNPA RCB Environmental Department, 2014).

Figure 4.18: Cost for the removal and disposal of the identified Hazardous/Industrial Waste Streams for 2013/2014. (Source: TNPA Environmental Department, Hazardous waste records, 2014).

Figure 4.19: Galley Waste Costs from 2011/2014 financial years.

Figure 4.20: Galley Waste skips requested by vessels for 2011/2014.

Figure 4.21: Vessel traffic count for Port of RCB (Source: TNPA RCB, Port control vessel traffic records, 2014).

Figure 4.22: Non- Conformances with the conditions of the IWMP as well as all relevant International and South African legislative requirements.

Figure 4.23: Daily Percentage at which respondents put waste streams listed in their office bin.

Figure 4.24: Weekly Percentage at which respondents put waste streams listed in their office bin.

Figure 4.25: Monthly Percentage at which respondents put waste streams listed in their office bin.

Figure 4.26: Number of people who are concerned about the current waste disposal.

Figure 4.27: Frequency at which information on waste is received through the various sources.

Figure 4.28: Preferred or best option for managing the wastes choice of different types of office wastes.

ACRONYMS

CSIR - Council for Scientific and Industrial Research

IWM - Integrated Waste Management

EPA - Environmental Protection Agency

MSDSs - Material Safety Data Sheets

NEMA - National Environmental Management Act

NEM: WA - National Environmental Management Waste Act

NWIS - National Waste Information System

PDF- Port and Development Framework

TNPA RCB - Transnet National Ports Authority, Port of Richards Bay

LTPF - Long Term Planning Framework

WMO's - Waste Management Officers

CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION

The National Environmental Management: Waste Amendment Act, 2014 (NEM: WAA, 2014) defines waste as any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes.

Waste can be classified by physical state (solid, liquid, gases) (NEM: WAA, 2014). Solid waste can be further characterised by original use (packaging waste, food waste etc.), by material (glass, paper, wood, etc.) and by physical properties (combustible, compostable, recyclable) (Tchobanoglous & Kreith, 2002).

The NEM: WAA classifies waste into two classes based on the risks it poses, specifically general and hazardous waste. General waste is defined as waste that does not pose an immediate hazard or threat to the health or to the environment (NEM: WAA, 2014). Hazardous waste is defined as waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within the business waste, residue deposits and residue stockpiles (NEM: WAA, 2014).

Waste generation, both domestic and industrial, continues to increase world-wide in tandem with growth in consumption. Increases in populations of developing countries results in increasing waste generation. This can result in environmental degradation and pollution on global, regional and local scales. These environmental effects in turn can cause detrimental effects to human health which places increased pressure on natural resources (Bosman, 2009).

Developed countries generate larger amounts of wastes; however they have developed adequate facilities and have competent government institutions and bureaucracies to manage

their wastes (Rajput, R., G. Prasad, and A. K. Chopra, 2009). Developing countries are still in the transition towards better waste management but they currently have insufficient collection and improper disposal of wastes (CSIR, 2011). South Africa is classified as a developing country (UNCTAD, 2009). Waste management in South Africa faces numerous challenges such as a growing population and economy, which means increased volumes of waste generated, increased complexity of waste streams because of urbanisation and industrialisation and growing pressure on outdated waste management infrastructure, with declining levels of capital investment and maintenance (NWMS, 2011).

The sources of waste generation are generated via various sectors. Examples of these include municipal, medical/clinical, agricultural and industrial sectors. The wastes generated within these sectors originate from households, schools, hospitals, clinics, horticulture, fruit growing, construction, industries and to ports that import and export such commodities (ABP Research, 1999).

Shipping and ports are essential components of the international trade and goods movement. The international shipping and port industry is responsible for the carriage and handling of approximately 90% of world trade. In 2009, world seaborne trade exceeded 8 billion tons compared to 4 billion tons in 1990, 3.7 billion in 1980 and 2.6 billion in 1970 (UNCTAD, 2009). It is expected to double or triple in some areas by 2020 (UNCTAD, 2009). Increased seaborne trade means more ships and increased risks of collisions, accidental and operational oil spills, air pollution and other threats to the environment.

Waste is one of the most visible environmental threats amongst ports affecting the marine environment. It affects the economies and inhabitants of coastal and waterside communities, but most important it endangers sensitive marine ecosystems and wildlife both in the open sea areas as well as coastal areas and land base. Serious public health issues are associated with hazardous materials, medical wastes, glass and other dangerous debris found at ports (Ng, A. K., & Song, S, 2010). Plastic materials, which are durable and slow to degrade, have become the most abundant material of marine litter worldwide. In addition, many plastic items are buoyant, allowing them to be carried with currents a long way. More than one million birds and 100 000 marine mammals and sea turtles die each year throughout the world after either becoming entangled in or eating plastic materials dumped in the sea (UNEP, 2006a).

According to the feasibility study on the sustainable management of marine litter by UNEP (2006b), waste has the following effects on the marine environment, which includes ports:

- entanglement and ingestion are the primary kinds of direct damage to wildlife caused by waste;
- potential source of accumulation of toxic substances in the marine environment;
- habitat destruction by affecting water quality and causing physical damage to ecosystems;
- Transfer and introduction of invasive species since plastic items can be highly buoyant and travel long distances.

In South Africa, Transnet National Ports Authority (hereafter referred to as TNPA) has the role of landlord at the ports. TNPA is responsible for ensuring that the port does not become polluted as a result of poor waste management practices or any other reason. TNPA must ensure that adequate measures are available for the management and removal of waste.

The purpose of this study is to evaluate the principles and the implementation of the waste management process at TNPA, Port of Richards Bay to ensure sustainable integrated waste management. This is particularly important in view of the large amounts of waste (general and hazardous) that are being generated at ports in South Africa (Transnet, Sustainability Report, 2012).

1.2 BACKGROUND OF THE STUDY

In a fast developing country, such as South Africa, major focus is placed on infrastructural, industrial and service delivery development - for the purpose of improving the economy and quality of life for citizens (Bosman, 2009). The country's economic and industrial policy has also turned towards export promotion as a pillar of South Africa's development (Makgae, 2011). South Africa's re-integration into the global economy and the Southern African political arena requires an improved pollution and waste management system.

Historically there was very little or no focus on sustainable waste management practices. This has contributed to the current waste problems in South Africa. Inadequate waste practices have resulted in substandard, ineffective or non-existent waste collection and street-cleaning systems; illegal dumping and littering; waste disposal sites which are poorly operated and impact negatively on the environment and human health (RSA, White paper on integrated pollution and waste management for South Africa, 2000).

South Africa is estimated to have generated 108 million tonnes of waste in 2011, of which 98 million tonnes was disposed at landfills (DEA, 2012a). Fifty nine million tonnes was general waste, 48 million tonnes was unclassified waste and 1 million tonnes was hazardous waste. Merely 10% of all waste produced was recycled in 2011 (DEA, 2012a). Waste management in South Africa is still heavily reliant on landfilling as a waste management option, with 90.1% of waste generated being disposed of to landfill in 2011. Unless properly managed waste has the potential to impact directly on human health and the environment (DWAF, 1997), whether it be by ground or surface water, soil or air. To guarantee the basic human right of the South African public to an environment that is not harmful to their health or well-being (RSA Constitution, 1996), it is imperative that waste be responsibly managed as one source of harm.

TNPA RCB can be viewed as a microcosm of the national issues being experienced in terms of waste management. This means that TNPA RCB contributes to the ever increasing problems as described above in South Africa with regards to waste management. Historically, waste at the TNPA RCB has been poorly managed, and principles of the waste hierarchy not given any consideration (SABS, 2012). Waste separation does not take place, and all waste produced by TNPA RCB is currently disposed of to landfill (SABS, 2012). Furthermore, the organisation is missing out on economic opportunities to not only decrease waste disposal costs, but to also potentially earn revenue from recycling initiatives.

This research was therefore undertaken so as to assess the waste management practices at TNPA, Port of Richards Bay.

1.3 STATEMENT OF THE PROBLEM

TNPA RCB is a waste generator as well as the landlord of the port and it retains the ultimate responsibility for ensuring that waste is handled, stored, transported and disposed of in an environmentally sound and responsible manner. There is limited information available to make sound conclusions on whether or not TNPA RCB is managing its waste appropriately. This research was therefore undertaken so as to assess TNPA RCB fulfilment of their above mentioned responsibilities.

It is critical to analyse the current state of waste management at TNPA RCB by identifying the different types and quantities of waste produced as well as analysing the current waste management model used by TNPA RCB.

Consequently the outcome of the analysis will provide accurate information towards the implementation of a sustainable waste management system at TNPA RCB. The research set to assess the waste hierarchy model in comparison to the current model to achieve optimised sustainability.

1.4 PURPOSE OF THE STUDY

The purpose of the study was to evaluate the waste management practices at TNPA RCB.

1.5 RESEARCH OBJECTIVES

The objectives of this study were:

- To identify, and quantify the composition of waste streams generated at TNPA RCB using a sampling methodology that would capture the main trends of waste streams generated;
- To evaluate the current waste management practices at TNPA RCB and compare this with international, national, provincial and local environmental legal obligations pertaining to waste;
- To recommend appropriate waste management strategies to TNPA RCB.

1.6 RESEARCH QUESTIONS

In order to achieve the objectives, the study sought to answer the following questions:

- What types and quantities of waste are produced at TNPA, Port of Richards Bay?
- Do the current waste management practices at TNPA, Port of Richards Bay, encompass the waste hierarchy principles?
- Is the Port of Richards Bay compliant to international, national, provincial and local environmental legal obligations pertaining to waste?
- What are the possible solutions and practical recommendations that will ensure that waste is managed according the waste hierarchy principles?

1.7 SIGNIFICANCE OF THE STUDY

Identifying and quantifying the waste produced at TNPA RCB and comparing current waste management practices to the principles of the waste management hierarchy would provide information on the current status of waste management at TNPA RCB and enable the

researcher to make recommendations to assist the port in ensuring sustainable waste management. Furthermore, the recommendations herein could provide a model to be utilised by other ports in South Africa to improve their own waste management practices.

CHAPTER 2

LITERATURE REVIEW

2.1 INTRODUCTION

A literature review of South African and International studies on integrated waste management was undertaken to investigate and gain insight into the principles of the waste hierarchy, waste management in South Africa, and the current waste management practices of the ports in South Africa. The literature review covered information sources on the following topics:

- Principles of the waste hierarchy and sustainable waste management;
- Waste management in South Africa;
- Legislation and legal requirements pertinent to waste management at ports in South Africa; and
- Impacts of waste on the impacts of waste on the receiving environment at the port.

2.2 THE WASTE HIERARCHY

2.2.1 INTRODUCTION

The Waste Act, 2008 provides a range of waste management measures that can be set up to accomplish the objectives of the Act and that are appropriate to the waste management challenges in the country. The national waste management strategy (NWMS) and national and provincial norms and standards, amongst others, the classification of waste, waste service delivery, and tariffs for such waste services is given effect by the Act. The conceptual approach to waste management is supported by the waste hierarchy, which was introduced into South African waste management policy in the White Paper on Integrated Pollution and Waste Management (White Paper, 2000).

The core of the approach is to group waste management measures across the entire value chain in a series of steps, which are applied in descending order of significance. The basis of the hierarchy, and the first choice of measures in the management of waste, is waste avoidance and reduction, (Lombard et al., 2009). Where waste cannot be avoided, it should be recovered, reused, recycled and treated. Waste should only be disposed of as a last resort.

Implementation of the waste hierarchy requires changes in the way products are designed and manufactured in order to promote their re-use and recycling, giving effect to the concept of 'cradle-to-cradle' waste management (Lombard et al., 2009).

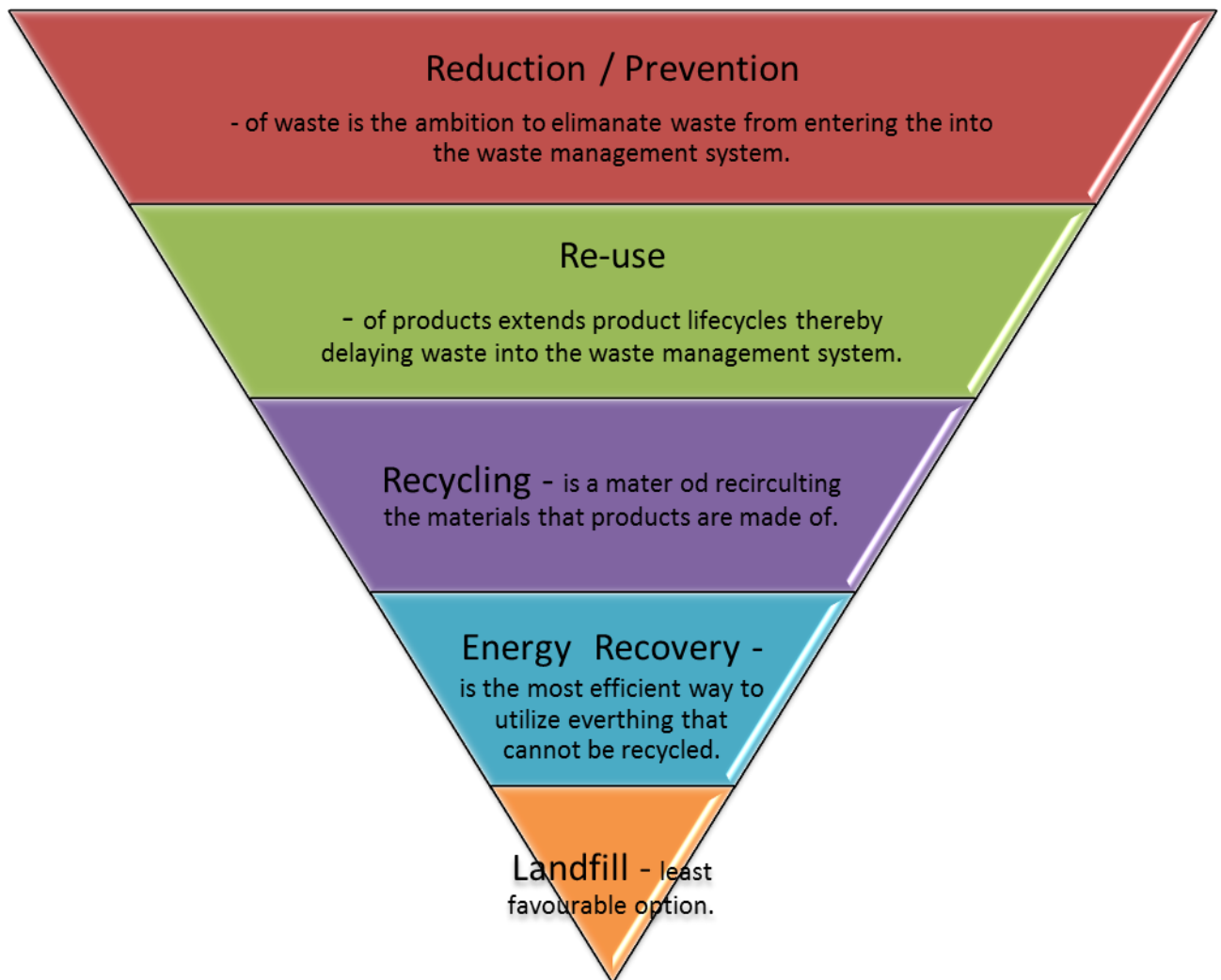


Figure 2.1: Waste hierarchy (<http://www.usitall.se/usitall/about-waste-to-energy/the-technology/>) accessed: November 2012.

2.2.2 WASTE PREVENTION

Waste prevention is the preferred approach to waste management. It involves either avoiding generating waste entirely or reducing the quantity produced. The use of cleaner production methods, energy efficient design and reduced packaging are examples of waste prevention. Specific strategies are needed to encourage waste prevention in addition to the basic framework of integrated waste management because barriers to such waste prevention exist. Preventing or reducing the amount of waste generated can be achieved in a number of ways. Some examples of waste prevention include:

- Increasing the durability of the product for longer life to minimize waste;
- Improved material handling and storage to prevent materials becoming waste;
- Reducing the over ordering of materials;
- Reducing off-cuts and rejects;
- Purchasing materials in bulk and using returnable containers;
- Purchasing products that can be reused or recycled;
- Minimising the use of disposable products (e.g. plastic cups);
- Using both sides of paper and set printer and photocopier defaults to double-sided; and
- Sending information electronically (Ball, 2006).

In order to achieve this it is important to work with suppliers and manufacturers to reduce the waste generated, such as agreeing for the supplier to accept the return of packaging upon delivery or to reduce the amount of packaging (Ball, 2006).

2.2.3 REUSE

Reusing a product more than once for its original purpose avoids the excessive consumption of resources and waste generation e.g. reuse of plastic containers.

Materials can be reused to prevent them becoming waste, such as given in the examples below:

- Choose a supplier that has a returns policy, e.g. many raw materials are delivered in drums that can be returned to the supplier for reuse or recycling. Printer toner cartridges are another example;
- Reuse packaging, e.g. boxes, pallets and drums can be re-used many times;
- Paper from misprints and drafts can be re-used as scrap paper in the office; and
- Old furniture and textiles may be of use to charities or to waste exchange groups (Ball, 2006).

2.2.4 RECYCLE

Recycling should be practiced whenever waste prevention or reuse is not possible, provided that any such recycling is cost effective, taking into consideration environmental benefits, financial costs and community interests. As is in the case with prevention, some specific strategies are required to ensure optimum level of recycling. When reuse can no longer be

carried out, the materials should preferably be recycled back into similar products or become secondary raw materials for the production of new products (UNEP, 2005).

Waste should be segregated at source to allow recycling as waste that has been mixed requires the extra effort of double handling is often contaminated and therefore may no longer be suitable and will have additional health implications.

Materials that typically can be recycled include glass, cans/tin, plastics, paper, organics, electrical and electronic products, wood, aggregates, plasterboard, oil and tyres. Current recycling and reuse options for tyres include using the rubber crumb for re-treading tyres, road base, aggregate, asphalt, speed bumps, mud flaps, floor mats, acoustic materials, runways, packaging and roofing, (Chung, 2007).

Waste electrical and electronic equipment (e-Waste) generally contains hazardous components such as transformers and capacitors containing polychlorinated biphenyls called PCBs; accumulators and batteries; mercury switches, glass from cathode ray tubes and other activated glass, equipment containing chlorofluorocarbons called CFC's (DEAT, 2009b). Therefore this waste should not be disposed of in landfill sites. The e-Waste Association of South Africa (eWASA) provides support to manufacturers, vendors and distributors of electronic and electrical goods and waste handlers to manage waste effectively (www.ewasa.org on 4th May 2015).

In order to improve markets for waste recycling it is important that there are markets for recycled products. Therefore, purchasing products with recycled content also helps to reduce waste, e.g. paper, cardboard boxes, and envelopes (Chung, 2007).

2.2.5 RECOVERY

Where further recycling is not feasible, it may be possible to recover the energy from the material and feed that back into the economy where this is acceptable to the community. Some materials may be inappropriate to re-use, recycle or recover for energy and instead require treatment to stabilise them and minimise their environmental or health impacts (Chung, 2007).

2.2.6 WASTE TREATMENT AND DISPOSAL

This is the last and the least preferred option in the hierarchy. There is always some residual material left over as waste after all spheres of waste hierarchy have been explored. This is the case even after undergoing the preferred options in the solid waste management hierarchy.

The left-over waste occasionally requires treatment prior to disposal to safe-guard against environmental risks, pest problems, social, health and safety issues (Chung, 2007).

2.3 WASTE MANAGEMENT IN SOUTH AFRICA

2.3.1 HISTORY OF SOUTH AFRICAN WASTE LEGISLATION, POLICY AND STRATEGY FRAMEWORKS

Since the birth of democracy, South Africa has made great strides in addressing key issues, requirements and problems experienced in waste management. In the past, Environmental legislation focused more on nature conservation than waste management. Waste management in South Africa relied on the Environment Conservation Act of 1989 (Bosman, 2009). The Act addressed waste in a fragmented manner, in that some sections like section 20 of ECA, 1989 that addresses waste disposal facilities was being dealt with by the Department of Water Affairs and Forestry (DWAF). Although the Environmental Conservation Act (ECA) addressed issues such as littering and regulatory competency, the Constitution of the Republic of South Africa Act, 1996 (Act 108 of 1996) for the first time, guaranteed the right of South Africans to a clean and healthy environment.

This was followed by the Draft White Paper on Integrated Pollution and Waste Management for South Africa, which was published in 1998. The White Paper advocates a shift from the present focus on waste disposal and impact control (i.e. end of pipe) to integrated waste management and prevention as well as minimisation. In terms of legal changes this has entailed national government drafting legislation requiring the prevention and minimisation of waste.

The White Paper, in turn, gave rise to the formulation of a National Waste Management Strategy and Action Plans, a collaborative effort between DEAT and DWAF with Danish financial and technical assistance and input by a great many interested and affected parties. DEAT developed a series of user-friendly guidelines called Working with Waste to implement needs identified in the strategy. In an attempt to address the current fragmentation in waste legislation in South Africa and to develop a holistic and integrated approach to waste management, the President of the Republic of South Africa signed The National Environmental Management: Waste Bill into an Act of Parliament in March 2008.

The National Environmental Management: Waste Act, 2008 (NEM: WA) came into effect on 1 July 2009. The overall purpose of the Waste Act is to regulate the management of waste in order to protect the health of people as well as the environment (plants, animals, land, air, water). The NEM: WA does this by putting minimum requirements for any person who undertakes an activity which produces waste or a person who handles any waste which has already been produced to comply with. This includes storage of waste, transportation, processing, including people who are reusing or recycling waste. The State has an obligation required by the Constitution, to protect the environment and prevent ecological degradation and it does that by making different regulations which everyone must comply to.

The most significant aspect of the NEM: WA is that it adopts an internationally recognised waste management hierarchy which says waste must first be avoided; where it cannot be avoided it must be reduced, reused, recycled or recovered and only disposed of if there is nothing else that could be done with it. The waste management hierarchy recommends that only a very small amount of waste must be disposed or buried on land but the current situation in South Africa is that most waste is disposed.

The objectives of the Waste Act are:

- minimising pollution;
- implementing the waste hierarchy;
- balancing environmentally sustainable development with economic and social development; and
- promoting affordable waste services to all citizens (NEM: WA, 2008).

Following the enactment of the Waste Act, the Minister of Environmental Affairs established the National Waste Management Strategy (NWMS) in terms of Section 6(1) for achieving the objects of the Act. The NWMS was approved for implementation by the Cabinet in November 2011 to give effect to the provisions of the Act (DEA, 2011a). This is a document which outlines the priorities of the country in terms of ensuring that waste is minimised and managed in a sound manner. All state departments, provinces, municipalities, the private sector and the general public are bound by the strategy, meaning that it has the same weight as an Act of Parliament. The strategy sets the targets for waste reduction, recycling, for example, it can come up with the tons or percentage of waste which must be recycled or

different waste streams which must be recycled over a period of five or more years. (DEAT, 2011a).

Other key aspects of the new waste management dispensation in South Africa are the systems of integrated waste management plans (IWMP) and the appointment of waste management officers (WMO's) (DEAT, 2009a). The purpose of IWMP is to improve the quality of life of all South Africans, through maximised efficiency of waste management services, provided at least cost with minimum environmental impacts (DEAT, 2000). To ensure effective implementation, 'interconnecting' IWMP's must be prepared by the two spheres of government (Provincial, and Municipal) to do situational analyses and implement national waste priorities (NEM: WAA, 2014). According to the national waste information baseline report of 2012, 104 of the 231 local municipalities in South Africa have developed IWMP's. In terms of district municipalities, 28 of the 47 municipalities have developed IWMP's (DEA, 2012a).

WMO's at national level are involved with policy-making and regulation; at provincial level with policymaking, regulation and capacity-building and at municipal level with compliance monitoring. The system is envisaged to create an independent monitoring mechanism across (government) levels to ensure that standards are implemented. To this effect, waste management licensees may also be compelled to appoint WMO's.

The NEM: WA also provides for economic instruments to be used to achieve behaviour changes in order to improve efficiency and effectiveness within the waste sector (DEA, 2011a). Both incentives and disincentives through pricing may be utilised. However, waste services are currently not appropriately priced and the lack of full cost accounting and the risks of over-inflation make it difficult to structure such incentives appropriately (DEA, 2011a). The examples of economic measures includes pricing, taxation, subsidies, incentives and fiscal measures which will also be aligned with the principles established by NEMA, including the 'polluter pays' principle (NWMS, 2011).

2.3.2 CURRENT STATE OF WASTE MANAGEMENT

South Africa is estimated to have generated 108 million tonnes of waste in 2011, of which 98 million tonnes was disposed at landfills (DEA, 2012a). Fifty nine million tonnes was general waste, 48 million tonnes was unclassified waste and 1 million tonnes was hazardous waste. (DEA, 2012a). The growth in national waste generation since 1997 reflects an average annual increase of 4.8% or a 62.5% overall growth (Savage, 2009). This growth has important

implications for both waste minimisation strategies and economic exploitation of the waste management sector (DEAT, 2009a). Despite the lack of complete and reliable waste management information in South Africa, the annual national expenditure on solid waste management is estimated to more than R10 billion with an estimated 30% accounted for by the private sector and 70% by the public sector (Goldblatt, 2009).

Merely 10% of all waste produced was recycled in 2011 (DEA, 2012a). Waste management in South Africa is still heavily reliant on landfilling as a waste management option, with 90.1% of waste generated being disposed of to landfill in 2011. Unless properly managed waste has the potential to impact directly on human health and the environment (DWAF, 1997), whether it be ground or surface water, soil or air.

An assessment of the state of waste management in South Africa and local government's capacity in this regard, highlighted the following significant constraints (Goldblatt, 2009):

- Waste management capacity is inadequate and below international best practice levels;
- 87% of municipalities do not have the capacity or infrastructure to promote and practice waste minimisation;
- Approximately 80% of municipalities have started some form of recycling but cannot sustain these programmes mainly due to capacity constraints;
- All municipalities need to have policies that cater for poor people who cannot pay for their municipal services outside of the free collection that they are entitled to;
- The uncontrolled growth of informal settlements adds to unmanaged waste volumes and hence collection backlogs;
- Many municipalities do not regard waste management as a priority service and therefore do not allocate enough money in their budgets to this function; and
- Non-income generating waste services such as litter picking and clearing of illegal dump sites requires additional funding.

2.4 LEGISLATION AND LEGAL REQUIREMENTS PERTINENT TO WASTE MANAGEMENT AT PORTS IN SOUTH AFRICA

2.4.1 Introduction

TNPA RCB, as the generator of the waste, is responsible for all the regulatory conformances, classifications and identifications of the various waste streams. The TNPA shall further ensure that all procedures are followed and adhered to in accordance to the applicable legislation. The waste management practices of the TNPA RCB are governed by a wide array of legislation at an international, national, provincial and local level. The following sections provide a short summary of some of the most important legal requirements.

2.4.2 Constitution of South Africa Act, 108 of 1996

Waste management practices have the potential to cause pollution and adversely impact on human health. The Constitution of South Africa elevated environmental rights and redesigned the framework for environmental governance. The constitution:

- Establishes the right to an environment that is not harmful to human health and well-being;
- Establishes the right to have the environment protected through measures that promote conservation;
- Balances the right to have the environment protected with rights to valid social and economic development;
- Allocated environmental functions to a wide range of government agencies in all spheres; and
- Requires co-operation between government agencies and the various spheres of government.

The Constitution of the Republic of South Africa, 1996, provides for the establishment of three spheres of government, constituted as national, provincial and local. These spheres are distinctive, interdependent and interrelated. The three spheres have to exercise their powers and functions in such a manner that their policies and executive actions can be effectively coordinated to facilitate efficient service delivery. Government at national, provincial and local level is therefore obliged to take reasonable legislative, operational and other measures to ensure the environmental rights as stated are fulfilled.

2.4.3 The Environment Conservation Act, 73 of 1989 (ECA)

The Environment Conservation Act, 73 of 1989 was historically the main Act that governed waste disposal in South Africa. Most of the sections of the ECA have been repealed following the promulgation of the National Environmental Management Waste Act 59 of 2008.

Section 20(1) of the ECA stipulated that no person may establish or operate a disposal site without a permit. It is noted that many industries still hold S20 permits which will require to be issued as Waste Management Licenses when this is directed by the Minister of the Department of Environmental Affairs.

Regulations promulgated under the ECA with relevance to port waste management include-

- Waste Tyre Regulations,
- Regulations for the Prohibition of the Use, Manufacturing, Import and Export of Asbestos and Asbestos Containing Materials.

2.4.4 The National Environmental Management Act, 107 of 1998 (NEMA).

- The National Environmental Management Act, 108 of 1998 is the framework Act dealing with environmental management in South Africa and all organs of State are bound by this Act. Section 28 of NEMA Act contains a Duty of Care Provision which requires that-
- *Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.*

2.4.4 The National Environmental Management: Waste Act, 59 of 2008 (NEM: WA)

The National Environmental Management: Waste Act, 59 of 2008 commenced on 1 July 2009. The Act replaced waste management legislation that was dealt with under the ECA and now is the overarching legislation for waste management. A number of sections are applicable to TNPA, port users and tenants are detailed in the following subsections.

2.4.4.1 General Duty of TNPA

TNPA as holders of waste are required by Section 16 to take all reasonable measures to-

- (a) avoid the generation of waste and where such generation cannot be avoided, to minimize the toxicity and amounts of waste that are generated;
- (b) reduce, re-use, recycle and recover waste;
- (c) where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner;
- (d) manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour or visual impacts;
- (e) prevent any employee or any person under his or her supervision from contravening this Act; and
- (f) prevent the waste from being used for an unauthorized purpose.

2.4.4.2 Reduction, Re-use, Recycling and Recovery of Waste

Section 17 requires persons undertaking an activity involving the reduction, re-use, recycling or recovery of waste to use fewer natural resources and to use a process that causes less harm to the environment than the disposal of the waste.

2.4.4.3 Guiding Principles

Waste management at the TNPA is guided by a number of principles that are relevant to environmental management in general. Waste management has been widely adopted in both South African environmental legislation and international best practice. These guiding principles are highlighted as follows:-

- **Duty of Care:** Pollution and degradation of the environment must be avoided, or, where they cannot be altogether avoided, are minimized and remedied. This means that the waste generator, transporter, disposer or recycler must ensure that the waste is managed in such a manner that it does not impact on the environment.
- **Polluter Pays:** The costs of remedying pollution, environmental degradation and consequently adverse health effects of preventing, controlling or minimizing further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment. It is noted that it is not only the generator but the contractor who transports and disposes the waste that could be held responsible if the waste is not handled and disposed in a legally compliant manner.
- **Precautionary Principle:** That a risk-averse & cautious approach is applied which takes into account the limits of current knowledge about the consequences of

decisions and actions. The precautionary principle assumes that waste is highly hazardous until proven otherwise. Since the legislation is stricter for highly hazardous and toxic wastes, the costs of treatment and disposal are consequently higher than for wastes of low hazard potential. It is therefore obviously in the generator's interest to obtain the necessary information to prove that the material or waste product is of lesser hazard potential. The burden of proof shall always be on the generator of the waste in question.

- **Cradle to Grave:** The responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life-cycle. This requires having effective waste management from the point of generation, through handling, storage and transport to the final stage of disposal. The generator retains the ultimate responsibility for ensuring that waste is handled, stored, transported and disposed / recycled according to the relevant legal requirements and environmentally sound and responsible manner.

2.4.4.4 Waste Management Activities

In terms of section 69(1)(a), (b), (g), (h), (m), (q), (r), (s), (dd), and (ee) read with section 73 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) for implementation in the Schedule hereto, published a list of waste management activities that have, or are likely to have, a detrimental effect on the environment. Section 20 prescribes that these activities will be subject to obtaining a waste management licence or complying with a published norms and standards.

2.4.4.5 Storage, Collection and Transportation of Waste

Sections 21 to 25 deal with the storage, collection and transport of waste.

General requirements for storage of waste are provided which oblige persons storing waste to take, at a minimum, steps to ensure that-

(a) the containers in which any waste is stored, are intact and not corroded or in any other way rendered unfit for the safe storage of waste;

(b) adequate measures are taken to prevent accidental spillage or leaking;

(c) the waste cannot be blown away;

(d) nuisances such as odour, visual impacts and breeding of vectors do not arise; and

(e) pollution of the environment and harm to health are prevented.

Section 22 requires that a waste generator (TNPA) whose general waste is collected by a municipality, must place the waste in the waste container approved, designated or provided by the municipality for that purpose and in a location approved or authorised by the municipality and that waste that is reusable, recyclable or recoverable and that is intended to be reduced, re-used, recycled or recovered may not be placed in the said container.

Section 23 provides that persons may only collect waste for removal from premises if they are a municipality or municipal service provider, or if they are authorised to do so by law and only if they are not prohibited from collecting the waste.

The Minister may require any person or category of persons who transports waste for gain to-

(a) register with the relevant waste management officer in the Department, province or municipality, as the case may be; and

(b) furnish such information as is specified in that notice or as the waste management officer may reasonably require.

2.4.4.6 Contaminated Land

Extensive provisions pertaining to the identification and assessment of contaminated land are dealt with under Sections 35 to 41. The Minister or MEC may issue orders to remediate contaminated land and ownership of such land cannot be transferred without the notification of the Minister or MEC and compliance with any conditions that may be specified. The Minister is also required to maintain a national contaminated land register. The TNPA have submitted a contaminated land register to the Minister for the management and remediation of contaminated land within the ports boundaries.

2.4.4.7 Waste Management Licences

Sections 43 to 59 deal with the licensing process. Applications for waste management licences must be submitted to the licensing authority and the applicant must appoint an independent consultant to manage an application process. The TNPA prior to undertaking any of the listed waste management activities are required to undertake the licensing application process

2.4.4.8 Compliance and Enforcement

Compliance and enforcement is dealt with in terms of Chapter 7 of the Act. National Environmental Management Inspectors appointed in terms of NEMA may require any person to submit a waste impact report if there are reasonable grounds to suspect that such person has on one or more occasions contravened or failed to comply with this Act or any conditions of a waste management licence or exemption and that the contravention or failure has had or is likely to have a detrimental effect on health or the environment, including social conditions, economic conditions, ecological conditions or cultural heritage, or has contributed to the degradation of the environment.

The Act provides for a substantial number of offenses for failure to comply with the specified requirements for treatment and disposal of waste, licensing to undertake waste related activities and disposal at authorised sites.

2.4.4.9 Regulations and Standards

A number of regulations and standards have been published in terms of NEM: WA. The regulations listed below are pertinent to the TNPA as they form part of the framework in waste management. The regulations are minimum standards that the TNPA is required to adhere to.

- **National Waste Information Regulations:** These regulations took into effect on 1st January 2013 and require certain categories of persons to register on the South African Waste Information System (SAWIS) developed by the Department of Environmental Affairs (DEA) in 2005. This system is to be used by government and industry to capture routine data on the tonnages of waste generated, recycled and disposed of in South Africa on a monthly and annual basis. Generators will need to register only and will not be required to submit information to SAWIS. Other categories of persons however will be required to submit information to the SWAIC on a quarterly basis. TNPA will therefore need to register as a waste generator.
- **Waste Classification and Management Regulations:** The Waste Classification and Management Regulations developed in terms of section 69 of the National Environmental Management: Waste Act, 2008 (the Act) serve to regulate the classification and management of waste in a manner which supports and implements the provisions of the Act. The regulations will enable the improved and more efficient

classification and management of waste; provide for safe and appropriate handling, storage, recovery, reuse, recycling, treatment and disposal of waste and will also enable accurate and relevant reporting on waste generation and management.

2.4.4.10 Phasing out of PCBs and Asbestos containing material

The Civils' Department of the TNPA is responsible for maintaining infrastructure related to electricity supply including transformers. All the transformers have to be located and tested for PCBs. Certification of testing needs to be provided to or made available to the ports Environment Department. Transformers that are still containing PCBs need to be placed in a maintenance schedule to be processed and made PCB-free.

The TNPA has embarked on the project of replacing all asbestos containing material within its premises. This includes roofs equipment, fascia-boards and pipes. Building and Marine Department has been playing a leading role in this process. Asbestos containing materials have been replacing with cement fibre containing material.

2.4.5 National Environmental Management: Waste Amendment Act, 26 of 2014 (NEM: WAA)

National Environmental Management: Waste Amendment Act, 26 of 2014 On 2 June 2014 in Government Gazette 37714 Notice Number 449 the President assented to and published the National Environmental Management: Waste Amendment Act 26 of 2014 (NEM:WAA). The NEM: WAA came into operation on 2 June 2014.

The NEM: WAA amends the NEM: WA by amending the following sections which include but are not limited to:

- Definitions such as the deletion of “by-product”, the revision of “recovery” and “re-use” and the inclusion of a new definition for “waste”;
- Insertion of Chapter 3A which provides for the content and application of the pricing strategy for waste management charges;
- Insertion of Part 7A which establishes the Waste Management Bureau;
- Amendment of section 11 to exclude the Department from the spheres of government responsible for preparing integrated waste management plans;
- Provides for transitional provisions in respect of existing industry waste management plans; and
- Insertion of Schedule 3 on defined wastes.

2.4.6 The National Water Act, 36 of 1998 (NWA)

The National Water Act, 1998 deals with inter alia the protection of South Africa's water resources. The NWA defines waste as any solid material or material that is suspended, dissolved or transported in water (including sediment) and which is spilled or deposited on land or into a water resource in such volume, composition or manner as to cause, or to be reasonably likely to cause, the water resource to be polluted.

Along similar lines to NEMA, Section 19(1) of the NWA contains a pollution prevention requirement placing a pollution prevention duty on landowners, persons in control, users or occupiers of land to take all reasonable measures to prevent water pollution from occurring, continuing or recurring. This is significant to the TNPA as the TNPA are landowners of the ports in South Africa. The duty to ensure the protection of the port's marine environment lies with the TNPA.

There are some water uses relating to waste in section 21 of the NWA that require registration and or licensing. These include -

- Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit; and
- Disposing of waste in a manner which may detrimentally impact on a water resource.

Section 20 of the NWA deals with the management of emergency incidents. There are a number of legal requirements pertaining to reporting (immediate and post incident investigation) and clean up and investigation requirements. It is essential that waste management is addressed on emergency management plans.

2.4.7 National Environmental Management: Integrated Coastal Management Act, 24 of 2008 (NEM: ICMA)

The NEM: ICMA seeks to establish a system of integrated coastal and estuarine management in the South Africa by inter alia prohibiting incineration at sea, controlling dumping at sea and pollution in the coastal zone.

Section 70 of the Act prohibits the-

- Importation into the Republic any waste or other material to be dumped or to be incinerated at sea within the coastal waters or the exclusive economic zone.

- Exportation from the Republic any waste or other material to be dumped or incinerated- on the high seas; or in an area of the sea under the jurisdiction of another state.
- Loading of any waste or other material to be dumped or incinerated at sea onto any vessel, aircraft, platform or other structure any place in the Republic including the exclusive economic zone unless the master of the vessel, aircraft platform or other structure produces written proof that the dumping at sea of that waste or other material has been authorised in terms of a dumping permit.

Section 70 of the Act deals with dumping permits which must be applied for to dump waste or other material at sea. Section 70 is important to the TNPA as the TNPA conducts maintenance dredging at all the ports in South Africa. The permits are granted by the Minister subject to a set of criteria. Permits may not be issued for wastes other than:

- (a) Dredged material;
- (b) Sewage sludge;
- (c) Fish waste or material resulting from industrial processing operations;
- (d) Vessels and platforms or other man-made structures at sea;
- (e) Inert, inorganic geological;
- (f) Organic material of a natural origin; or
- (g) Bulky items primarily comprising iron, steel, concrete and other similarly non-harmful materials which the concern is physical impact and limited to those circumstances where such wastes are generated at locations such as small islands with isolated communities having no practical access to disposal options other than dumping at sea.

2.4.8 National Ports Act, 12 of 2005 (NPA)

The National Ports Act has relevance for waste management at ports as it places a responsibility on TNPA to ensure that the infrastructure of ports is managed and maintained in a manner which ensures efficient, safe and orderly port operations.

The following extracts are highlighted-

Section 57 deals with the licence requirements for port services and facilities. It is under this section that a licence is required to offer a waste management service within the port.

Section 65- Any person who provided a port service or operated a port facility immediately prior to the date on which this Chapter came into force, is deemed to hold a licence for the provision of such port service or the operation of such port facility, but such person must apply for a licence in terms of section 57 within six months of the date determined by the Shareholding Minister by notice in the Gazette.

Section 69(1) - The Authority must in the performance of its functions ensure that a fair and reasonable balance is achieved between the protection of the environment and the establishment, development and maintenance of ports.

Section 69(2) (a) - The Authority must ensure that sustainable and transparent port planning processes are undertaken when formulating any port development framework.

Section 69(2) (b) - When undertaking any port planning processes, the Authority must ensure that stakeholders are consulted and that all relevant biophysical and economic aspects are taken into account.

The National Ports Act entitles the Harbour Master to give such written or verbal instructions as may reasonably be necessary for:

- Regulating the removal or disposal of any residues and mixtures containing oil or noxious liquid substances, sewage and garbage from vessels in a port and requiring any such matter to be deposited in reception facilities in the port ; and
- The detention of a vessel reasonably suspected of causing oil pollution and ensuring that the total cost of the pollution clean-up operation is recovered, or acceptable guarantees are provided, prior to the vessel being given permission to leave the port.

2.4.9 The Port Rules

The Port Rules No. 255 of 2009 was approved in terms of section 80(2) of the National Ports Act no 12 of 2005 for the control, management of ports, the approaches thereto, for the maintenance of safety and security; good order and the protection of the ports environment.

The Ports Rules address a number of aspects of waste, including the minimisation of waste, roles and responsibilities, and the provision of reception facilities.

The following sections pertaining to waste management are highlighted.

- **Rule 18: Notice of arrival**
- Rule (1) the owner, master or agent of a vessel must give at least 72 hours' notice in writing of the arrival of a vessel at a port to the Harbour Master of that port.
- Rule 18(2) the notice must include-
- (m) any nuclear installations, radio-active or toxic material or waste, explosives, flammable liquids or other dangerous goods on board, in accordance with Rule 20.
- Additional notice content is provided in subsection (2).
- **Rule 20: Notice of weapons, explosives and other dangerous goods on board**
- Rule 20(1) The owner, master or an agent of a vessel having any radio-active or toxic material or waste, weapons, explosives, flammable liquids or other dangerous goods on board must give the Harbour Master and the terminal operator full written particulars of these items at least 72 hours before the arrival of the vessel at the port.
- The notice content is provided in subsection (2).
- **Rule 85: Prevention of pollution and protection of the environment**
- Rule 85(1) all persons within a port must take all reasonable steps to prevent/ minimize and mitigate pollution or damage to or degradation of the environment.
- Rule 85(2) any person who pollutes or causes damage to the environment will bear the costs associated with the combating and cleaning up of that pollution, damage or degradation, and the associated impacts relating thereto (Polluter Pays Principle).
- Rule 85(3) If the person or persons responsible for the pollution or damage to the environment fail to take the necessary measures to prevent, minimize, mitigate, combat and clean up the pollution or damage to the environment, including its associated impacts, the Authority may take the necessary measures. The person or persons who caused the pollution or damage to the environment will be liable for the costs associated with the pollution, damage or degradation to the environment, its associated impacts and any mitigating measures.
- **Rule 86: Deposit of harmful matter, including oil, in a port**
- Rule 86(1) No person may throw or deposit within the port limits any harmful matter or substance of whatsoever nature, including effluent or polluted water or foreign organisms without the permission of the Authority, and, in the case where it is to be thrown or deposited from a vessel, without the permission of the Harbour Master.

- Rule 86(2) No person may cause or allow pollutants, including paint, or cause or allow substances that can cause pollution or negatively impact on the environment, whether or not the substance or pollutant is of a mineral, animal or plant origin, to be dumped on the property of a port or to be discharged or to escape into waters within port limits.
- Rule 86(3) No oil of any description or harmful matter or substances of whatever nature, including effluent, polluted water or foreign organisms, may be discharged or dumped from a (a) Vessel or be allowed to escape from a vessel into any part of the port, or (b) terminal or any other source, or be allowed to escape into port waters from a terminal or any other source.
- Rule 86(4) The master of a vessel that is berthed alongside a quay or jetty must cause all the discharge outlets of the vessel facing the quay or jetty to be closed or to be provided with adequate covers to prevent any inadvertent discharge of water or effluent or substances onto the quay or jetty surface, bollards, moorings, telephone cables, fenders or hose connections or into the environment.
- Rule 86(5) the clean-up of pollutants, including oil, which is spilled within port limits, must be dealt with in accordance with the applicable Port Contingency Plan.
- Rule 86(6) If the spill straddles the area within port limits and areas falling outside port limits, the spill must be dealt with in accordance with the applicable Port Contingency Plan, and in the case of oil pollution management, the National Contingency Plan and any applicable legislation.
- Rule 86(7) A person who drops or deposits any article within port limits that might cause a danger, obstruction, pollution, a negative impact upon the environment or a nuisance, or any person who witnesses a person doing this, must report the matter to the Authority immediately.
- Rule 86(8) The owner or master of a vessel, terminal operator, lessee or port user that contravenes this rule, causing an obstruction in the port must immediately cause the obstruction to be removed at their expense, failing which the Authority may remove the obstruction at their expense. If any damage arises from the obstruction, the person responsible for it is liable for the costs relating to the damage.
- **Rule 88: Ballast water**

- The master of a vessel and any other person to whom the Port Ballast Waste Management Plan applies must comply with that plan. TNPA RCB has no Ballast Water Plan.
- **Rule 89: Port waste reception facilities**
- Rule 89(1) every terminal operator and master of a vessel must make use of the port's facilities for the reception of wastes from vessels.
- Rule 89(2) despite sub-rule (1), the Authority may require:
 - A terminal operator to provide or procure proper and adequate facilities from a licensed waste management operator for the reception of wastes from vessels using the port terminal.
 - The vessel's owner or master to provide or procure proper and adequate facilities from a licensed waste disposal service provider for the reception of wastes from vessel if the berth is not operated by a terminal operator.
- Rule 89(3) in assessing the adequacy of the waste reception facilities to be provided or to be procured, the terminal operator must have regard to the Port Waste Management Plan. The Authority may, by written notice or by verbal instruction, direct the terminal operator that does not have adequate waste reception facilities to provide or procure them within a specified period.
- Rule 89(4) despite the provisions of this rule, the owner or master of a vessel must arrange to dispose galley waste in accordance with the Port Waste Management Plan.
- **Rule 90: Compliance with Port Waste Management Plan**
- All persons, to whom the Port Waste Management Plan applies, including terminal operators and tenants, must comply with that plan.
- **Rule 91: Compliance with Vessel Waste Management Plan**
- The owner, master or agent of a vessel must comply with their Vessel Waste Management Plan.
- **Rule 92: Use of port waste reception facilities**
- Any waste reception facilities provided for a particular purpose by the terminal operator must be open for use for that purpose by all vessels using the terminal.
- **Rule 93: Discharge or dumping in a port of sewage or residue water as a result of hatch or tank cleaning**
- Rule 93(1) No vessel may discharge or dump sewage into port waters or any part of the port except into a facility dedicated for that purpose.

- Rule 93(2) No vessel may discharge or dump residue water into port waters as a result of hatch or tank cleaning without the written permission of the Harbour Master. The Harbour Master may impose conditions upon the granting of his or her permission.
- **Rule 94: Removal of vessels having offensive matter on board**
- Rule 94(1) The Harbour Master may order the removal of a vessel from a port if that vessel has cargo or other matter on board that may be a threat to the environment.
- Rule 94(2) At the expense of the owner or master of the vessel, the Harbour Master may order that the cargo or other matter be disposed of.

2.4.9 Animal Diseases Act, 35 of 1984

The Animal Diseases Act, 35 of 1984 came into operation on the 1st of October 1986. The Act places a duty upon the government to ensure that animal diseases and parasites do not spread and the measures that should be implemented to improve the health of animals. This is of particular importance to ports in South Africa as ports are classified as points of entry into the country.

In terms of the Animal Diseases Act, 1984 Regulation 24(1) (d)

- No person shall, for any purpose whatsoever, make available any infectious or contaminated thing originating from any conveyance entering the Republic from any place outside the Republic, other than that in respect of which a permit has been issued under section 6(1) of the Act; and 24 (3) an infectious or contaminated thing referred to in paragraph (1) shall at the place of entry be burnt in an incinerator, or be disposed of in any other manner which the director may determine.

The Act contains a list of controlled diseases. Once animals are tested positive for one of these diseases the Act prescribes specific measures that should be taken by the government, more specifically the relevant state veterinarian, and what measures should be introduced to ensure that the disease does not spread. Diseases on this list include the following amongst others:

- Foot-and-mouth disease (cloven hoofed animals)
- Newcastle disease (poultry and birds)
- Rabies (all animals)

- Salmonella (poultry and birds)
- Rinder Pest (cloven hoofed animals especially cattle)
- Tuberculosis (all animals except fish, reptiles and amphibians)

The Department of Agriculture, Forestry and Fisheries regard galley waste as an infection / contaminated thing (Appendix 4: Galley waste recommendation issued by Department Of Agriculture).

2.4.10 MARPOL Convention

South Africa is the signatory to the International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 relating thereto MARPOL 73/78. The MARPOL Convention is the universally accepted international convention covering prevention of pollution of the marine environment by ships from operational or accidental causes. It is a combination of two treaties adopted in 1973 and 1978 respectively and updated by amendments through the years. The combined instrument is referred to as the International Convention for the Prevention of Marine Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78), and it entered into force on 2 October 1983 (Annexes I and II). The Convention includes regulations aimed at preventing and minimizing pollution from ships - both accidental pollution and that from routine operations - and currently includes six technical Annexes:

Table 2.1: MARPOL WASTE ANNEXURES.

Annex I	Regulations for the Prevention of Pollution by Oil
Annex II	Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
Annex III	Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
Annex IV	Prevention of Pollution by Sewage from Ships

Annex V	Prevention of Pollution by Garbage from Ships
Annex VI	Prevention of Air Pollution from Ships

[http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-\(marpol\).aspx](http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-(marpol).aspx) Accessed: November 2012.

Under the provisions of the Convention, the international community of maritime states is mandated to put in place measures to ensure that ships do not engage in the unacceptable practice of discharging their waste and cargo residues at sea. MARPOL 73/78 prescribes that there must be a properly planned, easy-to-use and cost-effective system to manage incoming waste streams at the reception facilities of all operational ports.

The requirements of the MARPOL convention are addressed through various pieces of South African legislation, including (but not limited to) Marine Pollution (Prevention of Pollution from Ships) Act 2 of 1986, and the Reception Facilities for Garbage from Ships Regulations, (GNR 1491, 1992). In order to fulfil its obligations under the Convention, South Africa has delegated the responsibility by means of the National Ports Act and the Port Rules, to provide adequate ship generated Waste Reception Facilities to harbours, ports and terminals without causing any undue delay to ships and according to the needs of the ships using them.

2.4.11 The Basel Convention

The Basel Convention is a global agreement which seeks to address the trans-boundary movement of hazardous waste. The convention is centred on the reduction of the production of the production of hazardous waste and restriction of trans-boundary movement and disposal of such waste. It also aims at ensuring that strict controls are in place when any trans-boundary movement and disposal of hazardous waste does occur, and ensures that it is undertaken in an environmentally sound and responsible manner.

The Basil Convention, held on 22 March 1989, came into effect during May 1992 after ratification by the prerequisite number of countries. South Africa ratified the convention in 1994, with DEA being the focal point for the convention.

Whilst South Africa subsequently acceded to this convention, no legislation was passed at the time to give effect to it. The second Basel Convention held on 08 October 2005, set standards

for the control of trans-boundary movements of hazardous wastes and their disposal between member countries. South Africa accedes to this convention and implements its provisions.

The key objectives of the Basel Convention are:-

- To minimize the generation of hazardous wastes in terms of quantity and hazardousness;
- To dispose of hazardous waste as close to the source of generation as possible;
- To reduce the movement of hazardous waste; and
- Locally, draft regulations are being prepared in an effort to control the movement of such waste.

The most significant provisions of the convention relate to the ban on certain importations and exportations, illegal traffic, bilateral, multilateral and regional agreements and the control system of the convention.

2.4.12 The London Convention

The London Convention on the Prevention of Marine Pollution by Dumping of Waste and Other Matter (1972) aims at preventing marine pollution by preventing dumping of wastes such as industrial waste, sewage sludge, dredged material and radioactive waste at sea, as well as incineration at sea. South Africa is a signatory to the convention and the associated 1996 Protocol.

This convention and its various protocols were incorporated into the following South African legislations:

- Prevention of Pollution from Ships Act (Act 2 of 1986), and the regulations concerning the Prevention of Pollution by Garbage from Ships regulations (GN R140, published in Government Gazette No. 14000, dated 29 May 1992).
- The Dumping at Sea Control Act (Act 73 of 1980).

The primary responsible agency is the DEA Sub-Directorate of General Oceans and Coasts who issue permits for dredge spoils and sinking of old vessels. It occasionally issues permits for ships in trouble, typically grounded, to release their cargo into the sea.

2.4.13 The Stockholm Convention

The Stockholm convention is a global treaty to protect human health and the environment from persistent organic pollutants (POPs). **POPs are chemicals** that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to humans and wildlife (DEA, 2012b). POPs circulate globally and can cause damage wherever they travel. In implementing the Convention, Governments will take measures to eliminate or reduce the release of POPs into the environment (DEA, 2012b).

The Convention entered into force, on 17 May 2004, 90 days after the ratification by the fiftieth country. South Africa ratified the Convention on the 23 May 2001 and became a party on 4 September 2002 (DEA, 2012b).

The Stockholm Convention has five essential aims:

Eliminate dangerous POPs, starting with the 12 worst;

Support the transition to safer alternatives;

Target additional POPs for action;

Clean-up old stockpiles and equipment containing POPs;

Work together for a POPs-free future (DEA, 2012b).

2.4.14 Montreal Protocol on Substances that Deplete the Ozone Layer under the Convention

The Montreal Protocol on Substances that Deplete the Ozone Layer was designed to enable specific actions to control ozone-depleting substances. The Protocol was agreed to on 16 September 1987 and entered into force on 1 January 1989.

A unique adjustment provision under the Montreal Protocol enables the parties to the Protocol to agree to accelerate the reductions required on chemicals already covered by the Protocol in response to new scientific information available. The adjustments are automatically applicable to countries that ratified the Protocol.

2.4.15 Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade

The Rotterdam Convention is a multilateral treaty. It promotes shared responsibilities in relation to the import of hazardous chemicals and an open exchange of information. It calls on the exporters of hazardous chemicals to make use of proper labelling, include directions on safe handling, and inform purchasers of any known restrictions or bans.

Signatory nations can decide whether to allow or ban the import of chemicals listed in the treaty. Exporting countries are obliged to ensure that producers within their jurisdiction comply with their responsibilities.

2.4.16 The Minamata Convention on Mercury

The Minamata Convention on Mercury is a global treaty to protect human health and the environment from the adverse effects of mercury. Mercury is recognized as a substance producing significant adverse neurological and other health effects, with particular concerns expressed about its harmful effects on unborn children and infants. The global transport of mercury in the environment was a key reason for taking the decision that global action to address the problem of mercury pollution was required.

2.4.17 Ballast Water Management Convention (BWM)

The IMO developed and adopted “The International Convention for The Control and Management of Ships Ballast Water Ballast Water and Sediments, 2004’ with the aim of protecting the marine environment from the transfer of harmful aquatic organisms in ballast water carried by ships. The BWM prevents harm to the environment by establishing standards and procedures for the management and control of ships' ballast water and sediments. The Convention is divided into Articles; and an Annex which includes technical standards and requirements in the Regulations for the control and management of ships' ballast water and sediments. Due to the absence of ballast water management legislation in South Africa, TNPA requests vessels to comply with the BWM (TNPA, NWMS, 2014).

2.4.18 TNPA Waste Management Strategy

The Bill of Rights under section 24 of the Constitution of South Africa, states that, ‘everyone has a right to an environmental that is not harmful to their health and well-being and also to have the environment protected for the benefit of the present and future generations. Therefore, the TNPA has committed to waste management that is environmentally, socially and economically sound. This TNPA waste management strategy (WMS) has been designed

ensure consistency and efficiency within the TNPA, but does not overlook port specific dynamics.

This document serves as a guideline for ports to develop waste management plans specific to the port and other associated documentation. The review of existing waste management strategies and plans is essential in order to include and update the new principles of the TPNA Waste management strategy.

This WMS aims to avoid waste generation and if not possible, to ensure that the handling, storage, transport, treatment and disposal for waste generated or legally received at the national ports is environmentally, socially and economically sound. TNPA promotes integrated waste management to its stakeholders, especially the ones operating within port boundaries. The main objective of the 2014 TNPA WMS is to provide a framework within which waste can be managed effectively to minimise or avoid adverse impacts on the environment within the TNPA, as far as practical by:

- Ensuring compliance with relevant applicable legislation;
- Implementing national and international waste management principles and practices;
- Promoting and facilitating integrated waste management;
- Promote education and awareness to all employees at different levels;
- Improve cost effectiveness of waste management (Avoid, reuse, reduce, recycle, reprocess and treat);
- Promotion of more efficient use and conservation of resource particularly non-renewable resources;
- Promote recycling of appropriate waste streams;
- Provide adequate and effective waste reception facilities and services;
- Ensure service quality and efficiency;
- Ensure continual improvement by setting meaningful and measureable objectives relating to waste management which are continuously reviewed and improved realistically.

It should be noted that this WMS, in line with the NEM: WA, 2008 does not provide measures for the following classes of waste, which the port may under exceptional circumstances be required and/or requested to manage:

- Radioactive wastes that are regulated by the Hazardous Substances Act, 1973 (Act No. 15 of 1973), the National Nuclear Regulator Act, 1999 (Act No. 47 of 1999), and the Nuclear Energy Act, 1999 (Act No. 46 of 1999);
- Residue deposits and residue stockpiles that are regulated under the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002);
- The disposal of explosives, regulated by the Explosives Act, 2003 (Act No. 15 of 2003);
- The disposal of animal carcasses that is regulated by the Animal Health Act, 2002.

2.5 IMPACTS OF WASTE ON THE RECEIVING ENVIRONMENT AT PORTS

Waste is generated within a port from four main sources namely; operational and domestic waste from ships and boats, waste from commercial cargo activities, waste generated from maintenance activities and associated maritime industry activities and domestic waste generated by port employees and users. The types of waste generated from these four sources are indicated below in table 2.2.

Table 2.2: Types of waste generated within ports

Type of waste	Hazard Classification
Metal/Scrap	General/ Recyclable
Organic Waste. Domestic (Perishables)	General
Plastics	General
Glass	General
Paper & Cardboard	General
Wood Waste	General
Empty Drums	General/ Hazardous
Building Rubble And Demolition Waste (Excluding Asbestos Containing Materials)	General
Waste Oil And Grease	Hazardous
Local Vessel Waste International: General	General
Local and International Vessel Waste: Oil	Hazardous
Local Vessel Waste: Gas Cylinders	Hazardous
International vessel: Galley	Hazardous
Asbestos Containing Waste	Hazardous
Batteries	Hazardous

Fluorescent Tubes And/or Mercury Vapour Lamps	Hazardous
Sandblasting Waste	Hazardous
Radioactive Substances	Hazardous
Lead	Hazardous
Contaminated Soil	Hazardous
Medical (General)	Hazardous
Electrical Transformer Oils	Hazardous
Tyres/Fenders	General
Ropes/ Working Lines From Tugs	General
Used Electrical And Electronic Equipment (E- Waste)	Hazardous
Scrap Conveyor Belts	General or Hazardous (depending on material transported, and degree of impregnation with such material)
Sewage And Grey Water	Hazardous
Sanitary Waste	Hazardous
Cargo spillages	General or hazardous (depending on the cargo being imported/exported)

2.5.1 Effects of general waste on the marine environment

General waste enters the port environment through numerous pathways. General waste enters the ports through overboard dumping from ships and boats and through waste generated within the operational areas of the port such as maritime industries and port users (Galgani, 2013). General waste can also enter the port through rivers, streams and adjacent city storm water systems (ABP Research, 1999).

Inadequate waste reception facilities may discourage port users from disposing of their litter responsibly, and may lead to general waste being disposed both onshore and offshore (Ng *et al.*, 2010).

It is the disposal of non-biodegradable items, particularly plastics, that poses a growing threat to marine life. The strength and durability of plastics make them very persistent, and they can be transported by currents and winds, sometimes great distances, to form accumulations of litter along certain beaches and other sinks (ABP Research, 1999). The following are potential impacts of general waste on the environment:

- Larger pieces of debris, such as sheets of plastic, may cause suffocating of benthic animals and plants in intertidal and sub tidal habitats and abrasion of debris against hard sediment surfaces may cause damage.
- Plastic litter, including litter from ships and on shore operational areas such as plastic bags and strapping bands, can have adverse effects on birds and marine mammals, including dolphins and seals, as a result of entanglement and ingestion.
- Floating general waste can also provide a means of transportation for harmful aquatic organisms (Derraik, 2002).

2.5.2 Effects of oily waste on the marine environment

There are numerous ways that oil may be introduced into the marine environment, including operational, accidental and illegal discharges from shipping accidents resulting in major oil spills, dumping of industrial wastes by land base activities, sewage and industrial discharges and atmospheric deposition (Ng *et al.*, 2010). For ports and harbours located within urbanised areas, all of these sources are likely to occur (Fleisher, 2010). For many estuaries, inlets or bays chronic inputs (for example recurring sewage and industrial effluents) are the most important source of oils.

Marine faunae and florae tend to be tolerant of low level concentrations of oil in sediments from chronic or small releases; however this is not always the case (ABP Research, 1999). Exposure to major and minor oil spills can lead to the mass mortality of benthic communities, marine fauna/flora and birds. Inversely, the effects of oil spills on marine habitats and species can often be temporary and non-fatal (Farrington, 2014). Contamination of sediments with oil may change chemical, physical and biological processes. Contaminants can be trapped in the sediments and later released as a result of disturbance, such as erosion (Fleisher, 2010). In sediments, as it is organic, oil will be broken-down relatively quickly by micro-organisms which may result in the localised removal of oxygen from the sediments and surrounding water with possible effects on marine life (ABP Research, 1999). The persistent toxic constituents of oil, such as heavy metals, can become stored in the sediments and taken up into the food chain (Farrington, 2014). Therefore, following large oil spills, even where animals recover in diversity and density, they may continue to suffer physiological and behavioural disorders which can result in reduction of growth and reproduction, and in the worse cases, death (ABP Research, 1999). The decomposition of oil tends to be slowest in

intertidal areas, which leads to the highest concentrations and longest residence times (Farrington, 2014).

2.5.3 Effects of sewage waste on the marine environment

Raw sewage that enters the marine environment can contain harmful pathogens. The releases of raw sewage can occur from leakages or spillages from septic systems. Maritime discharge of sewage can harm the environment and people by contaminating seafood, and transmitting diseases to water users (MARPOL, 73/78).

Sewage can contain disease causing bacteria and viruses which pose a risk to public health for swimmers and those eating contaminated shellfish (Fleisher, 2010). Sewage discharges also contain nutrients which when elevated may increase algal and plant growth under certain background conditions. However, when present in high concentrations nutrients can be responsible for the formation of algal blooms which reduce light penetration through the water column that may produce toxins and can cause oxygen depletion when decomposition takes place (ABP Research, 1999).

The primary sources of sewage waste pollution can be grouped into two categories, depending on the point of origin:

Point source pollution refers to contaminants that enter the waterway or water body through a single site. Examples of this includes discharge of either untreated sewage or wastewater from a sewage treatment plant, industrial effluent, leaking underground tanks, or any other discrete sources of nutrients, toxins or waste (GESAMP, 2001).

Non-point source pollution refers to contamination that does not originate from single source, but is often cumulative effect of small amounts of contaminants (such as nutrients, toxins, or wastes) gathered from a large area (GESAMP, 2001).

Estuaries and coastal waters also receive large quantities of pollutants from upstream sources. Industrial and municipal plants discharge into rivers that flow into estuaries. Non-point runoff is also a major contributor of pollutants to rivers (GESAMP, 2001).

2.5.4 Effects of ballast water on the marine environment

Ballast is defined as any solid or liquid that is brought on board a vessel to increase the draft, change the trim and regulate the stability or to maintain stress loads within acceptable limits (Davidson & Simkanin, 2012).

The movement of vessels around the world requires the intake of ballast water to give them a safe degree of stability when light. This disposal of water, when it takes place within ports and harbours is classed as a waste product (Davidson & Simkanin, 2012). The ballast water that is disposed of may contain a variety of harmful substances, including in certain cases oil contaminants, non-native marine animals and plants, and disease causing organisms in sewage contaminated water (Wenning, 2007).

This introduction of non-native species is considered to be one of the five major threats to marine biodiversity identified in the Convention of Biodiversity (Davidson, 2012). The introduction of non-native species from ships' ballast water, in addition to other sources, is a matter that is causing increasing concern and is a potentially serious, but highly unpredictable problem, in all coastal marine ecosystems. The effects of introducing new animal and plants can be almost undetectable, or conversely they can completely dominate and displace native communities (Wenning, 2007).

TNPA does not have facilities and/or areas to provide for ballast discharge within any the ports system (TNPA, NWMS, 2014). TNPA requires vessels wanting to undertake ballast water exchange comply to Regulation B-4 ballast water exchange of the Ballast Water Management Convention, adopted in 2004, which states all ships using ballast water exchange should: whenever possible, conduct ballast water exchange at least 200 nautical miles from the nearest land and in water at least 200 metres in depth, taking into account Guidelines developed by IMO; in cases where the ship is unable to conduct ballast water exchange as above, this should be as far from the nearest land as possible, and in all cases at least 50 nautical miles from the nearest land and in water at least 200 metres in depth (TNPA, NWMS, 2014).

2.5.5 Effects of galley waste on the marine environment

Galley waste is defined as ship board kitchen waste materials from a vessel. Galley waste includes galley and accommodation refuse including non-washable items which may have been in contact with such wastes and organic waste which may constitute a health risk (TNPA, NWMS, 2014).

Galley waste can contain hazardous microbial, chemical or physical agents. Furthermore, those may harbour infectious agents. Unsafe management and disposal of ship wastes can readily lead to adverse health consequences. Food wastes and refuse readily attract disease vectors including rodents, flies and cockroaches (Swamy, 2012).

Humans can become exposed directly, both on ship and at port, due to contact with waste that is not being managed in a safe manner. Exposure can also occur via the environmental transfer of disease-causing organisms or harmful substances due to unsafe disposal (Swamy, 2012). However, waste can be managed and disposed of in ways that prevent harm from occurring. Risks of harm arising due to improperly managed galley waste are increasing with the increasing number of ships in service and the increase in shoreline habitation (Mohee *et al.*, 2012) In South Africa, galley waste classified as quarantine waste in 2000 due to the outbreak of foot and mouth disease in Kwa-Zulu Natal. According to the recommendation issued by the Department of Agriculture, galley waste is to be treated with lime and disposed at a H: H landfill site (Appendix 4).

2.6 WASTE MANAGEMENT ROLES AND RESPONSIBILITIES AT PORTS IN SOUTH AFRICA

- **Transnet National Ports Authority**

TNPA has the responsibility to manage waste associated with its operational activities. This includes waste from TNPA offices, depot, port control, vacant sites and other public areas within the port limits (TNPA WMP, 2012).

TNPA is the landlord of the ports in South Africa, as such TNPA is responsible for ensuring that the port does not become contaminated as a result of poor waste management practices or any other reason, and must ensure that adequate processes are available for the removal of waste. In practice this will be achieved through the delegation of responsibilities to waste generators, for example tenants are responsible for the management of waste. Like any other stakeholder within the port, TNPA also has a responsibility to minimise waste generated as a result of its own activities (TNPA WMP, 2012).

To ensure proper management of its operational activities generated waste, the following are implemented:

- Procedures for handling of waste were developed and communicated to different business units;
- Appointed waste contractors to remove and dispose of waste for TNPA operational activities;

- A service level agreement with the waste contractor prior to commencement with the work; and
- Regular inspections or audits of waste storage areas for TNPA operations within the port, waste management contractors from the transportation of wastes to their final re-use, recycling and/or disposal and audit of treatment, recycling and disposal facilities.
- **Tenants**

All tenants have to manage all waste generated within the operational area under their leased areas as provided for in their respective lease agreements signed with TNPA. All waste handling has to be contracted to TNPA licensed service providers as the licensing process has been effected as provided for, in the NPA. Criteria used to licence waste service providers include but not limited to:

- compliance with the provisions of the NPA, in particular sections 58 to 64, and all other relevant legislation;
- compliance with any Regulations adopted in terms of section 80(1) of the Act;
- compliance with the Port Rules for the commercial ports of South Africa, adopted in terms of section 80(2) of the Act and with the Harbour Master's Written Instructions and the Authority's Written Instructions;
- Compliance with all other applicable legislation and generally the requirement to conduct its waste disposal services in accordance with the law (TNPA WDL, 2012).

Tenants also have the responsibility for the maintenance of good waste management practices. The responsibilities for tenants include the following;

- Complying with all waste related legislation, policies and procedures;
- Complying with the TNPA WMP as per the Port Rules and / or Lease Agreement entered into with TNPA;
- Ensuring that their waste is transported by an approved/ licensed carrier/operator and destined for and disposed of at a licensed disposal facility for the waste type involved or destined for and accepted at licensed and approved premises for further use or processing;
- Minimise waste in accordance with the accepted hierarchy of sanitary and effective waste management (reduce, reuse, recycle, dispose);

- Ensuring that goods and materials are handled and stored in a manner designed to avoid/minimise damage and prevent deterioration in quality or sanitary condition;
- Segregating waste to ensure that waste types are recorded / logged to minimise wastage of resources;
- Observing ‘good housekeeping practices’ in all their daily operational activities;
- Appointing waste contractors to manage waste and ensure that waste is recycled or disposed of in an approved site;
- To control littering in all its forms, to use the litter bins and to encourage their use as this is the responsibility of all persons entering or leaving the port area; and
- Tenants are required to develop a waste management process as part of their Environmental Management Plan to be approved by TNPA (TNPA, WMP 2012).

2.7 PORT OF RICHARDS BAY

The port of Richards Bay is one of the world's leading deep-water ports, which was originally established as a bulk port to export coal. It now efficiently handles in excess of 80 million tons of cargo per annum, representing approximately 57 % of South Africa's seaborne cargo making it the country's leading port in terms of volume handled (Townsend, 2003). In terms of land and water surface, the port comprises of 2 157 hectares of land surface and 1 443 hectares of water surface, making it the largest in South Africa, with only 40 % of that land developed to date, thereby furthering the potential for future port-related development. Over and above being South Africa's largest bulk export and import harbour, the port has developed and diversified into other forms of cargo handling over the years (see layout in figure 2.2 below). High speed, volume cargo handling and a fast turnaround of vessels are possible with the ample storage facilities and the port's six cargo-handling terminals that include:

- Richards Bay Coal Terminal, the world's largest single steam coal exporting company, with the capacity to export 72 million tonnes per annum;
- The Dry Bulk Terminal that imports and exports a wide variety of ores, minerals and woodchips. A conveyor belt network of 43 kilometres is linked to six harbour-bound industries;
- The Multi-Purpose Terminal handles various cargoes, such as Ferro alloys, pig iron, steel, forest products, granite, aluminium, bagged cargo, pitch coke, containers, heavy lifts, scrap steel and abnormal loads;

- Island View Storage handles a wide range of bulk liquids and liquefied gases such as propylene, ammonia, octane, acetone and butadiene;
- Richards Bay Bunker Terminal imports bunker fuel oils from Durban and Cape Town;
- The Sasol Agribulk Terminal exports phosphoric acid direct from the manufacturer through a pipeline to the tankers.

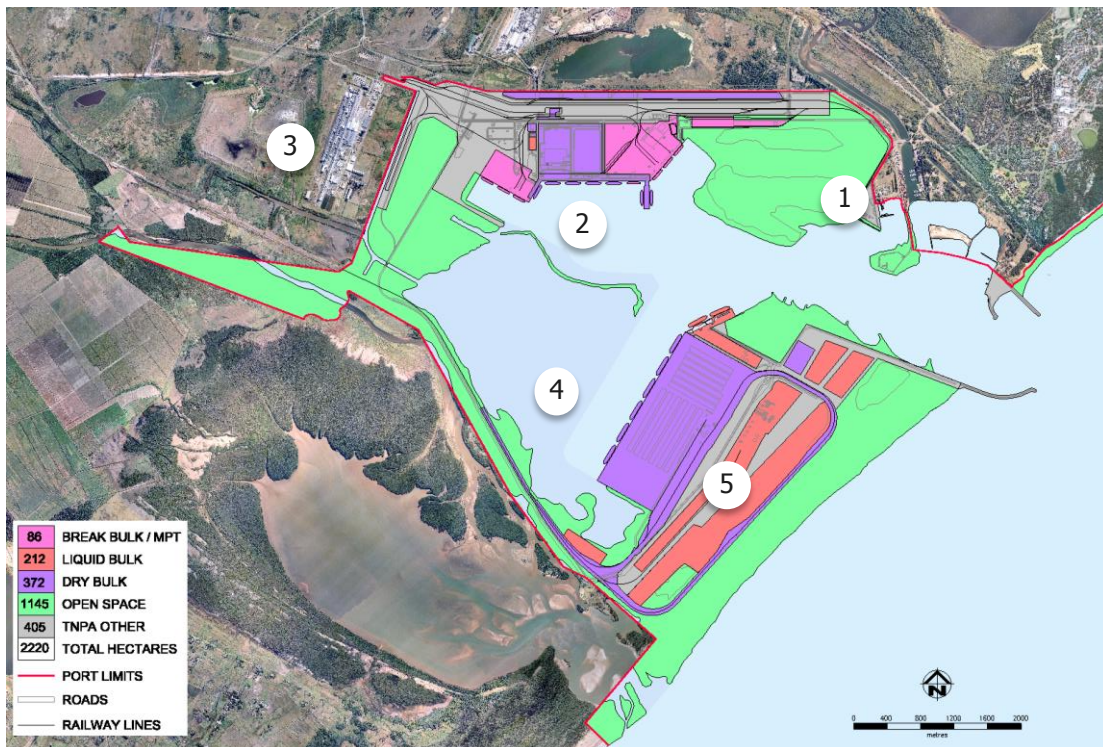


Figure 2.2: Port of Richards Bay current layout (Source: RCB Planning department, 2012).

1.	Umhlatuzi waterfront
2.	Dry bulk and multi-purpose terminal
3.	Bayside smelter
4.	Richards Bay coal terminal
5.	South Dunes Precinct (die duine, South dunes)

The National Ports Authority (NPA) is actively pursuing further planning and development through a Port and Development Framework (PDF) that will guide the expansion of the port in the short as well as long term (Transnet LTPF, 2012).

- **Short-term developments**

The Richards Bay Capacity Development Plan is preparing plans which will guide future development of the dry bulk and multi-purpose operations in the port. This will increase capacity from 14 to 24 million tonnes per annum (Mtpa), with the provision of a rail balloon, new terminal equipment, storage areas, rail infrastructure, and rationalised terminal operations (Transnet LTPF, 2012).

A new coal export terminal is also included with capacity, at 600 series berths initially, with potential to locate to a new site at Die Duine, with new berths. Liquid bulk capacity will be increased through the completion of berth 208 and additional storage area, providing an opportunity for a second operator (Transnet LTPF, 2012).

- **Medium-term layout**

The capacity of the coal export terminal will be increased through ongoing corridor expansion and operational efficiencies. Dry bulk capacity will be increased in the medium term through an extension to the finger jetty to create two additional berths. Break bulk expansion will be at the 700-series, with berths 709 to 711, and then 712 to 714 providing for future needs (Transnet LTPF, 2012).

A proposed deepening of the repair quay will enable its use for handling vessels and citrus exports (Transnet LTPF, 2012).

The development of ship repair facilities, including a new graving dock, could take place in the medium term. This operation could be sited adjacent the small craft harbour, or on a preferred site on the opposite side of the bay, where the impact on the CBD and on other port expansions would be minimised (Transnet LTPF, 2012).

- **Long-term layout**

The long-term layout for the port shows the potential for development through a series of new basins accessed by a new channel. The layout attempts to maximise on good founding conditions to the north of the channel, and avoid unbuildable areas of hippo mud to the south. This development will require extensive realignment of both road and rail infrastructure, and careful consideration of environmentally sensitive areas (Transnet LTPF, 2012).

This expansion will provide for the long-term requirements of all cargoes and port operations.

The long-term layout also shows the comprehensive development of the Die Duine, Bayside and Umhlatuzi precincts, and indicates a fully developed port capable of providing, in a complementary pairing with Durban, for the very long-term needs of the South African ports system's eastern region (Transnet LTPF, 2012).

The above stated plans (short, medium, long term) will not only have a direct impact on the receiving environment (fauna, flora and marine) but will also result in increases of waste generation within the TNPA RCB because of the increased economic activity. It is therefore required that TNPA RCB sets the standard for sustainable waste management at the earliest time to mitigate the impacts of waste on the receiving environment during the implementation of the above mentioned plans.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 METHODOLOGY

Nothing was known prior to the study regarding the types and quantity of waste or waste habits of individuals at TNPA RCB. Also unknown prior to the study was the portion of waste produced that could be diverted from the landfill, and also what materials were being disposed of properly. The researcher used questionnaires, audits, and interviews and carried out documentation reviews to determine these aspects.

Questionnaires and interview were used to gather information on the perceptions and attitudes of the staff at TNPA RCB, regarding waste management. Documentation review and site inspections were carried out to establish the level of compliance and the effectiveness of waste management at TNPA RCB. Figure 3.1 below provides the steps of activities undertaken by the researcher to understand the waste management practices at TNPA RCB.

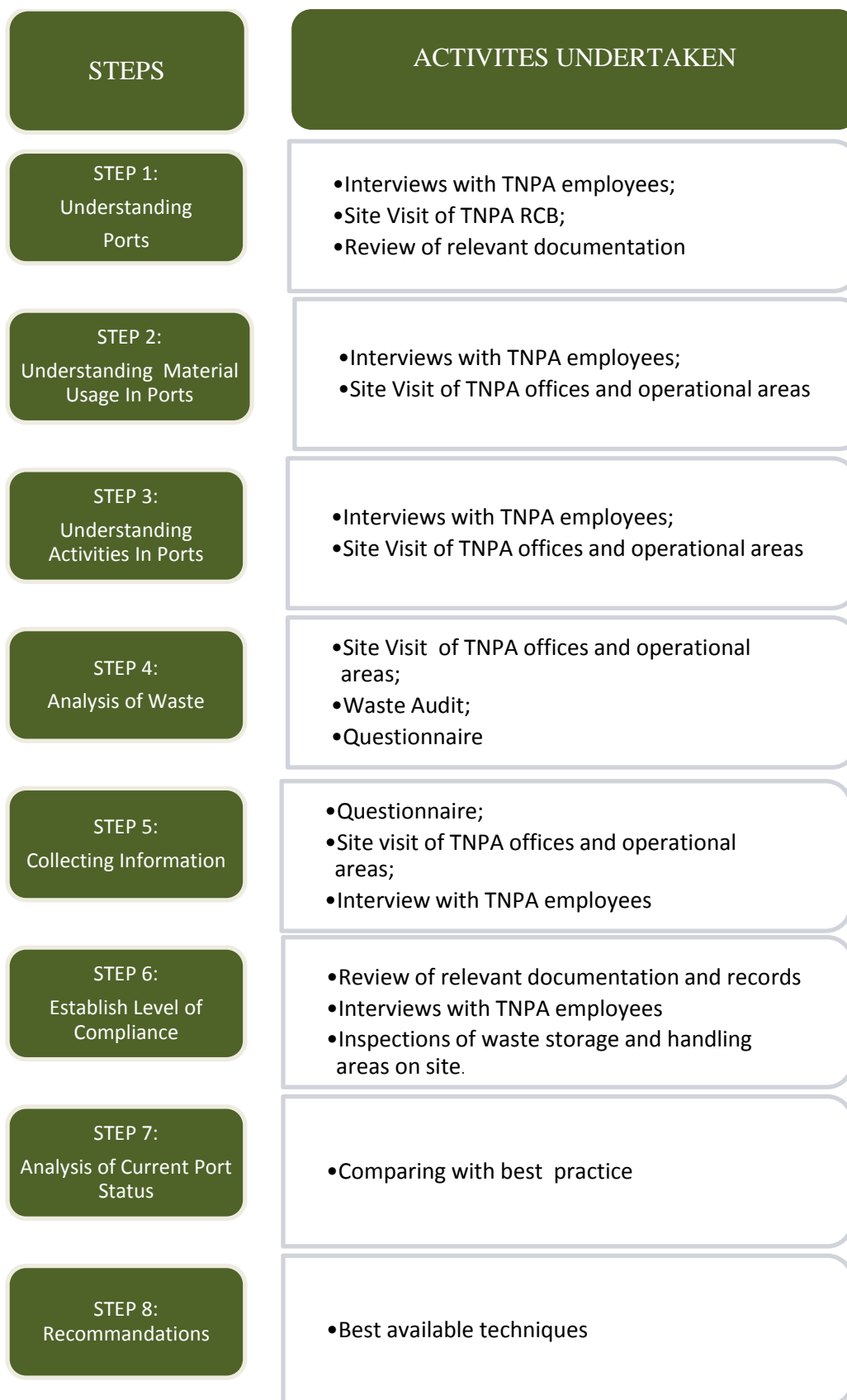


Figure 3.1 Organisation of activities used in the determination of waste management practices at TNPA RCB.

3.2 REVIEW OF BACKGROUND INFORMATION ON WASTE MANAGEMENT AT SOUTH AFRICAN PORTS

Literature was reviewed throughout the course of the research to gain an understanding of waste management practises in ports.

The following were reviewed in order to gain understanding of TNPA RCB practices and an in-depth knowledge of the research, the following were reviewed:

Literature on:

- International environmental legal waste requirements;
- National, provincial and local legal waste requirements;
- South African ports systems;
- Waste management practices in South Africa;
- TNPA RCB.

Waste Management Acts, Policies, journal articles and relevant reports on waste management were sourced to determine the research framework, waste audit methodology and questionnaire design. The TNPA RCB is in ownership of an Environmental Legal Register which was used to acquire knowledge about all the Environmental Laws pertaining to ports in South Africa.

3.2.1 SITE INVESTIGATION

An initial walk about of the site was undertaken to become familiar with the layout and internal activities in the offices, workshops and various places of work. A series of site visits were made to collect data by observing, talking to people, and collecting samples of waste they had generated. The site visits gave an insight into what actually happens at TNPA RCB, ports and the culture of staff members in context to the intention of the study.

3.2.2 AUDIT PROCESS

An audit can be defined as being a ‘systematic, independent and documented verification process of objectively obtaining and evaluating audit evidence to determine whether specified criteria are met’ (DEC NSW, 2006). The audit process can be categorised into three activities, namely pre-site visit activities, on-site activities and post-site visit activities (DEC NSW, 2006).

These activities are illustrated in figure 3.2 below:

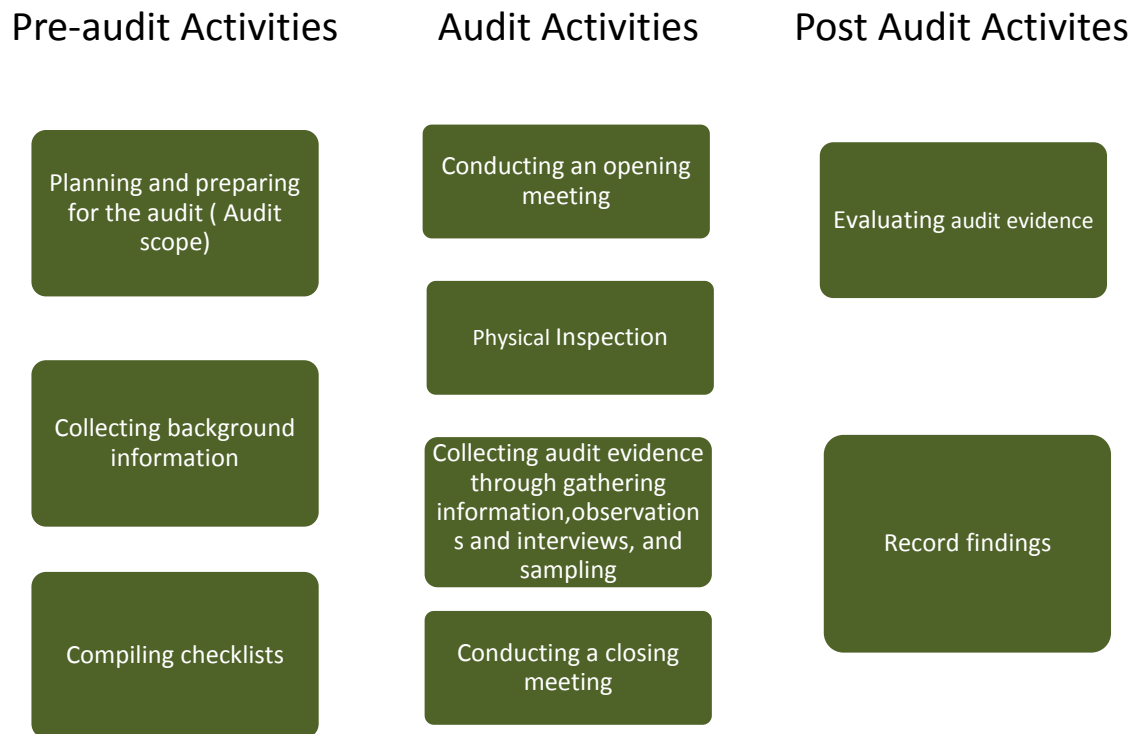


Figure 3.2 Audit Activities for the port of RCB.

3.3 WASTE COMPLIANCE AUDIT

Compliance to environmental legal requirements is one of the critical phases identified in the TNPA WMS. The waste management legislation is continuously evolving in South Africa, and TNPA needs to identify new legal obligations and risks, and also ensure compliance at all times. The complexity is also compounded by international requirements such as MARPOL, the BASIL Convention and London Convention.

3.3.1 PRE-AUDIT ACTIVITIES

The existing TNPA safety, health and environment (SHE) legal register was used to identify the pieces of national and international legislation applicable to waste management within TNPA RCB. The SHE legal register is a software solution which includes references to all legal requirements that place an obligation or prohibition on the organization based on that organization operations and/or activities.

An initial meeting was undertaken with the TNPA RCB environmental team and senior staff to inform them of the waste compliance audit. During the planning phase, members of the TNPA Environmental team were briefed on the objectives and purpose of the waste compliance audit. The following objectives were discussed with the TNPA environmental team:

- Ascertaining the extent to which TNPA's waste management at port of RCB complies with applicable National and International Waste Legal requirements;
- To identify areas of risk requiring attention (e.g. fines, litigation or penalties for short & long-term waste management risks);
- To identify gaps in the existing waste management practices at port of RCB and to furnish best practice solutions to the identified gaps; and
- To make recommendations to TNPA so as to ensure and maintain compliance with relevant local and international waste management legislative requirements TNPA RCB.

From the meeting with TNPA RCB environmental team and staff, it was agreed that all waste legal contraventions identified by the researcher will not be provided in detail in the researchers' dissertation but rather listed in statistics/numerical data. The researcher carried out a desktop study of the TNPA SHE legal register to identify all pieces of legislation that is pertinent to waste management at the port of RCB. From the desktop study of the TNPA SHE legal register the researcher created a waste compliance audit checklist.

An initial walk about survey was conducted on February 4, 2014 with the TNPA Environmental Team, the following were identified:

- Different types and quantities of waste produced by TNPA RCB (Hazardous/General);
- Existing waste storage areas;
- Different waste receptacles.

The documentation listed in table 3.1 was reviewed prior to the audit, on site on the day of the audit, and immediately post the audit. Where documents that were required to be available on site could not be accessed, it was noted in the findings.

Table 3.1: Documents reviewed for the Waste Audit.

Title	Location / sourced from
TNPA National Waste Management Strategy (2009)	Electronic version – TNPA RCB internal server
TNPA WMP for Richards Bay (January 2012)	Electronic version – TNPA RCB internal server
SHE Legal Compliance Audit Report	Electronic version – TNPA RCB internal server
Final Scoping Report for the proposed contractor slab and associated infrastructure (11 January 2013) EAP: Kanya Gas	Electronic version – TNPA RCB internal server
Draft Environmental Impact Report for the proposed contractor slab and associated infrastructure for RCB; Umhlatuze Local Municipality (November 2013). EAP: Kanya Gas	Electronic version – TNPA RCB internal server
IMPLEX legal compliance solutions (Internal legal framework – intranet)	Electronic version – TNPA RCB internal server
Waste Management Procedure (EM-04 rev 1) 26 January 2010	Electronic version – TNPA RCB internal server
Current list of waste disposal licences issued in terms S57 of NPA 2005 (September 2013)	Electronic version – TNPA RCB internal server
Waste Management Procedure (EM-04 rev 1)	Electronic version – TNPA RCB internal server
Galley Waste Handling Procedure (IMS SOP 020 revision 00) 01 August 2013	Electronic version – TNPA RCB internal server
Waste Licence UThungulu Landfill general	Electronic version – TNPA RCB internal server
Waste Licence: Shongweni hazardous	Electronic version – TNPA RCB internal server
Waste Licence: SAPPI	Electronic version – TNPA RCB internal server
Standard Operating Procedure Guideline: Disposal of Medical Waste (TNPA/OHC/GDL; November 2009)	Electronic version – TNPA RCB internal server
Disposal of Expired Medication (EM 07 rev 00) 14 March 2011	Electronic version – TNPA RCB internal server
Asbestos Handling And Disposal (EM 08 rev 02) 10 February 2011	Electronic version – TNPA RCB internal server
Stormwater Management Plan for NPA RCB Port Of Richards Bay (rev 00). January 2012	Electronic version – TNPA RCB internal server
TNPA Waste Management Checklist (Landfill Audit Checklist)	Electronic version – TNPA RCB internal server
Department of Environmental Affairs: TNPA RCB Permit for Dumping at Sea (1 February 2012 to 31 December 2013)	Electronic version – TNPA RCB internal server
TNPA Waste Management Checklist (Contractor Audit Checklist)	Electronic version – TNPA RCB internal server
Safe Disposal Certificates: Interwaste Environmental Solutions 2013	Waste Management File; SHEQ Office
TNPA Landfill Checklist (April 2010; version 2)	Electronic version – TNPA RCB internal server
Transnet Disposal and Scrap Directive for movable assets, components, production materials and scrap metal (Version 1; May 2010)	Electronic version – TNPA RCB internal server
Dredging Permit (V1/1/2/32/5/1) valid from 1 February 2012 to 31 December 2013	Electronic version – TNPA RCB internal server

3.3.2 AUDIT ACTIVITIES

The geographical scope of the audit was limited to:

- TNPA RCB Environmental Management Office
- Infrastructure /stores
- Canteen
- Small craft harbour
- Break bulk quays and storage areas
- Liquid bulk quays and storage areas
- Dry bulk quays and storage areas
- Marine and main clinic
- All communal waste storage areas

The sites were audited against a checklist that was developed outlining the requirements of all legislation pertinent to waste management at TNPA RCB. The checklist was developed using the TNPA SHE legal register. The TNPA waste storage areas were inspected as well as those of tenants. The inspections focused on compliance with legislation and general housekeeping. All TNPA waste management areas were inspected, see figure 3.3 below.



Photograph 1: Richards Bay coal terminal quay, galley waste cages.



Photograph 2: Pioneer Centre/ Mess and ablution



Photograph 3: 6 series quayside



Photograph 4: TNPA waste tyre storage area

Figure 3.3: The port of RCB operational areas that were inspected

3.3.3 POST AUDIT ACTIVITIES

A report was compiled on the findings from the compliance audit and submitted to TNPA RCB environmental department. The findings are reported in the results section of chapter 4.

3.4 WASTE AUDIT

3.4.1 PRE-AUDIT ACTIVITIES

During the planning phase, members of the TNPA environmental team and researcher selected the appropriate techniques to deliver waste from offices and other areas of identified activities to the waste disposal/collection bay for sorting for qualitative and quantitative analysis. The following were identified and agreed upon:

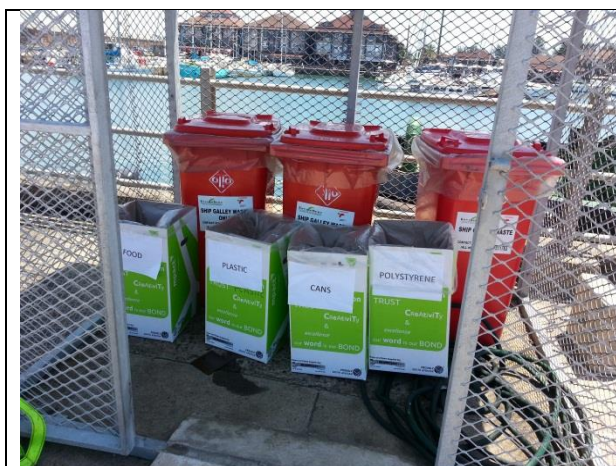
- The waste audit will be limited to general waste streams and it was agreed that the researcher will audit the records of the quantities of hazardous waste produced by TNPA RCB;

- TNPA RCB environmental team to provide the researcher with access to hazardous waste records which comprises of invoices, safe disposal certificates and weigh bridge certificates;
- Identification of other individual waste streams that would be encountered during the audit and develop a comprehensive recording checklist;
- Bin bags will be placed in labelled boxes to assist in waste separation;
- Strategic areas within TNPA buildings to place bins;
- Identifying problems that could be encountered during the audit and possible solutions;
- Ensuring that requisite materials needed for the audit are available (protective equipment: nose masks, leather gloves and safety boots);
- Ensuring that procedures set out for collection and transportation to the waste collection/disposal bay has been understood.

From an initial walk around survey conducted on the 6th February 2014 with the TNPA Environmental Team, the following were identified:

- The different buildings and offices that constitute TNPA RCB ;
- The areas within the buildings and offices to place the labelled waste boxes for use as disposal bins in the section;
- Identification of waste separation bay (area to separate and weigh waste);
- Time and distance to collect waste from the TNPA buildings/offices.

Donated waste boxes were used to assist with the physical quantitative analysis of the waste streams. These waste boxes were used to hold the bin bags. On the 7th February 2014 marked recycling boxes with bin bags were placed in the identified areas within the TNPA RCB buildings as shown below in photographs 1 and 2 in figure 3.4. The researcher acquired disposal bins for each category of general waste to be measured. The researcher acquired two scales for measurement. The first scale (hook scale) was used to weigh the bags. The hook scale was mounted onto a beam protruding from the wall to ensure accuracy of results. The 2nd scale was used to weigh the disposal bins.



Photograph 1: Marked waste boxes placed within a galley waste cage at tug boat jetty.



Photograph 2: Marked waste boxes placed within Osisweni building.

Figure 3.4: Setting up of waste receptacles for the waste audit.

3.4.2 AUDIT ACTIVITIES

A 10 day audit period from 10th February to 21st February (only Monday to Friday) was selected to represent ‘normal working hours’ for TNPA RCB. The researcher was unable to carry out audit activities on weekends due to the admin buildings being closed. The audit was focused on the areas listed in table 3.2 below. The geographical locations of the audited areas are shown on below in figure 3.5. The distance from area 6 (port control) to area 4 (berthing crew) is 21 km.

Table 3.2 Areas studied at TNPA RCB.

Area 1	Area 2	Area 3	Area 4	Area 5	Area 6
<ul style="list-style-type: none"> Pioneer Centre Mess And Ablution Pioneer 	<ul style="list-style-type: none"> Bayview Building Osisweni Building IT Department 	<ul style="list-style-type: none"> Risk Clinic Berthing Crew Fire 	<ul style="list-style-type: none"> Berthing Crew (Berth 3 Series) Firefighting Control Room (Berth 208) 	<ul style="list-style-type: none"> Maritime House Mess And Ablution Maritime Diving Department 	<ul style="list-style-type: none"> Port Control

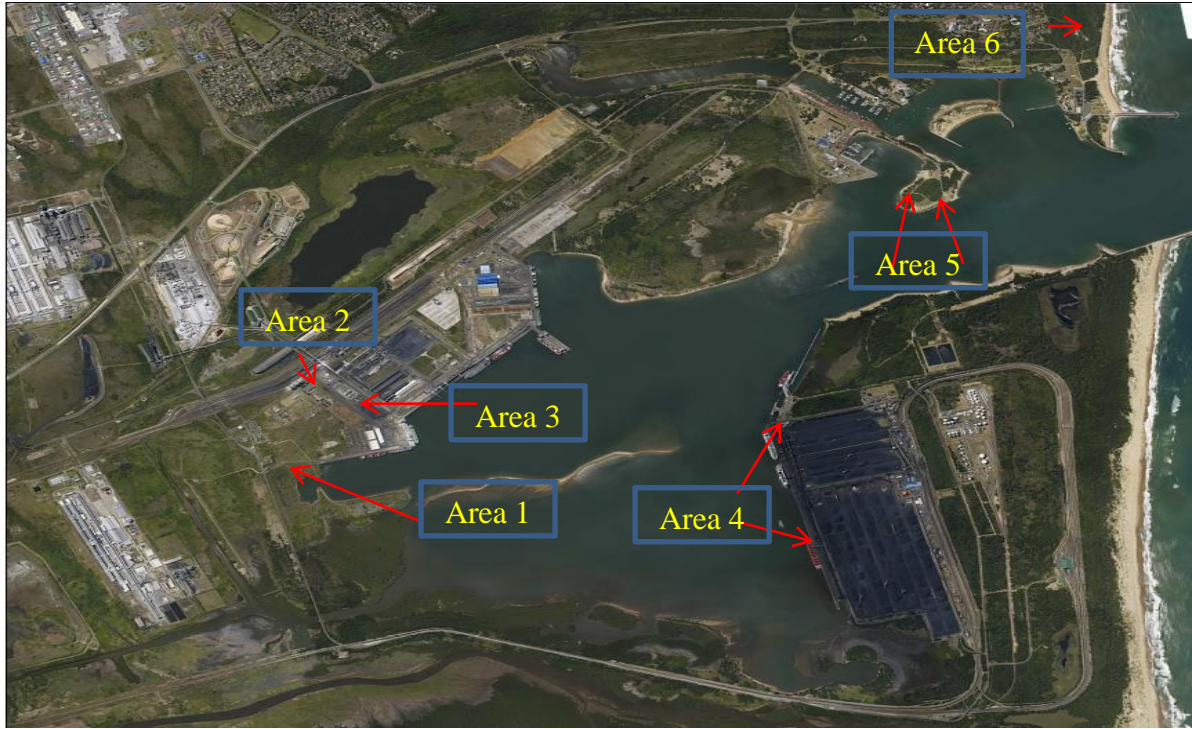


Figure 3.5: Aerial view of the port showing areas of study (www.googleearth.com) Accessed: October, 2012.

At the close of each working day, the bin bags were collected from the marked boxes. Each bin bag was thereafter labelled accordingly with permanent markers. The clearly marked boxes with bin bags are shown below in photographs 1, 2, 3, and 4 in figure 3.6 below. The bin bags were then loaded into a 4x4 truck and transported to the designated waste area where segregation took place.



Photograph 1: Clearly marked waste bins found at Mess and Ablution, Pioneer.



Photograph 2: Clearly marked waste bins found at Risk/Clinic Department.



Photograph 3: Bags of plastic bottles and cans.



Photograph 4: Waste bags at pioneer centre.

Figure 3.6: Waste collected in boxes.

At the designated waste separation area the following process was followed:

Step 1: Each bin bag was weighed using the hook scale and the measurement was recorded;

Step 2: Each bag was then opened and emptied onto a table for sorting to ensure there was no cross contamination of waste and to ensure further sub categorisation (paper was separated from newspaper and magazines).

Step 3: The sorted waste was then placed into the categorised bins below:

- Food waste
- Cans (aluminium)
- Polystyrene
- Non-recyclable plastic

- Recyclable plastic
- Paper
- Newspaper and magazines
- Tissue
- Glass

Step 4: When all of the waste from the bags were sorted and placed into the categorised bins and when the categorised bins were full, each bin was weighed and the measurements were recorded.

Step 5: At the close of each day the sorted waste was then disposed of in the appropriate way. The designated waste segregation area and equipment was thereafter cleaned and disinfected.

Auditing of the hazardous waste records followed the procedures below:

Step 1: Identification of hazardous waste contracts. The researcher identified three existing hazardous waste contracts:

- galley waste contract;
- medical waste contract; and
- a broad hazardous waste contract covering the following types of waste such as contaminated oil drums, oil contaminated waste, asbestos containing waste sludge and oil paint tins and fluorescent tubes.

Step 2: Separation of hazardous waste records. The researcher separated the records for each waste contract to allow the researcher to gain a clear understanding of the management of the hazardous waste contracts.

Step 3: Verify waste records: The researcher compared and verified the hazardous waste invoices with safe disposal certificates and waste manifests for each hazardous waste stream to ensure the following:

- TNPA RCB hazardous waste was disposed at the appropriate landfill site;
- TNPA RCB hazardous waste records are reliable;
- To identify the types and quantities of hazardous waste being produces; and

- To identify the cost of hazardous waste management at TNPA RCB.

Step 4: Analysis of the hazardous waste records: The researcher analysed the hazardous waste records to produce comments, figures and tables and to provide graphical interpretation of hazardous waste management. It followed the procedures below:

- Generated tables in Microsoft Excel;
- Entered responses of each hazardous waste stream in the appropriate rows and columns that were created;
- Counted the tonnage and cost for each hazardous waste stream identified in step 3;and
- Calculated the percentage that represented each hazardous waste stream.

3.4.3 POST AUDIT ACTIVITIES

Upon the completion of the collection and sorting components of the waste audit process the data values recorded were then entered into the excel spreadsheet. Once the data was entered into the spreadsheet the researcher was able to do calculations showing the waste production values. The details of the weights for the different waste streams are reported in the results section 4.2.

3.5 QUESTIONNAIRE SURVEY

3.5.1 DESIGNING THE QUESTIONNAIRE

The questionnaire designed was based on best practice methodology and covered several issues to:

- Gain an understanding on respondents' knowledge of waste management;
- Determine respondents' awareness of what happens to their waste (cradle to grave);
- Ascertain respondents' attitude concerning the methods of waste disposal;
- Ascertain perceived barriers and solutions to managing waste; and
- Ascertain TNPA staff that can champion and possibly help to improve a more sustainable approach to office waste management.

The self-completion questionnaire method was adopted for this research where respondents answer questions by completing the questionnaires themselves, as it tends to be cheaper to administer, can be distributed in very large quantities at the same time and also eliminates

interviewer effects caused by ethnicity, gender, and social background (Bryman, 2004). To ensure the questionnaire is understood by all respondents, the questionnaire was translated into Zulu using a professional translator for those that are not able to converse fluently/read in English.

3.5.2 SENDING THE QUESTIONNAIRE

The questionnaires (Appendix 3) were sent via email to all staff (top/ senior management, middle management, supervisors and general workers) at TNPA RCB that had access to computers. Supervisors at each business unit were then asked to print the questionnaires and avail it to staff that did not have access to email or printers. The magnitude of the layout of the site made distribution via email easier and practical. Responses were received through the business unit managers. A total of 103 questionnaires were received two weeks from the day it was sent. Of the 103 questionnaires received, 85 were in English and 18 were in Zulu. The results are shown in section 4.4.

3.5.3 ANALYSIS OF THE QUESTIONNAIRE

Analysis of the questions was to produce comments, figures and tables and to allow the answers of the questionnaires to be presented graphically suitably interpreted. It followed the procedures below:

- Produced tables in Microsoft Excel;
- Entered responses of each questionnaire in the appropriate rows and columns created;
- Counted the number of each answers to each answered question from questionnaire received;
- Calculated the percentage that represented each answer. Total number of answered questions was taken into account. This was done because not all the questionnaires received had every question answered.

CHAPTER 4

RESULTS

The results produced from the work described in chapter 3 are presented in four parts. The first section presents the results of the current waste management practices. The second and third section gives the results of the general and hazardous waste audit and the questionnaire responses respectively. The fourth section gives the results of the waste compliance audit.

4.1 CURRENT WASTE MANAGEMENT PRACTICES

The assortment of materials that people use and dispose of is reflected on the varied activities that take place in a port. Understanding sites activities helps to identify specific processes that cause waste generation (Cagno *et al.*, 1999).

4.1.1 COMMON ACTIVITIES AT TNPA RCB

Table 4.1: Identified activities within TNPA RCB.

Category	Activity
Offices (Administration, HR, finance etc.)	<ul style="list-style-type: none">• Typing and printing of documents;• Reports (internal and external)• Minutes and agendas of meetings;• Scanning documents electronically and hard copies;• Sending and receiving emails;• Filing of documents;• Lunch; and• Other events such as meetings• Property Department manages the general waste stream for the TNPA RCB.
Marine Department	<ul style="list-style-type: none">• Berthing of vessels via tugs and shore hands.• Repairs to port marine infrastructure• Diving• Fuelling of tugs• Removal of oil slops
Infrastructure Department	<ul style="list-style-type: none">• Maintenances of buildings (electrical, structural)• Maintenance of railway tracks• General maintenance of ports infrastructure (Roads, grass cutting etc.)• Design office• Project office
Health Care (Clinic)	<ul style="list-style-type: none">• Medicals;• Storage of medicine;• Provision of flu vaccines.

Environmental Department	<ul style="list-style-type: none"> • Management of waste removal for TNPA RCB. (Galley waste, non-hazardous general waste, hazardous waste streams). • Management of other environmental activities (EIA's, audits, monitoring etc.)
Fire Department	<ul style="list-style-type: none"> • Management of fire services within the Port of RCB.
Security	<ul style="list-style-type: none"> • Management of security within the Port of RCB

4.1.2. MATERIALS USED IN OFFICE BASED AND ADMINISTRATIVE ACTIVITIES

Some of the materials used in offices at TNPA RCB include paper, toners, ink-jet and ribbon cartridges, IT accessories, batteries for air condition remotes, files, CDs, fasteners such as paper clips, drawing pins and staples, pens, pencils, plastic pockets, and cardboard.

The waste streams from these activities are managed as shown in table 4.2 below.

Table 4.2: Identified materials used within offices at TNPA RCB and their disposal.

Source and type of wastes	Storage (waste receptacle used)	Disposal company	Frequency of collection	Disposal method (type of landfill site)
Bayvue, Pioneer centre, Osisweni (: Waste paper, magazines, newspapers, envelopes, office paper.	Card board paper recycling bins	Mpact recyclers	Twice a month	Recycling depot
Other TNPA buildings: Waste paper, magazines, newspapers, envelopes, office paper.	General waste skip	Umhlatuze Municipality	Twice a week	Landfilled (General landfill site)
Food waste, bottles, plastics, tissues, food wrappers and cans.	General waste skip	Umhlatuze Municipality	Twice a week	Landfilled (General landfill site).
Batteries and florescent tubes	Hazardous waste skips	Interwaste Environmental Solutions	As and when required	Landfilled (H:h landfill site)
Ink cartridges	Stored in plastic boxes	Green Office	As and when required	Recycling depot
E-waste Note: IT equipment is not being disposed, refer to section 5.1.	Stored in cardboard boxes.	N/A	N/A	N/A

4.1.3. MATERIALS USED IN MARINE BASED ACTIVITIES

Some materials used in marine based activities are fuel, oil, cardboard, batteries for radios, first aid kits, lifting equipment, paint and ropes. Waste generated as a result of these activities and the materials used include oily slops, florescent tubes, empty paint containers, galley waste, scrap metal used tyres, batteries, oil drums, ropes, food waste, bottles, cardboard, plastics, medical waste, and cans.

The management of the waste streams is indicated in Table 4.3 below.

Table 4.3: Identified waste generated by marine based activities at TNPA RCB and their management.

Type of waste	Storage (waste receptacle used)	Disposal Company	Frequency of collection	Disposal method (Type of landfill site)
Oily slops	Hazardous waste skips.	Interwaste Environmental Solutions	Once a month.	Oil refiners for recycling.
Oily drums	Hazardous waste skips.	Interwaste Environmental Solutions	Once a month.	H:H/H:h Class A landfill site.
Galley waste	Hazardous waste skips.	EnviroServ Waste Management	Galley waste is collected twice daily. Seven days a week.	H:H/H:h Class A landfill site.
Medical waste	Sharpsmart reusable sharps containment system.	Compass Waste	As and when required.	Autoclave technology for treatment of infectious waste then After treatment, the waste residue is land filled. A general landfill site is used for delisted autoclaved shredded waste (GLB+) Class B. H: H/H: h landfill site for incinerated ash.
Paint containers	Hazardous waste skip	Interwaste Environmental Solutions	Once a month.	H:H/H:h Class A landfill site.
Used/damaged tyres	Stored on site at the waste tyre storage area. The waste tyre storage is permitted from Umhlatuzi municipality to store tyres. TNPA RCB awaiting the implementation of Recycling and Economic Development Initiative of South Africa (REDISA) to arrange the removal of the waste tyres.			

4.1.4. MATERIALS USED INFRASTRUCTURE BASED ACTIVITIES

Some materials identified during the study that are used in infrastructure/maintenance based activities are florescent tubes, paint, batteries, electrical transformers, railway sleepers, tyre

fenders, plans/drawings, material used in infrastructure upgrades. Waste generated as a result of these activities and the materials used include batteries, electrical transformers, contaminated railway sleepers, galley waste, florescent tubes, asbestos, used/damaged tyres, oily drums, paint containers, food waste, cardboard, bottles, plastics, tissue paper, food wrappers, cans, etc.

The waste streams are managed as follows as given in Table 4.4.

Table 4.4: Identified waste generated by infrastructure based activities at TNPA RCB.

Source and type of wastes	Storage (waste receptacle used)	Disposal Company	Frequency of collection	Disposal method (Type of landfill site)
Oily slops	Hazardous waste skip	Interwaste Environmental Solutions	Once a month.	Oil refiners for recycling.
Oily drums	Hazardous waste skip	Interwaste Environmental Solutions	Once a month.	H:H/H:h Class A landfill site.
Galley waste	Hazardous waste skip	EnviroServe Waste Management	Galley waste is collected twice daily. Seven days a week.	H:H/H:h Class A landfill site.
Asbestos roofing	Hazardous waste skip	Interwaste Environmental Solutions	As and when required.	H:H/H:h Class A landfill site.
Paint containers	Hazardous waste skip	Interwaste Environmental Solutions	Once a month.	H:H/H:h Class A landfill site.
Contaminated railway	Hazardous waste skip	Interwaste Environmental Solutions	As and when required.	H:H/H:h Class A landfill site.
Electrical transformers	Hazardous waste skip	Reclamation Group	As and when required.	Reclamation scrap yard
Waste tyres	Stored on site at the waste tyre storage area. The waste tyre storage is permitted from Umhlatuzi municipality to store tyres. TNPA RCB awaiting the implementation of Recycling and Economic Development Initiative of South Africa (REDISA) to arrange the removal of the waste tyres. The TNPA RCB has a total of 210 waste tyres.			

4.1.5. CURRENT WASTE MANAGEMENT PRACTICES

Table 4.5 below summarises the observations made during the audits conducted. It can be seen that the current waste practices shown below is largely unsustainable.

Table 4.5: Current sustainability of waste management practices at TNPA RCB.

Environmental aspect	Rating	Current practices for waste streams
Waste Management In Offices	Unsustainable	<ul style="list-style-type: none"> All waste produced at offices is disposed in same bins. No colour coding system is used. Apart from paper (office paper, newspapers, magazines, envelopes) recycling, no other forms of recycling takes place. Office waste is collected into black bins and disposed into municipal skips Recyclable and non-recyclable plastic, glass bottles, cans, food waste and tissue paper are landfilled.
Waste Management Marine Department	Unsustainable	<ul style="list-style-type: none"> Oily waste produced by marine department is collected by Interwaste Environmental Solutions. TNPA RCB does not recover any fees from the oily waste disposal. Scrap metal was found dispersed around the marine department. TNPA RCB does not have a designated scrap metal waste area. Waste tyres used by the tug boats are stored within the designated waste tyre area. No abatement plans exists. Food waste produced by the tugs are disposed in Galley Waste bins and collected by EnviroServe Waste Management.
Environmental Department	Unsustainable	<ul style="list-style-type: none"> Galley Waste is disposed at Shongweni (H: H) landfill site. Shongweni is +- 260kms away from port of RCB. Galley waste is removed daily and disposed. The transportation fee for the disposal of galley waste is covered in section 4.2.5.
Infrastructure	Unsustainable	<ul style="list-style-type: none"> Oily waste produced by infrastructure department is collected by Interwaste Environmental Solutions. TNPA RCB does not recover any fees from the oily waste disposal. Scrap metal is left to collect within the marine department. No current procedure available for the collection and removal of Scrap metal. Tyres used by the infrastructure department for quay walls and other berthing structures are stored within a designated waste tyre area, however no procedure for the removal and disposal of tyres exist.
Clinic	Unsustainable	<ul style="list-style-type: none"> All medical waste is collected by Compass waste and transported to Durban for treatment and disposal. The Compass Waste permitted facility is 200 kms away from port of Richards Bay. In this regards it is unsustainable. The reason for this is that the Local Umhlatuzi Municipality does not have an incinerator, autoclaving, mechanical/chemical nor disinfection facilities to treat medical waste, There is also no suitably permitted landfill site to handle the medical waste.. However, no landfill site can receive untreated medical waste. The current option is the only viable option at the moment.
IT department	Unsustainable	<ul style="list-style-type: none"> IT E-waste is currently stockpiled in a room and no disposal method has been identified.

4.2 WASTE AUDIT

This section describes the general and hazardous waste streams found during the waste audit.

4.2.1 GENERAL WASTE AUDIT (10 DAY WASTE MEASUREMENT)

Table 4.6: Composition of general waste weighed during the 10 day audit period.

Waste stream	Mass (kg/10 day audit period).	% of total waste collected over the 10 day audit period
Food waste	111	28
Cans (beverage, aluminium).	28	7
Polystyrene	24	6
Non-recyclable plastic	9	2
Recyclable plastic	34	8
Paper	114	28
Newspaper and magazines	51	13
Tissue	23	6
Glass	7	2

Paper and food were the largest waste streams found during the 10 day audit. Large amounts of paper found during the audit were from reports, print outs, invoicing, etc. Paper found in the finance department has been shredded, whilst the majority was crumpled by hand.

Recyclable plastics were mainly spring water bottles and cold drink bottles.

Non-recyclable plastics included polystyrene containers. The large amount of polystyrene containers is generated from the food that the TNPA staff purchase from the canteen. There were quite some amounts of shopping polythene bags, cling films, laminations, wrappers, sweets wrappers, etc.

Glass bottles found were mainly from peanut butter jars, coke bottles used by berthing crew and office staff.

Cans in the waste stream were all aluminium based such as coke, fanta and sprite. Tissue papers were mainly hand towels.

Newspapers and magazines were also found in the waste stream and made up of local community papers and provincial papers.

4.2.2 AREA ANALYSES

The % composition is based on: mass (kg)/Total mass (kg).

The compositions of waste for each audit area are shown in figure 4.1 through to 4.10 below.

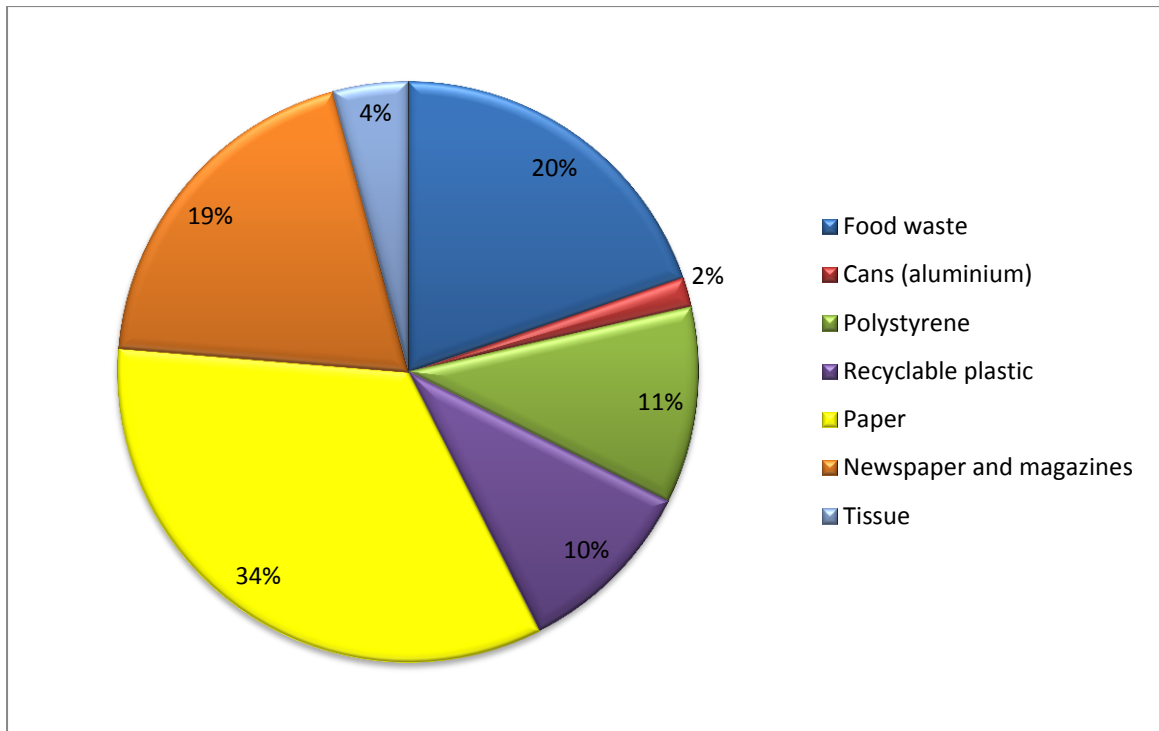


Figure 4.1: Composition (%) of waste streams for the 10 day audit at Pioneer Centre.

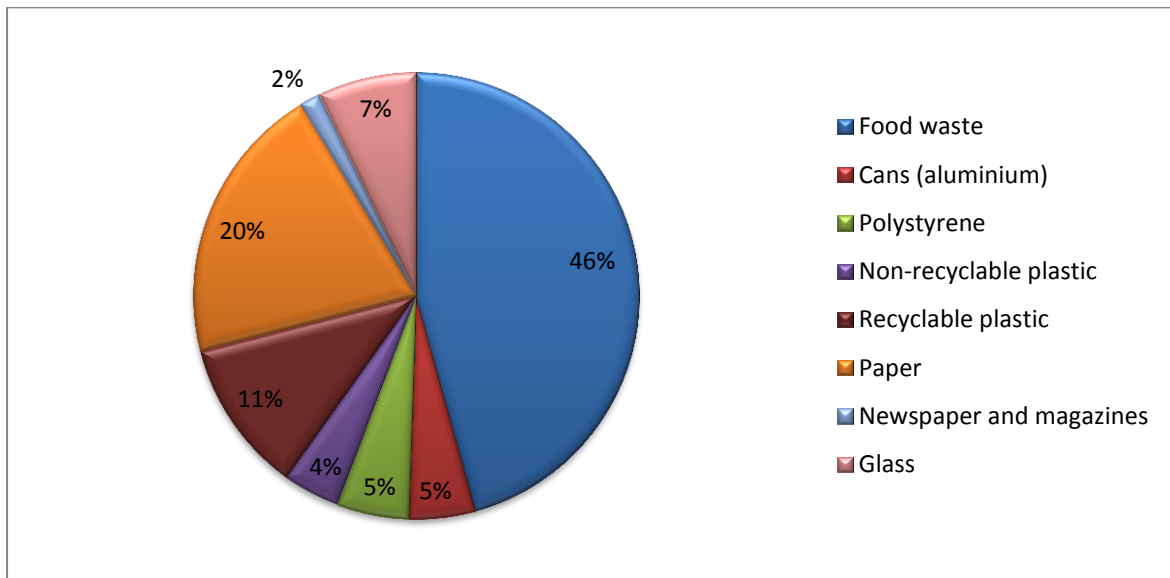


Figure 4.2: Composition of waste streams (kg) for the 10 day audit at Mess (Dining area) and Ablution Pioneer.

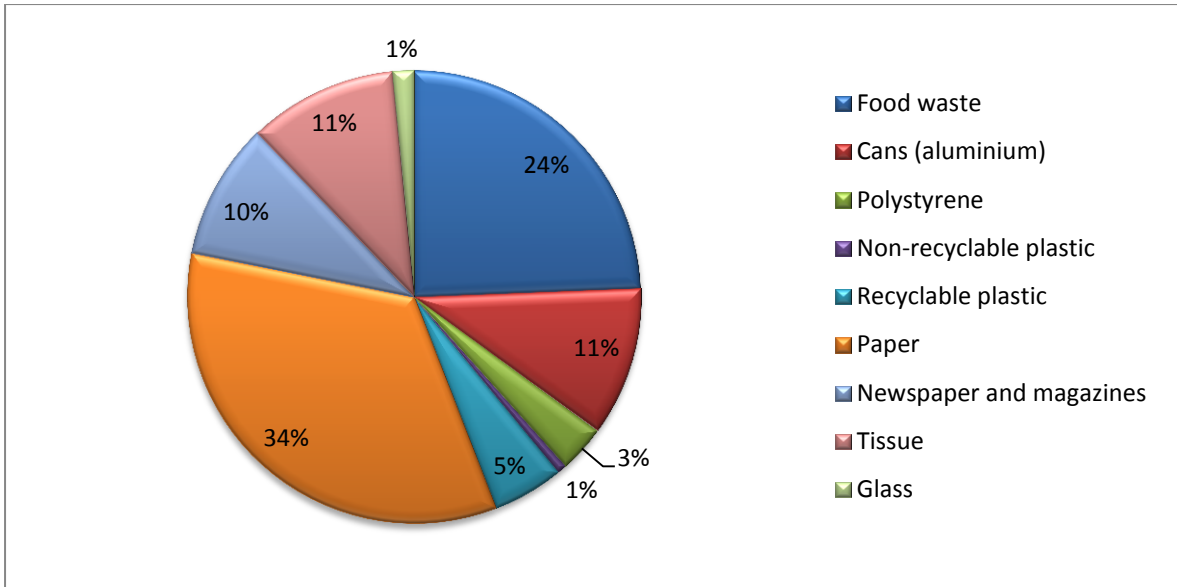


Figure 4.3: Composition of waste streams (kg) for the 10 day audit at Bayvue building.

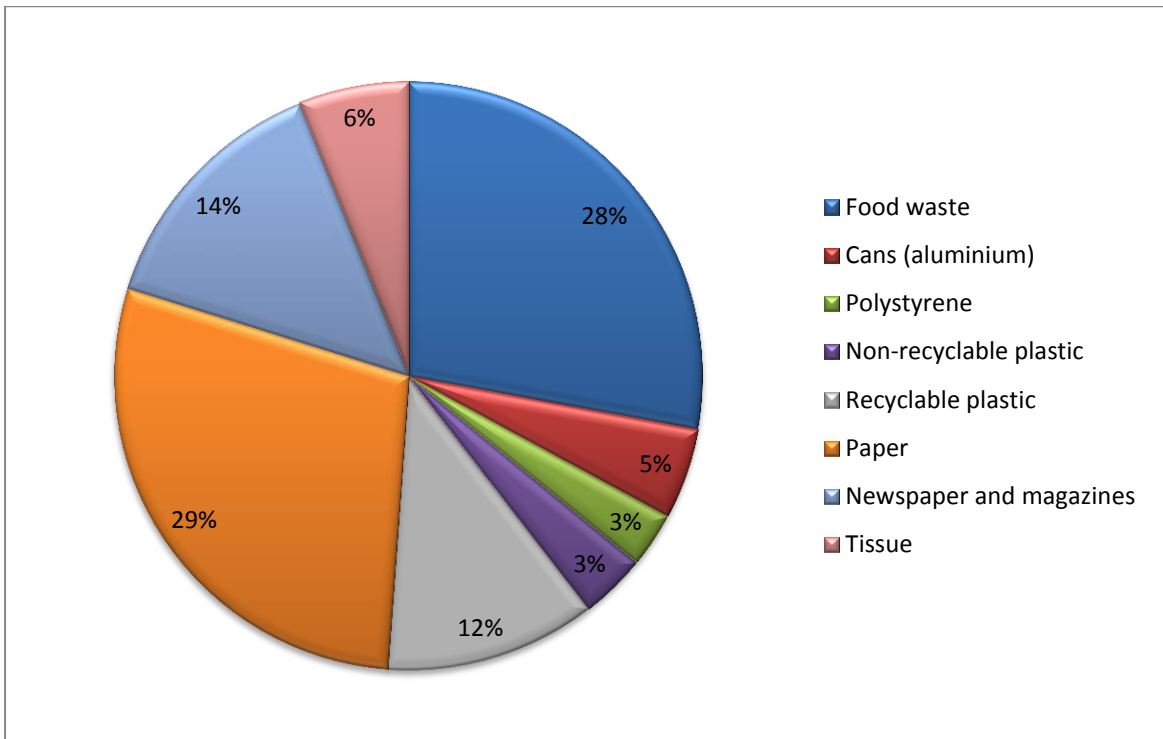


Figure 4.4: Composition of waste streams (kg) for the 10 day audit at Osisweni building.

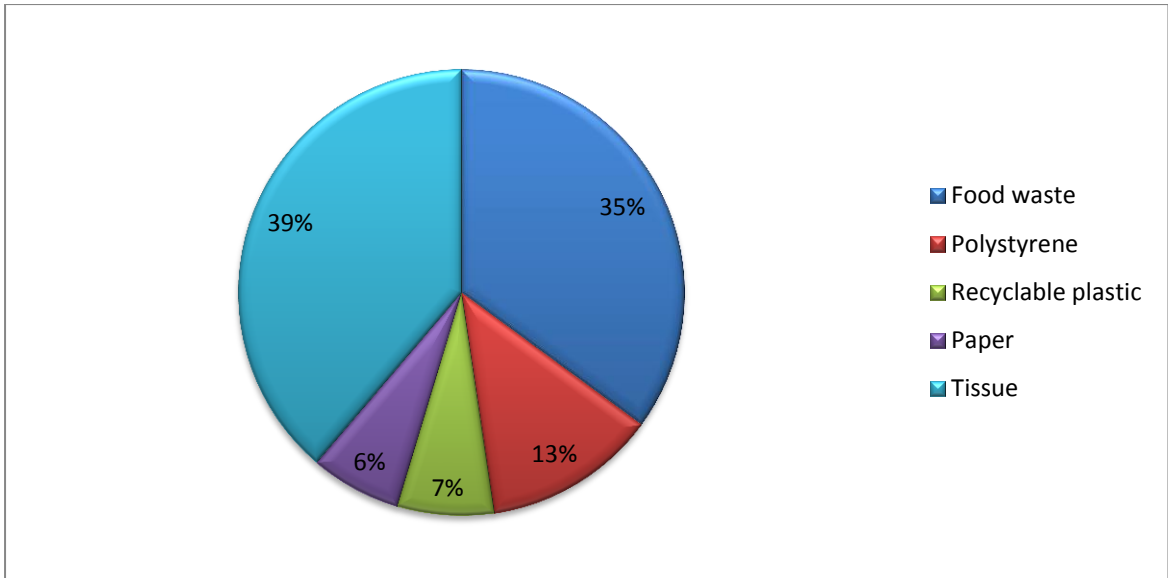


Figure 4.5: Composition of waste streams (kg) for the 10 day audit at IT Department.

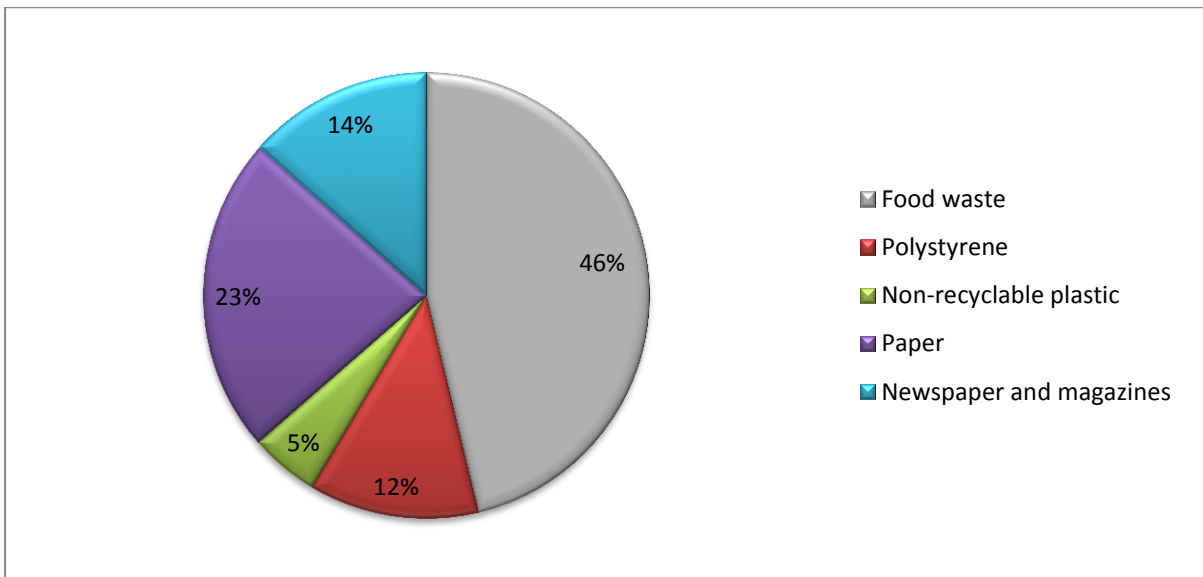


Figure 4.6: Composition of waste streams (kg) for the 10 day audit at Clinic, Risk and Fire Department.

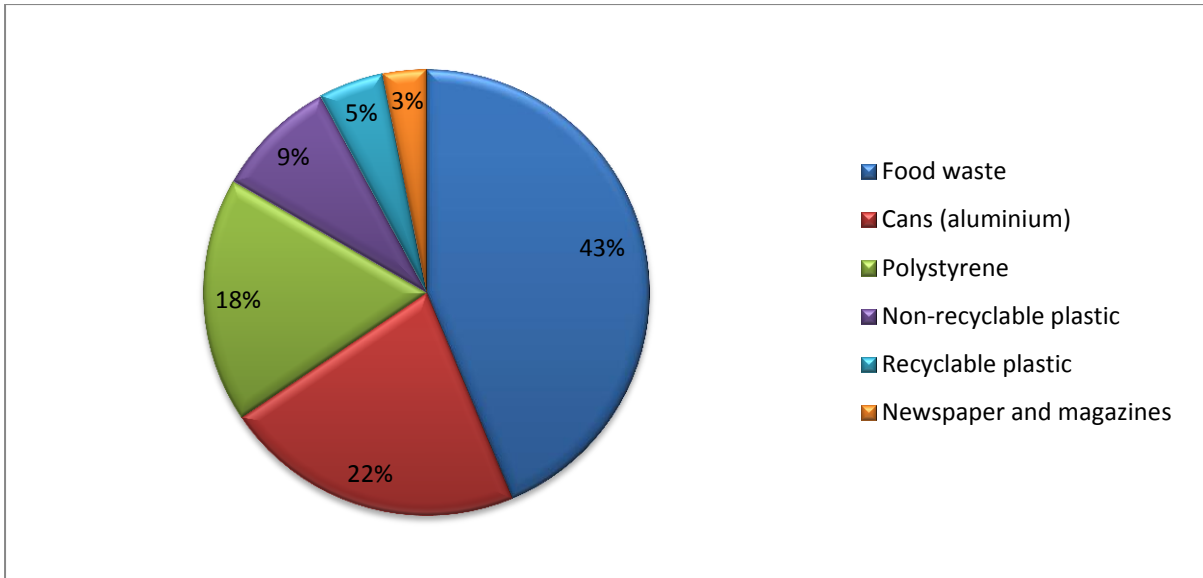


Figure 4.7: Composition of waste streams (kg) for the 10 day audit at Berthing Crew.

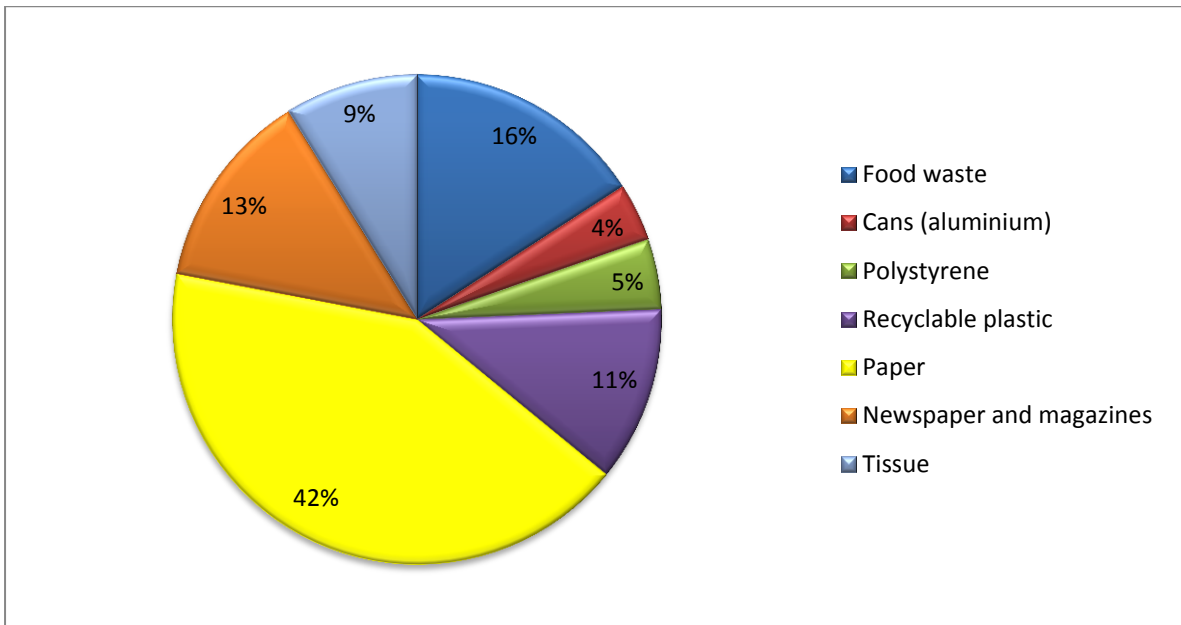


Figure 4.8: Composition of waste streams (kg) for the 10 day audit at Maritime House.

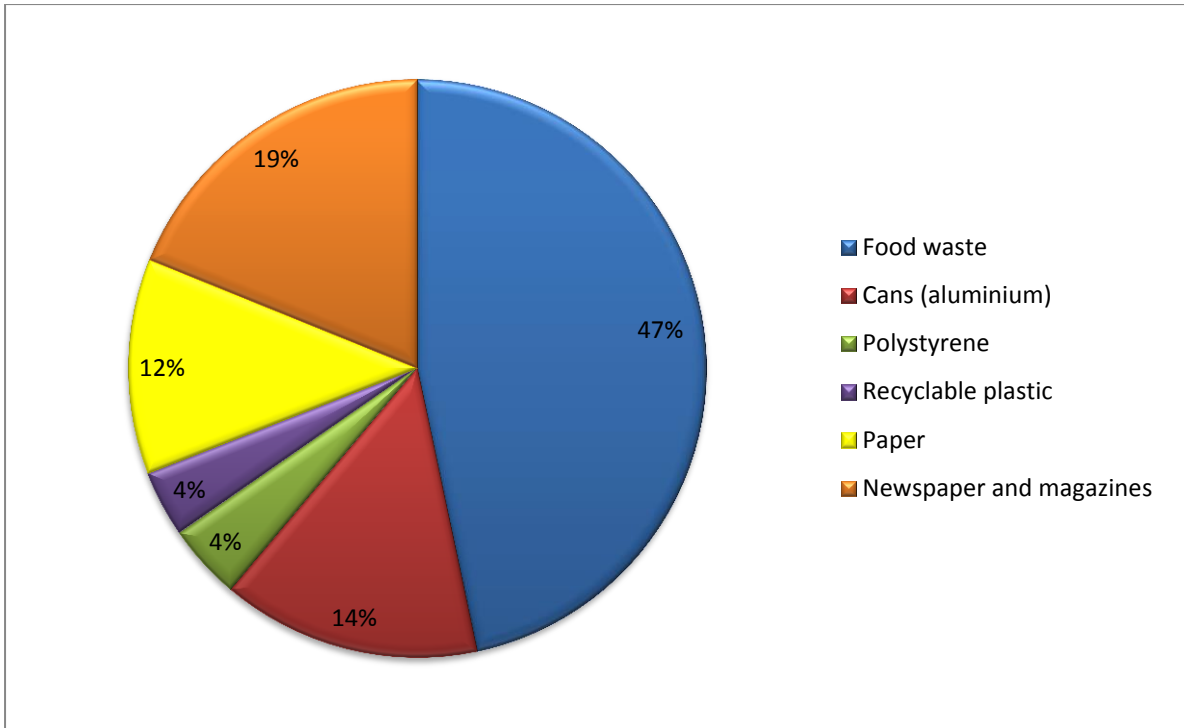


Figure 4.9: Composition of waste streams (kg) for the 10 day audit at Mess and Ablution Maritime.

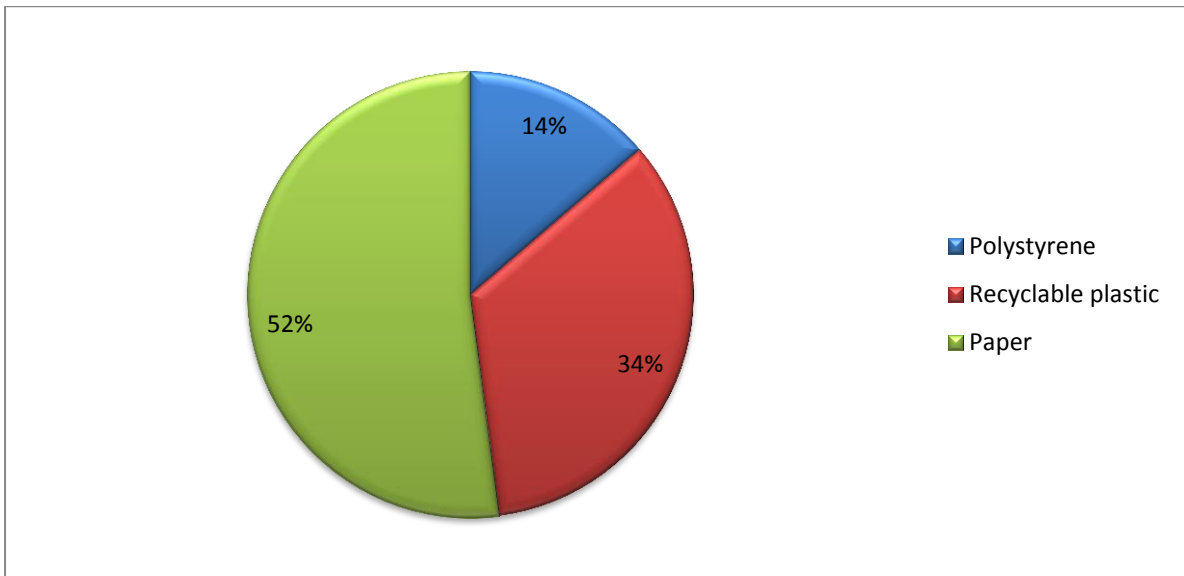


Figure 4.10: Composition of waste streams (kg) for the 10 day audit at Diving Department.

In figure 4.10, three waste streams were identified at the diving department. Other waste streams such as food waste, cans, tissue or glass were not found in the waste receptacles during the audit.

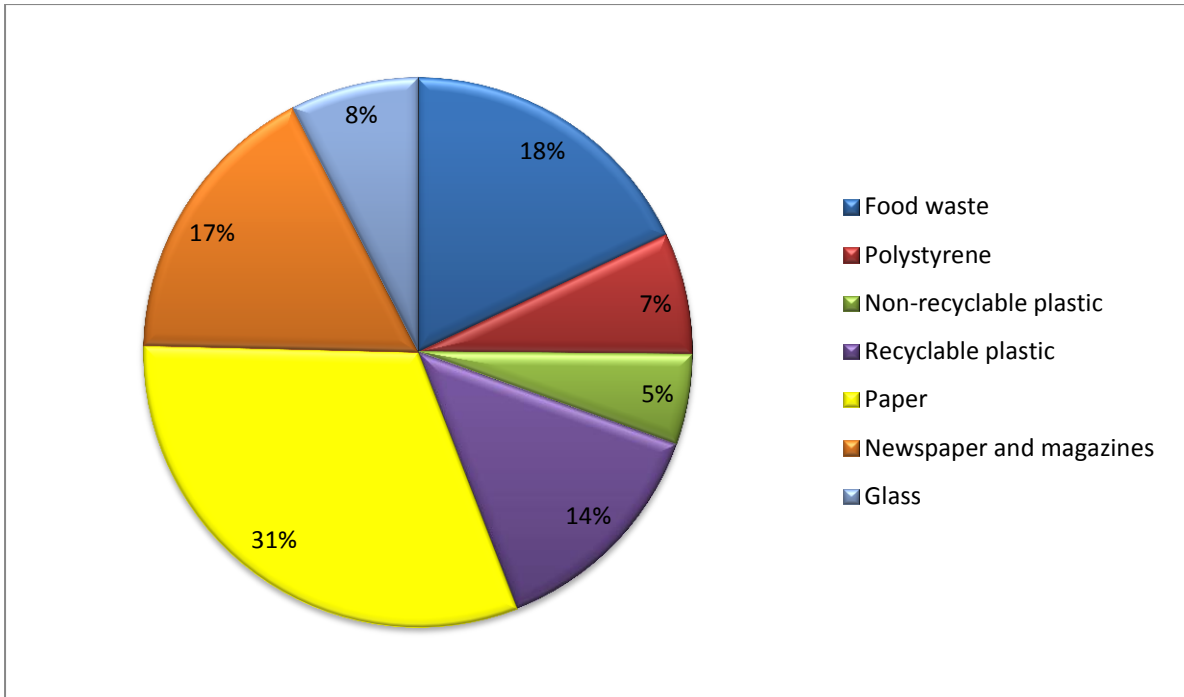


Figure 4.11: Composition of waste streams (kg) for the 10 day audit at Tugboats.

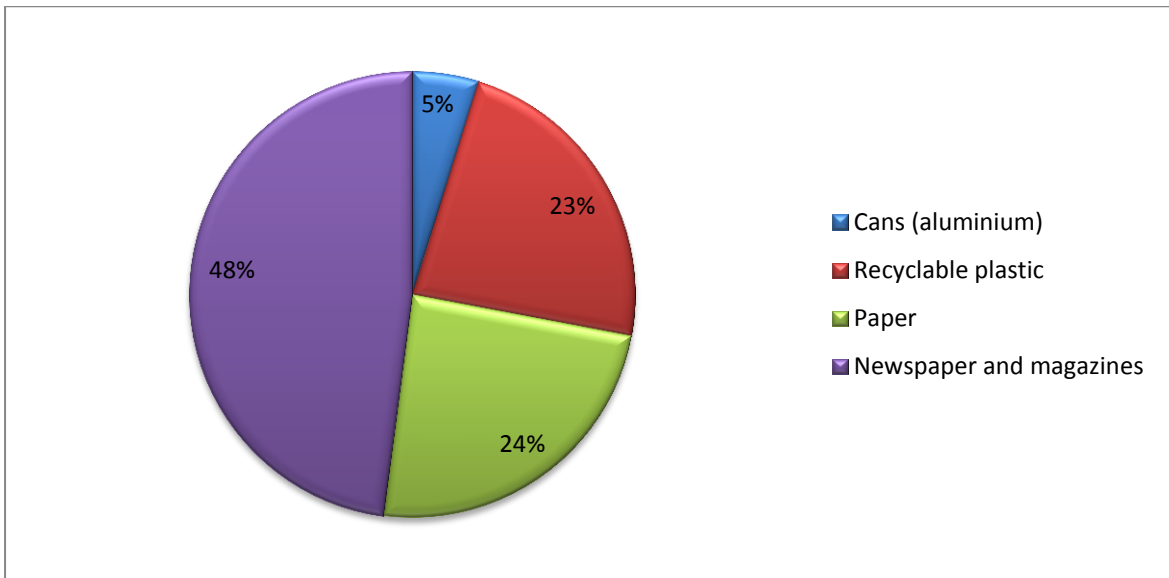


Figure 4.12: Composition of waste streams (kg) for the 10 day audit at Port Control.

From the figures 4.1 to 4.12 it can be interpreted that office paper and food waste are the dominant general waste streams found at TNPA RCB buildings. Analysis is shown in figures 4.13 of the five highest areas where food waste is dominant.

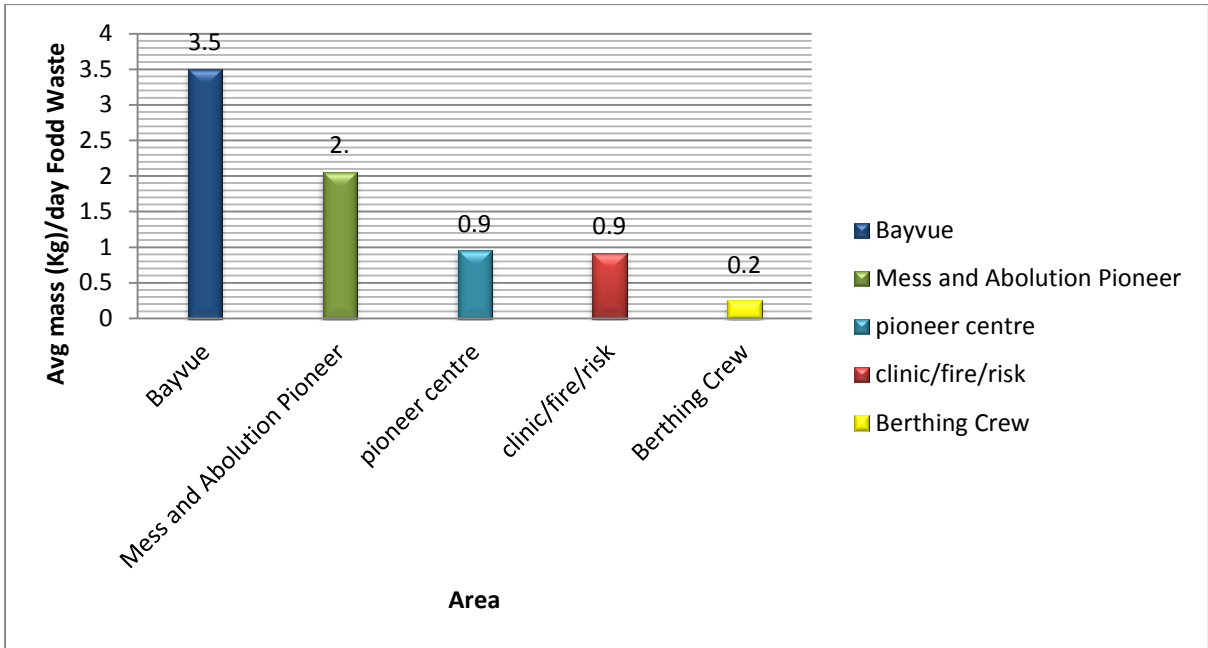


Figure 4.13: Top five areas for food wastes (kg/ Day) produced at TNPA RCB.

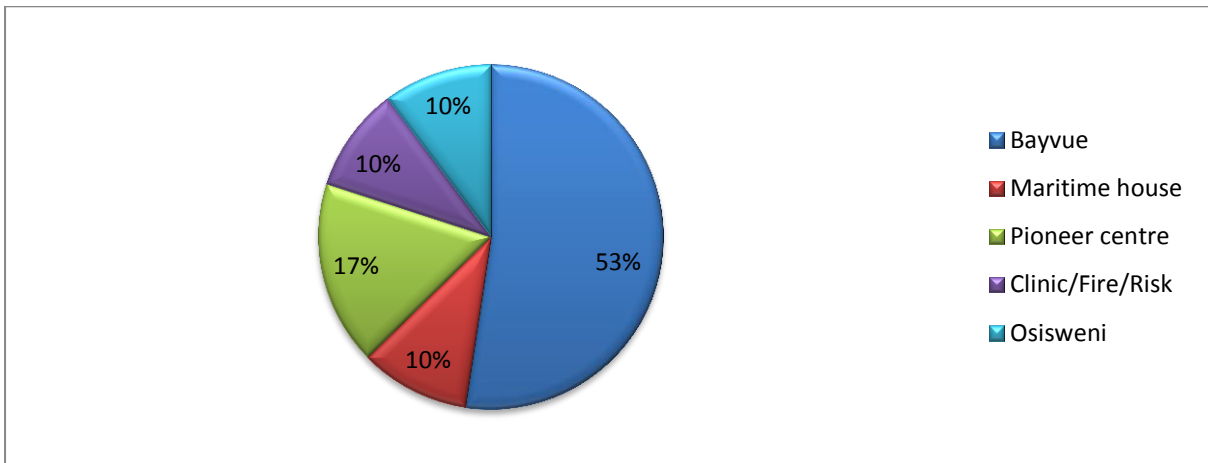


Figure 4.14: Top five sources of waste papers at TNPA RCB.

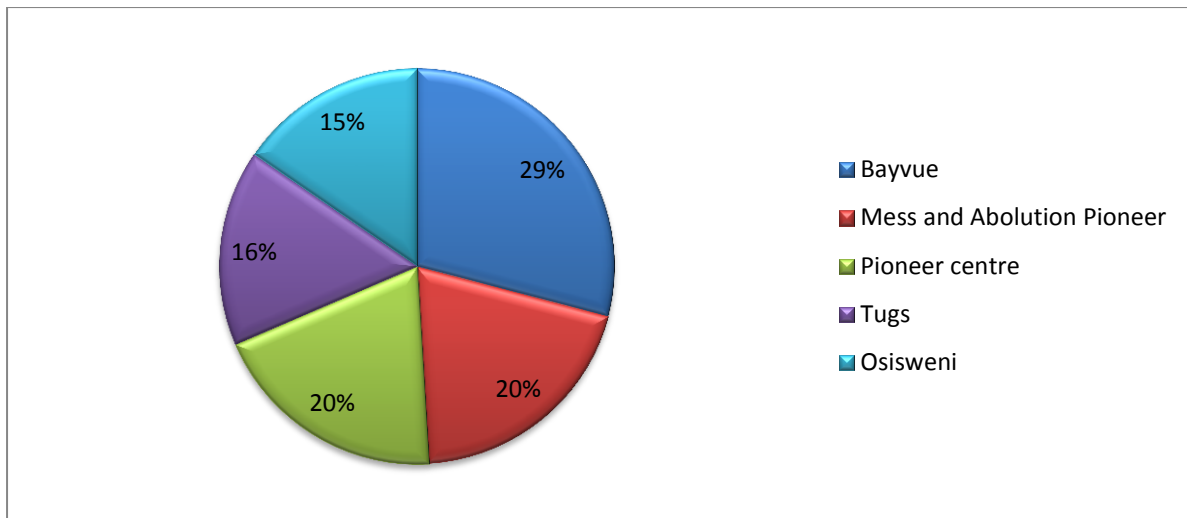


Figure 4.15: Top five areas where recyclable plastic waste is produced at TNPA RCB.

The majority of paper and recyclable plastic is generated at Bayvue building, Pioneer centre, Mess & Ablution (Pioneer), Osisweni building and Risk/Fire/Clinic as is shown in figures 4.14 and 4.15 above.

Summary of the 10 day waste audit is as follows:

- There was **402 kg** of general waste produced in TNPA buildings;
- Out of the **402 kg** of general waste found, 328 kg is destined for landfill while 74 kg is diverted from landfill;
- 74 kg diverted from landfill consisted of paper to be recycled from Bayvue Building, Pioneer Centre, Osisweni Building;
- The 328 kg destined for landfill is at a cost of approximately R 3225 per two working weeks. The monthly rate for the collection of general waste at TNPA RCB is R 6450 as monthly contract with Umhlatuzi Municipality.
- 272 kg of potentially recyclable waste is discarded to landfill;
- Newspapers and magazines represent 13% of the waste discarded;
- Food waste represent 28% of the waste discarded;

4.2.3 DIVERTING WASTE FROM LANDFILL

The general waste at TNPA RCB comprises of waste from offices, clinics, operational areas and communal staff eating areas. In the absence of data on general waste from TNPA RCB,

results from the 10 day audit excluding weekends, forms the basis of the cost analysis. The cost analysis evaluates the current scenario of no recycling. The actual financial year for TNPA RCB starts from April to March of the following year. The waste streams audited is used to interpolate forward to the start of the financial year April 2014 and to the end of March 2015. Further projections were made up to year 2020.

The opportunity cost for diverting some general waste streams from landfill using two scenarios is analysed. The two scenarios employed are:

1. 'No action' to divert recyclable and reusable materials from landfill and the cost projections up to 2020.
2. 'Action' to divert recyclable and reusable materials from landfill and the savings projected up to 2020. The total general waste streams of **402 kg** is summarised in table 4.7.

Waste best practise guidelines indicate that office paper, newspapers and magazines, cardboard, envelopes, recyclable plastics, glass, cans and food could be diverted from landfill and either reduced, reused or recycled. Table 4.7 indicates the 'no action' scenario to divert waste from landfill and the cost projections up to 2020, calculated on an increase of 8% every year. In chapter 6 the researcher has undertaken a case study on the costs associated with establishing a general waste recycling programme. Table 4.8 indicates that the TNPA RCB will spend an estimate of **R 567 720.00** over the next six years on general waste management. The estimated cost for TNPA to establish a recycling programme is **R 208 770** excluding the monthly rentals for the food waste compactor unit.

Table 4.7: Estimated disposal costs from 2014 to 2020.

Disposal Cost of general waste for 2014/15 @ 6450 per month	Disposal Cost of general waste for 2015/16 @ 6966 per month	Disposal Cost of general waste for 2016/17 @ 7523 per month	Disposal Cost of general waste for 2017/18 @ 8124 per month	Disposal Cost of general waste for 2018/19 @ 8773 per month	Disposal Cost of general waste for 2019/20 @ 9474 per month
R 77400	R 83592	R 90276	R 97488	R 105276	R 113688
				Total over 6 years	R 567 720.00

Note: Estimated cost includes handling, collection, transportation and disposal.

4.2.4 HAZARDOUS WASTE AUDIT

As per agreement with the TNPA RCB environmental team, the audit of the hazardous waste streams involved a desk top exercise. The following is the composition of hazardous waste produced by TNPA RCB from February 2013 to February 2014.

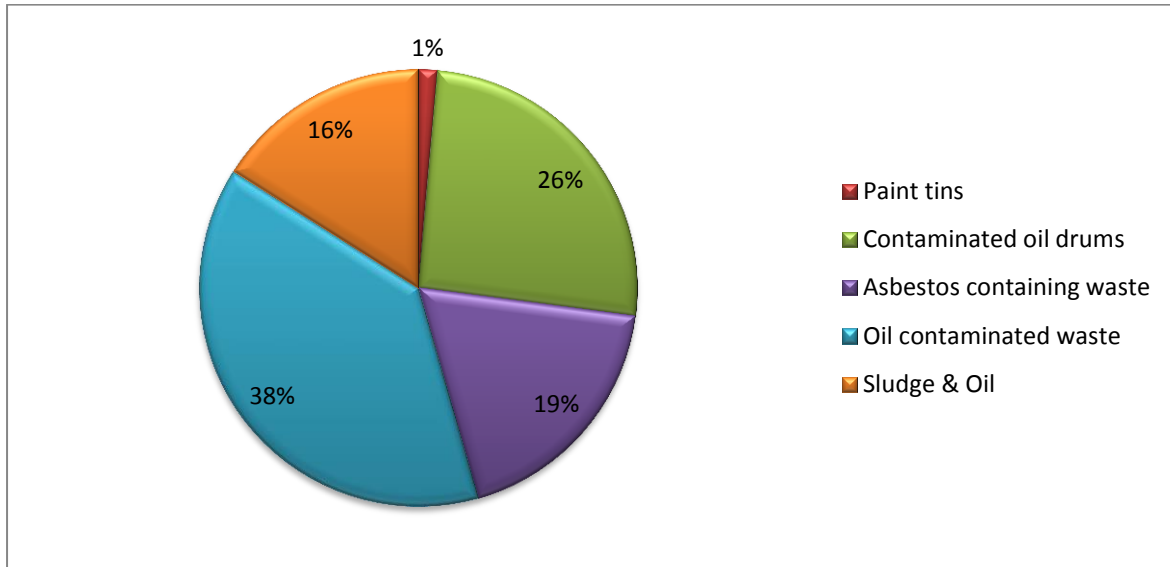


Figure 4.16: Composition of hazardous waste produced by TNPA RCB from February 2013 to February 2014.

In figure 4.16 above, oil contaminated waste makes up the largest percentage of hazardous waste produced at TNPA RCB. Medical waste and fluorescent tubes make up less than 1% of the total tonnage of hazardous waste produced by TNPA RCB during February 2013 to February 2014 (medical waste and fluorescent not shown in figure 4.16 due to % being less than one).

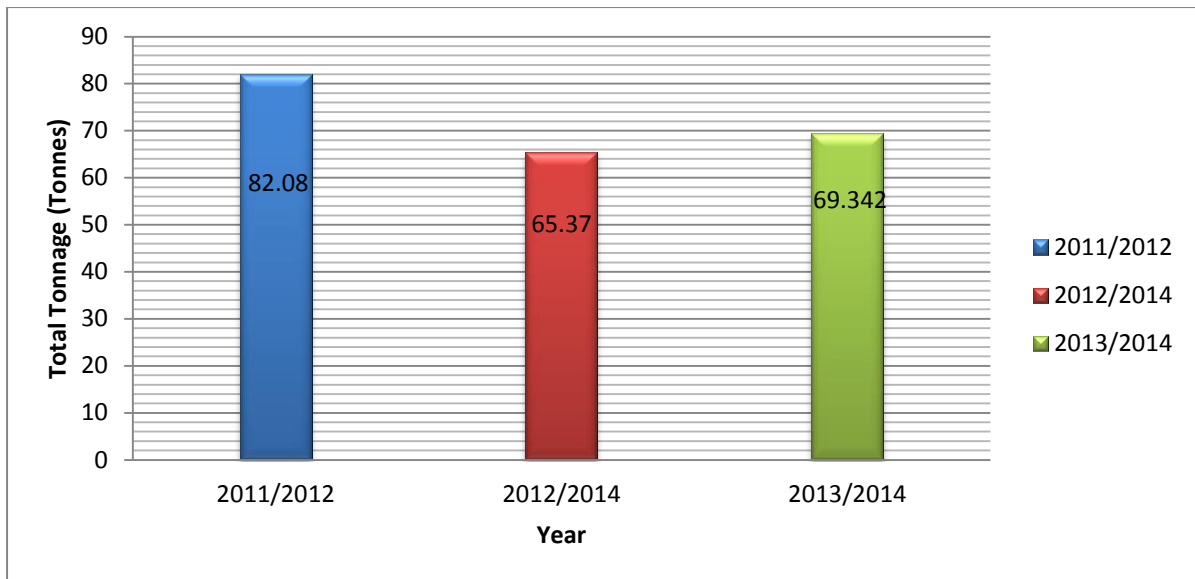


Figure 4.17: Total tonnage of hazardous produced for 2011 to 2014 financial years. (Source: TNPA RCB Environmental Department, 2014).

Figure 4.17 above indicates the total tonnage of hazardous waste produced per year for three financial years at TNPA RCB. Hazardous waste volumes were the highest in 2011/2012 financial year.

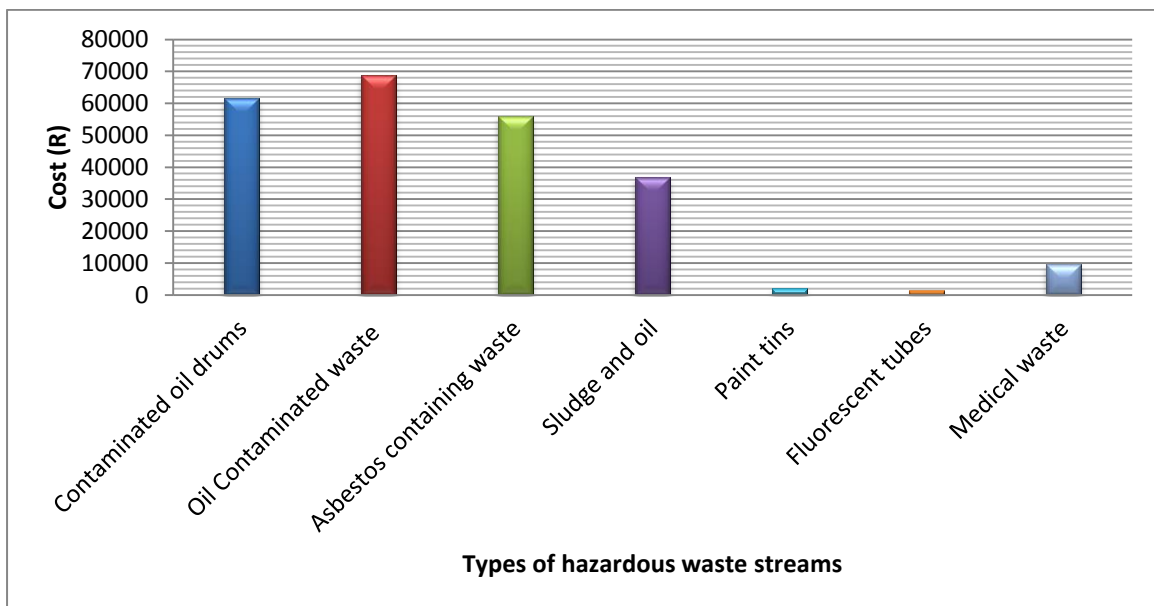


Figure 4.18: Cost for the removal and disposal of the identified hazardous waste streams for 2013/2014. (Source: TNPA Environmental Department, hazardous waste records, 2014).

In figure 4.18 above oil contaminated waste and contaminated oil drums are the mostly costly waste streams.

4.2.5 GALLEY WASTE

Table 4.8 Galley Waste cost breakdown for the 2013/14 financial year.

Month	Mass (kg)	Number of skips	Cost for the removal of galley waste skip (R 5239.63/skip)	Recovery fee from vessel (R260/skip)	Flat Monthly Fee	
April 13	17850	15	78594.45	3900	R62 000	
May	20400	30	157188.9	7800	R62 000	
June	18200	21	110032.23	5400	R62 000	
July	17550	25	130990.75	6500	R62 000	
Aug	14100	20	104792.58	5200	R62 000	
Sept	11450	16	83834.08	4160	R62 000	
Oct	15000	25	118023.08	6500	R62 000	
Nov	17900	28	146709.65	7280	R62 000	
Dec	20655	24	125751.08	6240	R62 000	
Jan	42050	42	220064.36	10920	R62 000	
Feb	15450	30	15718.87	7800	R62 000	
Mar-14	29802	22	116850.48	5720	R62 000	
Total	240407	298	R 1408550.51	77420	R744000	
				Total Cost (Monthly flat fee+ skip cost)		R 2 152550.51

Note: The flat monthly fee is the amount that the port of RCB pays as a standard amount for the placement, removal and disposal of all galley waste bins per month

Table 4.8 above shows the quantity and cost of galley waste which TNPA RCB managed for the 2013/2014 financial year. The flat monthly fee is the amount that TNPA RCB pays as a standard amount for the placement, removal and disposal of all galley waste bins per month. TNPA RCB pays R 5 239.63 for the removal of a single galley waste skip. TNPA RCB charges each vessel R 260 per call at the port for galley waste service whilst they are anchored at the port. However the standard galley waste charge (contained in the TNPA tariff book) only covers 5% of the cost for the collection, removal and disposal of the galley waste. TNPA RCB pays for the other 95% of the cost for the collection, removal and disposal of galley waste. TNPA RCB recovered R 77 420 from the R2 152 550.51 spent on providing the galley waste service at the port of RCB.

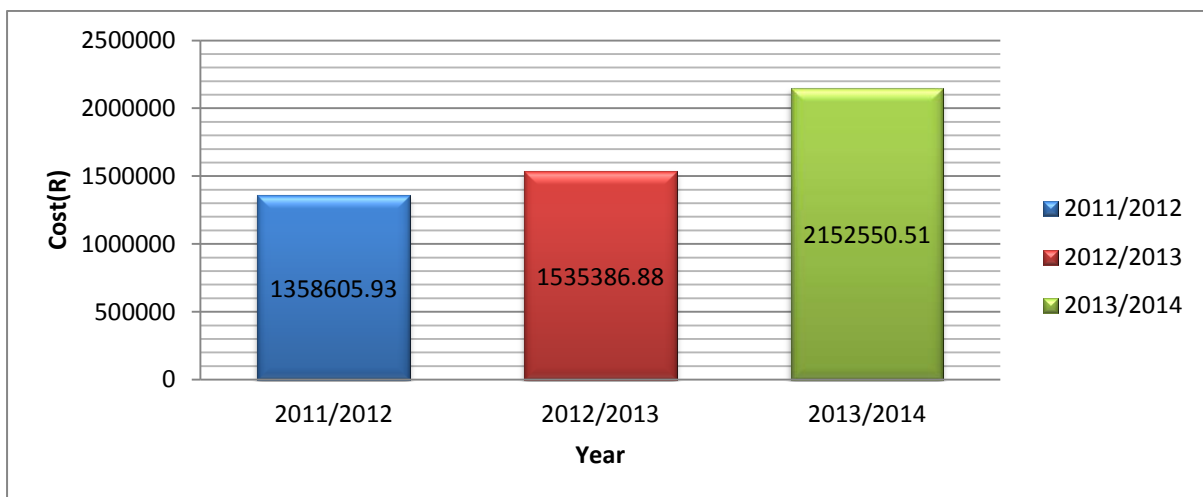


Figure 4.19: Galley Waste Costs from 2011/2014 financial years.

Figure 4.19 above indicates management costs for galley waste. The cost of managing galley waste at TNPA RCB has almost doubled from the 2011/2012 financial year to the 2013/2014 financial year.

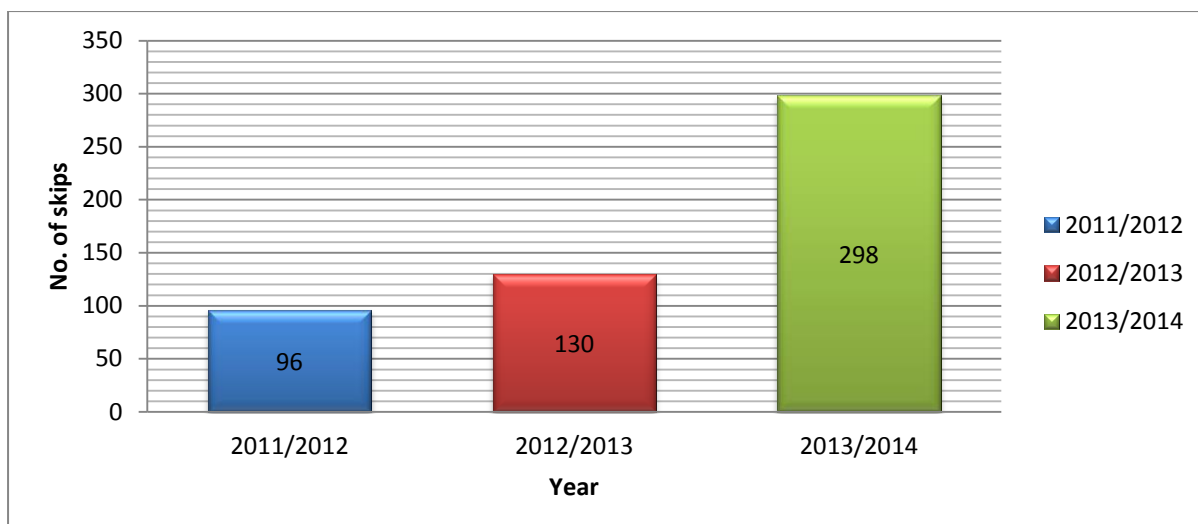


Figure 4.20: Galley Waste skips requested by vessels for 2011/2014.

The figure 4.20 above indicates the increase in galley waste skips requested by vessels. Upon verification with TNPA RCB vessel traffic count records, it was found that the number of vessels entering the port has remained fairly consistent as shown in figure 4.21 below. The reason behind the increase of requests for galley waste skips is attributed to vessels dumping other waste streams into the galley waste skips. The addition of other waste streams into the galley waste skips has increased the quantities of required galley waste skips thereby increasing costs incurred by TNPA RCB.

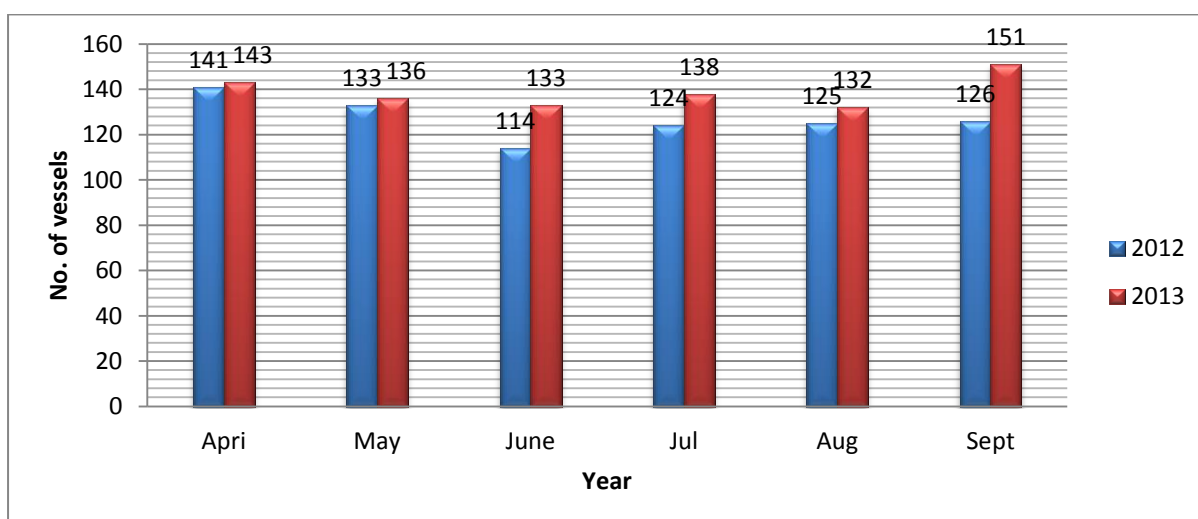


Figure 4.21: Vessel traffic count for port of RCB (Source: TNPA RCB, Port control vessel traffic records, 2014).

4.3 WASTE COMPLIANCE AUDIT

A waste compliance audit of TNPA Port of RCB was carried out against the audit criteria developed during the desktop study of the SHE legal register. The criteria was developed from studying international, national and regulatory requirements, standards, guidelines,

protocols, conventions or any other specified requirements that is pertinent to waste management at TNPA RCB. Figure 4.22 below indicates level of compliance by the TNPA RCB. TNPA RCB was largely non-compliant with the international legislation applicable to port operations, and partially compliant to national obligations. Furthermore, while the documented WMP developed by TNPA RCB aligns to the requirements of the NEM: WA and sets out clear objectives for effective waste management in the port, the implementation of these objectives are predominantly non-compliant. The management of waste on site ranged from excellent at clinics to poor at Marine Areas. Management of documentation and related records and certain site activities is of concern. During the waste audit the researcher found fluorescent tubes incorrectly stored on site of the new fire station. The contractor working on site did not have any receptacles on site to store the fluorescent tubes.

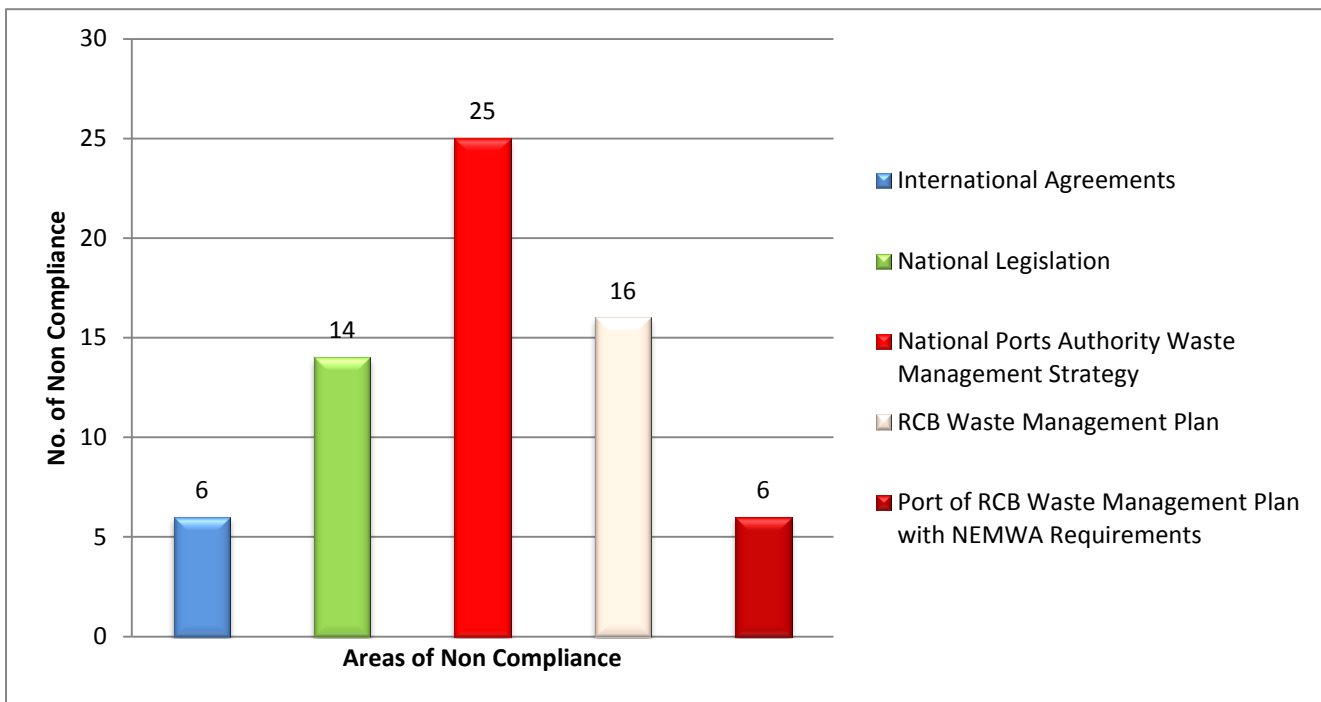


Figure 4.22: Non - compliances with the conditions of the IWMP as well as all relevant International and South African legislative requirements.

4.3.1 WASTE COMPLIANCE AUDIT FINDINGS

COMPLIANCE WITH INTERNATIONAL AGREEMENTS

Table 4.9: Waste Compliance findings

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
Montreal Protocol 1987			
1.	Does TNPA RCB undertake a programme for phasing out of the production of substances that contribute to Ozone Depletion? (This has relevance for waste management in instances where such obsolete products enter the waste stream).	[REDACTED]	NC 1
Rotterdam Convention 1998			
2.	Does TNPA RCB ensure that there is transparency when importing hazardous chemicals? (Although the Rotterdam convention excludes waste, its implementation may lead to bans on listed chemicals).	The Rotterdam Convention is listed in the legal register; however the procedure for the acquisition of hazardous chemicals was not clear at the time of the audit.	NC 2
3.	Does TNPA RCB employ an extended producer responsibility scheme to effectively manage obsolete chemicals?	[REDACTED]	NC 3
Stockholm Convention 2001			
4.	Has TNPA RCB ensured that Persistent Organic Pollutants (POPs) have been phased out and prevented their import or export?	Although the Stockholm Convention is listed in the legal register, it is not presently considered in waste management planning.	NC 4

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
		[REDACTED]	
The Minimata Convention on Mercury 2013			
5.	Does TNPA RCB generate mercury any other waste streams apart from Fluorescent tubes?	The New Mercury Convention is not available on the legal register. The only waste containing mercury that is generated is fluorescent tubes. [REDACTED]	NC 5
International Trade Administration Act (Act 71 of 2003).			
6.	Does TNPA RCB have a permit system to control the import and export of chemicals and hazardous waste specified by regulation?	This legislation was not available on the legal register. [REDACTED]	NC 6

COMPLIANCE WITH NATIONAL LEGISLATION

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
National Ports Act (Act 12 of 2005)			
7.	Rule 148: In terms of Port Rule 148 an application submitted by the prospective waste contractor in terms of a Port Services Licence must register for pollution control (waste management). After a waste service provider is licensed, updates are sent through annually to RCB to show that licensed waste operators are:	TNPA RCB appoints all contractors used on site, and tenants are then required to use the list of approved contractors. [REDACTED]	NC 7

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
	<ul style="list-style-type: none"> Members of the Institute of Waste Management Professional drivers permit Training in the transportation of dangerous goods Trade effluent permits Air emission licenses. etc. 	<p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p>	NC 8
8.	Has TNPA RCB ensured that each vessel has developed a management plan for ballast waste approval by the Harbour Master?	<p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p>	NC 10
9.	<u>Ballast water:</u> As per current legislation, does the port ensure that all vessels which release Ballast develops and submits a Management Plan to the Harbour Master?	<p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p>	NC 11

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
		management plan will need to be aligned to the South African Maritime Ballast Water Management Bill when this is promulgated.	
The South African Maritime Draft for Ballast Water Management Bill 2013			
10.	The Bill provides the requirements that vessels must comply with in terms of Ballast Water, and data that must be reported. The port is required to obtain and review the Ballast Water Management Bill and ensure that it is complied with when it comes into effect.	As above.	See NC 11
National Environmental Management: Waste Act (Act 59 of 2008) Section 21; Schedule 1 Category A, and Schedule 1 Category B:			
11.	Developing a dangerous goods identification and phase out programme?	[REDACTED]	NC 12
Occupational Health And Safety Act (Act 85 Of 1993) Hazardous Chemical Substance Regulations (GN R 1179)			
Regulation 15:			
12.	Does TNPA RCB ensure that wastewater generated flows to a wastewater treatment system, and not to storm water or uncontained surface areas? In addition, does TNPA RCB have agreements with all hazardous waste removal contractors that bind the contractors to compliance with the provisions of GN R 1179?	[REDACTED]	NC 13
Government Notice R 155, Asbestos Regulations & Department Of Water Affairs And			

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
Forestry's Asbestos Waste Disposal Policy:			
13.	Has TNPA RCB maintained a documented waste tracking system for all asbestos waste removed with a view to demonstrating disposal at an H: h or other approved site?	The Asbestos register was reviewed at the Umfolozi training centre at the time of the audit; however the register needs to be updated to include buildings that are not in the register.	NC 14
DWAF Minimum Requirements For the Handling, Classification and Disposal of Hazardous Waste, Second Edition, 1998.			
14.	<u>Disposal of fluorescent tubes:</u> Does TNPA RCB have a procedure detailing method to dispose fluorescent tubes, in accordance with this regulation?	[REDACTED]	NC 15
SANS 10231, SANS 10228			
15.	Do TNPA RCB waste consignments exceed the "exempt quantity" (determined with reference to the particular waste stream and the corresponding "exempt quantity" identified in SANS 10231).	Unknown. Classification would be required to determine types and quantities of hazardous waste. And hazardous waste has not yet been classified.	NC 16
SANS 10406, SANS 10229			
16.	Is the decanting and handling of nominally empty drums undertaken in accordance with SANS 10406?	Decanting and handling of nominally empty drums is not undertaken in accordance with SANS 10229. A copy of this standard is not retained on site.	NC 17
Waste Tyre Regulations (R149, 2008)			
17.	Has a Waste Tyre Storage Area Plan been developed for any Waste Tyre Storage Area (defined a "facility that is used for the temporary storage of waste tyres")?	[REDACTED] • Waste tyre stockpiles may not	NC 18

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
		<p>exceed a height of 3 metres</p> <ul style="list-style-type: none"> Waste tyre stockpiles may not exceed a length of 20 metres Waste tyre stockpiles may not exceed a width of 10 m. <p>TNPA RCB is currently in process of identifying potential service providers to remove/ recycle tyres.</p>	
18.	Has the Waste Tyre Storage Area Plan been approved by the municipal fire department.		NC 19
19.	Is the Waste Tyre Storage Area Plan available on site at all times?		NC 20

COMPLIANCE WITH NATIONAL PORTS AUTHORITY WASTE MANAGEMENT STRATEGY

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
PART 1: GENERAL ASPECTS OF WASTE MANAGEMENT GENERATED BY TNPA AND OTHER STAKEHOLDERS			
21.	<p>TNPA National Waste Management Strategy (2009)</p> <p>Does the TNPA RCB have a copy of the TNPA WMS on site and has this been reviewed and implemented by the designated Waste (Environmental) Management Officer?</p>	At the time of the audit, a copy of the TNPA WMS was not available at the TNPA RCB. Furthermore the Environmental Department was not familiar with the content of the NWMS.	NC 21
Section 2. Roles and Responsibilities			
22.	Develop associated documents and tools to ensure implementation of the plan.	Although the TNPA RCB has developed documentation required for implementation of its waste management plan, important	NC 22

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
		documentation is still not available: <ul style="list-style-type: none"> waste inventory of waste types and volumes are not recorded; management of Ballast water; Tyre abatement plan. 	
23.	Implement the principles and guidelines of this strategy as provided by head office.	TNPA RCB is not complying with all the requirements of the National Strategy. For example, one of the objectives of the National Strategy is to promote awareness to relevant stakeholders and yet not all of the TNPA RCB tenants have been issued with a copy the RCB WMP.	NC 23
24.	Ensure compliance with the port Waste Management Plan.	There are a number of areas where the TNPA RCB operations are not complying with the WMP. Refer to 5.1.2.	NC 24
25.	Develop and monitor key performance indicators (KPIs) to measure waste management performance.	TNPA RCB WMP does not set KPIs hence no measurement of waste management performance is possible.	NC 25
Section 7. Storage and Handling of Waste on Site			
26.	An appropriate storage area is to be identified for different types of waste including a bunded (contained) area for materials containing hazardous waste.	The integrity of waste facilities and storage conditions observed around the site were inadequate: <ul style="list-style-type: none"> Oil waste in the Canteen area as well as the Marine Waste handling area must be bunded and skips must be covered. Hazardous drums containing oils are currently stored outside the designated bund area, adjacent to the fuel tank in the marine department. Waste containers must be sealed in order to prohibit Scavenging animals (monkeys, 	NC 26

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
		birds). <ul style="list-style-type: none"> Redundant waste (electronic waste) is stored at the small craft area, however housekeeping needs to be improved. 	
Section 8. Transportation of Waste On and Off Site			
27.	The requirements and control for transportation include, but are not limited to: <ul style="list-style-type: none"> Labelling of waste containers 	Labelling of all waste bins has not been undertaken. Only galley waste is labelled.	NC 27
Section 9. Disposal			
28.	Waste to be disposed of at authorised landfill site.	[REDACTED]	NC 28
Section 10. Education, Awareness and Information Sharing			
29.	TNPA RCB stakeholders should be trained or made aware of the waste management strategy, programs, principals and the benefits of managing waste within the port.	No training has been undertaken and the training needs matrix is outdated. A training needs analysis for relevant and level appropriate waste training should be scheduled and undertaken. The environmental officer informed that Waste Management Training is currently limited to the following: <ul style="list-style-type: none"> Induction (all employees are inducted) Toolbox talks Environmental awareness 	NC 39

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
		<p>days.</p> <ul style="list-style-type: none"> Operational Procedures. <p>However, no evidence of training was available on the day of the audit.</p>	
30.	Awareness posters should be prepared and distributed amongst stakeholders and be placed on strategic points where the majority of people can see and read them.	No waste management posters were observed within the port area during the audit. It could not be verified if posters had been distributed to stakeholders.	NC 30
Section 11. Monitoring and Measurement/ Compliance and Enforcement			
31.	The implementation of WMS should be monitored and measured. Compliance to legislation including waste bylaws also needs to be monitored.	Compliance with the WMS is not being monitored.	NC 31
Part II: SPECIFIC ASPECTS OF MANAGEMENT OF WASTE GENERATED BY VESSELS			
Section 6. Port Waste Management Plan			
32.	Each port shall develop a port waste management plan which will address the management of waste generated by vessels.	<p>TNPA RCB Waste Management Plan addresses the management of waste from vessels. [REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>A key activity listed in the Waste Management Plan is to develop an inventory/data base for all waste contractors used by ships. However this has not been undertaken.</p>	NC 32
Port waste management plan shall also include information regarding:			
33.	Signage	The WMP requires waste reception facilities to have clear signage and	NC 33

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
		include port control contact details. None of the waste receptacles inspected on site had contact details for Port Control.	
34.	Notification procedure	The WMP does not address notification, and this is not specifically addressed in any procedures.	NC 34
35.	A description of how the prescribed wastes are disposed of	The WMP plan does not describe how each of the main types of waste is to be disposed of.	NC 35
36.	Compliance and enforcement plans	No compliance and enforcement plan is presented in the WMP. The WMP requires weekly inspections of waste storage areas. The Harbour Master and Environmental Management Department can enforce the provisions of the port WMP and recover the costs of remedial action or take legal action against the responsible party.	NC 36
37.	Training and education	No training has been undertaken and the training needs matrix is outdated. A training needs analysis for relevant and level appropriate waste training should be undertaken and should be scheduled.	NC 37
38.	Budget	While the WMP stipulates that sufficient budget must be provided to implement the Waste Management Plan, it does not include the budget required for waste management activities.	NC 38
39.	Maintenance cost	See above. The WMP does not indicate the cost of maintenance activities.	NC 39
40.	Recovery system	There is no financial data recorded in the plan to determine how successful the RCB are at recovering costs.	NC 40

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
41.	Disposal cost	No indication of disposal costs is given in the WMP.	NC 41
Section 10. Waste Stream Analysis			
42.	Each port must keep rigorous records of the type/ classes	TNPA RCB does not keep an electronic database / spreadsheet of waste records. Although records of the general and hazardous waste skips are kept, TNPA RCB does not record type/ classes.	NC 42
Section 12. Compliance with Enforcement Plan			
	The compliance and enforcement plan shall provide for:		
43.	Monitor efficient facilities maintenance (housekeeping)	TNPA RCB does not have a specific compliance and enforcement plan.	NC 43
Section 13. Terminals			
44.	The operator shall provide a waste management plan to TNPA RCB for approval.	At the time of the audit, no Waste Management Plan was available from any operators.	NC 44
45.	Every six months the operator shall provide TNPA RCB with a waste management report.	At the time of the audit, no Waste Management Plan was available from any operators.	NC 45

COMPLIANCE WITH PORT OF RCB WASTE MANAGEMENT PLAN

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
Tenants and Other Port Users: (Collective Responsibility for Maintenance of Good Waste Management Practice)			
46.	Waste Classification Has the responsible department, i.e. Environmental Management, classified its waste into their respective general and hazardous waste streams?	Waste Classification has not yet been undertaken at the TNPA RCB. Waste Characterisation must include the source of waste.	NC 46
47.	Waste Inventory/ Database	A waste inventory has not been developed (waste inventory from 2010	NC 47

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
	Has TNPA RCB obtained waste information from all port users, terminal operators, tenants and contractors on the type of waste they produce and the amounts so that these can be included in the Waste Inventory?	is no longer valid). At the time of the audit not all port users, terminal operators, tenants and contractors have submitted the types and quantities of waste they produce.	
48.	Has a method for monitoring and reporting waste been documented and implemented?	Waste procedures must be updated to document a process for monitoring and reporting waste.	NC 48
49.	Does TNPA RCB provide suitable waste facilities for all types waste streams generated to ensure waste is properly confined (including areas for storage and disposal of the marine department's lubrication oil drums)?	<p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <p>[REDACTED]</p> <ul style="list-style-type: none"> [REDACTED] [REDACTED] [REDACTED] [REDACTED] 	NC 49
50.	Does TNPA RCB employ a standardised colour coding system for waste bins with correct waste labelling and has this been communicated to TNPA: RCB personnel?	Colour coding of waste bins has not undertaken. Only galley waste is labelled.	NC 50
51.	Has TNPA RCB established port housekeeping programmes?	Cleaning staff ensure the site maintains good housekeeping. The environmental department further undertakes visual inspections as part of their site checks	NC 51

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
55.	<p>Waste Transporters</p> <p>Does TNPA RCB audit waste transporters and compile a report with recommendations /comments?</p>	Documentation for registrations and audits of transporters was not available at the time of the audit.	NC 55
56.	Has TNPA RCB audited landfill sites and compiled a report with recommendations/ comments?	The Environmental Department undertakes annual audits of the Landfill sites. [REDACTED] (general) has not been audited and has not been included in the audit programme.	NC 56
57.	<p>Business Unit Managers</p> <p>Has the waste management plan been communicated to all business unit managers and do they take responsibility for the implementation of the plan within his/her business unit?</p>	On the day of the audit training and distribution records were not available to show that Business Unit Managers had received training or copies of the TNPA RCB Waste Management Plan.	NC 57
58.	Has TNPA RCB included waste management on the training needs analysis and developed a waste management training schedule?	At the time of the audit the training needs matrix was outdated and did not identify training needs of all staff in all positions.	NC 58
59.	Does TNPA RCB ensure that all contractors performing work on its behalf have developed an EMP (which includes waste management) prior to commencement with the activity?	<p>On the day of the audit a construction contractor did not have a copy of a SHE Management Plan on site and was not aware of the environmental requirements of the RCB.</p> <p>Although the Standard Operating Procedure for Handling and Disposal of Asbestos Material in the port (SOP 020, rev.03) included a requirement to submit a SHE Management Plan, records were not available at the time of the audit to confirm if this had been done.</p>	NC 59
60.	Has the waste management guideline been communicated and submitted to Lease holders?	On the day of the audit records were not available to reveal that the waste management guideline had been	NC 60

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
		produced and had been communicated with lease holders.	
61.	Does TNPA RCB create awareness regarding recycling opportunities?	Minimal recycling is currently undertaken in TNPA RCB. Records of awareness training regarding recycling opportunities within the TNPA RCB were not available at the time of the audit.	NC 61

**COMPLIANCE OF PORT OF RCB WASTE MANAGEMENT PLAN WITH NEM:
WA REQUIREMENTS**

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
National Environmental Management Waste Act (Act No. 59 of 2008) Section 30 (2)			
62.	(c) Targets for waste minimisation through waste reduction, re-use, recycling and recovery.	TNPA RCB WMP requires port tenants to minimise waste in accordance with the waste management hierarchy and segregate waste. Although the plan refers to waste minimisation, no targets are given for port users or for TNPA RCB themselves. There are also no recycling facilities available to tenants with the exception of IBCs for spent oil.	NC 62
63.	(d) Measures or programmes to minimise the generation of waste and the final disposal of waste.	TNPA RCB WMP requires port tenants to minimise waste in accordance with the waste management hierarchy and segregate waste. Although the plan refers to waste minimisation, no targets or programmes have been developed for port users or for TNPA RCB themselves.	NC 63
64.	(f) The phasing out of the use of specified substances.	The WMP does not address this.	NC 64
65.	(g) Opportunities for the reduction of waste generation through changes to	The WMP does not address this.	NC 65

No.	REQUIREMENT	FINDING	
		DESCRIPTION	
	packaging, production design or production processes.		
66.	(h) Mechanisms for informing the public of the impact of the waste-generating products or packaging on the environment.	The WMP does not address this.	NC 66
67.	(i) The extent of any financial contributions to be made to support consumer based waste reductions programmes.	The WMP does not address this.	NC 67

4.4 QUESTIONNAIRES TO STAFF AT TNPA RCB ON WASTE MANAGEMENT PRACTICES

The staff complement for TNPA RCB is 397. As outlined in chapter 3, an email was sent from TNPA RCB Corporate Affairs department to all staff requesting their assistance in the completion of the questionnaire, attached Appendix 3. The number of questionnaires sent out was 397 and the number returned was 103.

Thus the percentage response rate was 26% from the total staff complement. The response returned represented all levels of the company. The entire questionnaire was made up of fourteen questions. However, not all the questions were answered, therefore the number of respondents differed for each question.

Interpretation of the results is divided by the different sections of the questionnaire as follows:

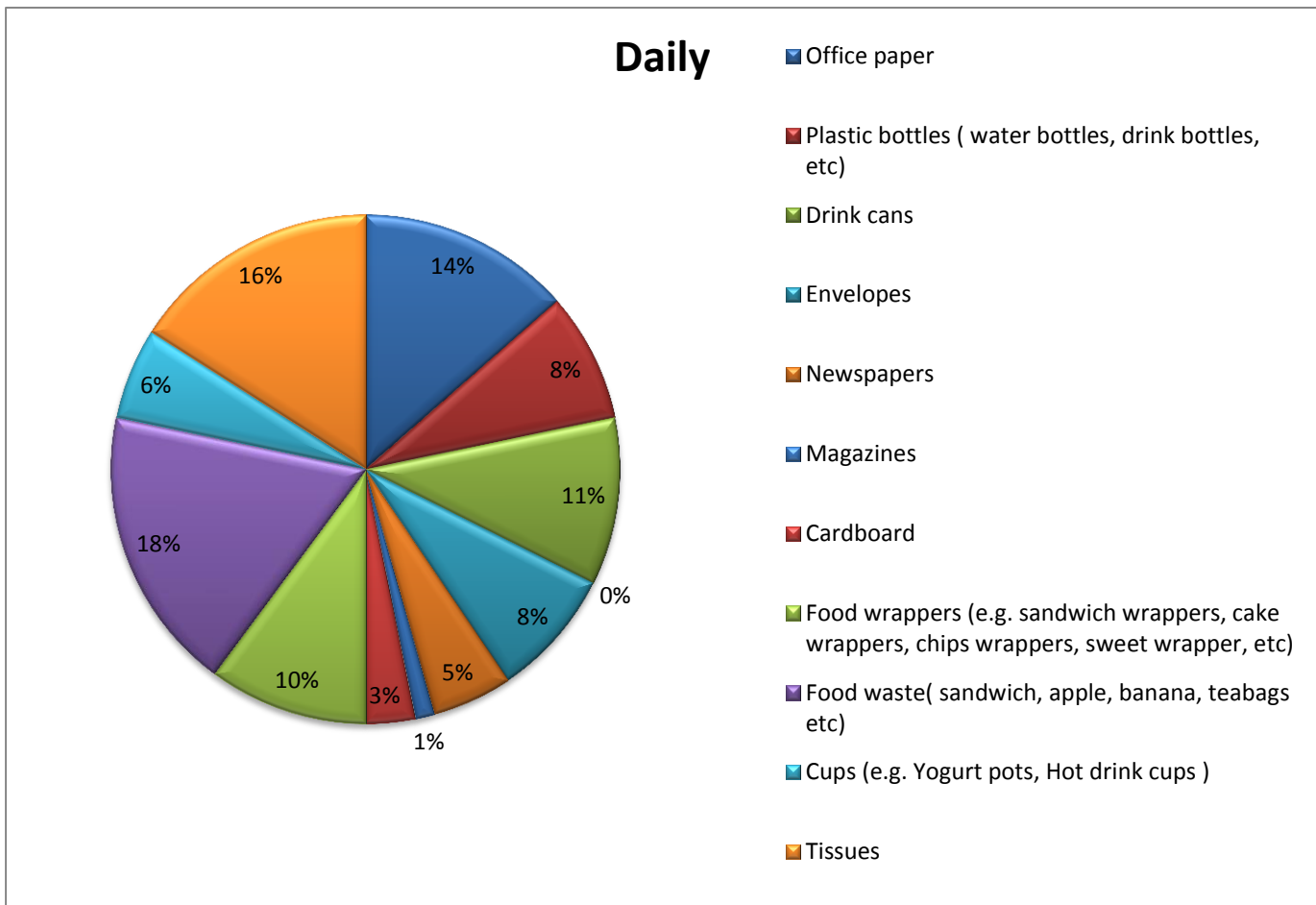
4.4.1 BACKGROUND OF RESPONDENTS

In the first part of the questionnaire, respondents were asked which department they belonged to and their specific roles. The departments represented were HR, Infrastructure, Finance, Marine, SHE (Safety, Health and Environment), Fire, Real Estate and Procurement.

4.4.2 CURRENT WASTE MANAGEMENT IN OFFICES AT TNPA RCB

The percentage (%) at which individuals waste streams are put into office bins daily, weekly and monthly are shown below in Figures 4.23 below. Currently, ink cartridges are diverted

from landfill so they were virtually not found in the waste stream. The emptied ink cartridges



are stored in designated receptacles and removed by the supplier.

Figure 4.23: Daily Percentage at which respondents put waste streams listed in their office bin

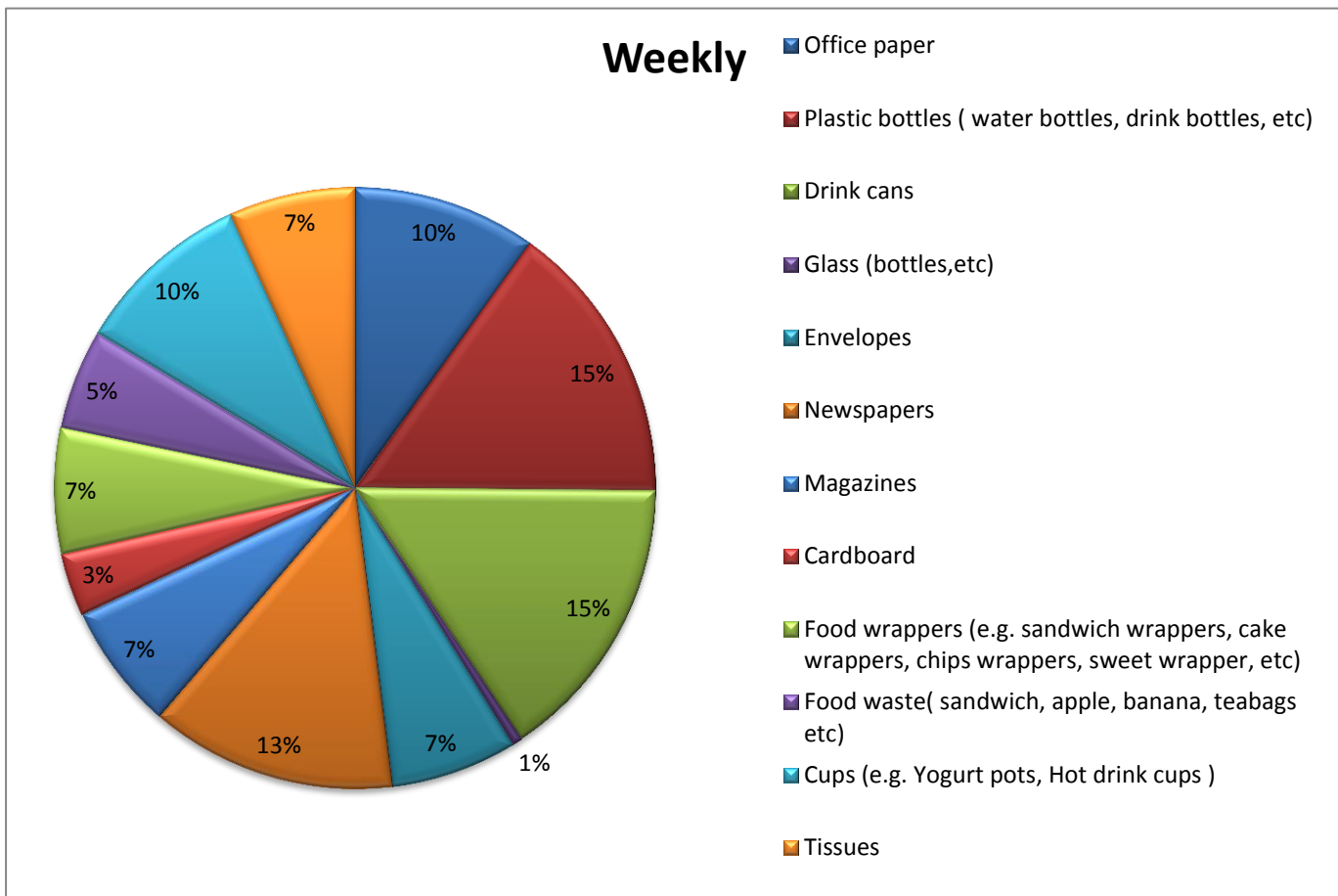


Figure 4.24: Weekly Percentage at which respondents put waste streams listed in their office bin.

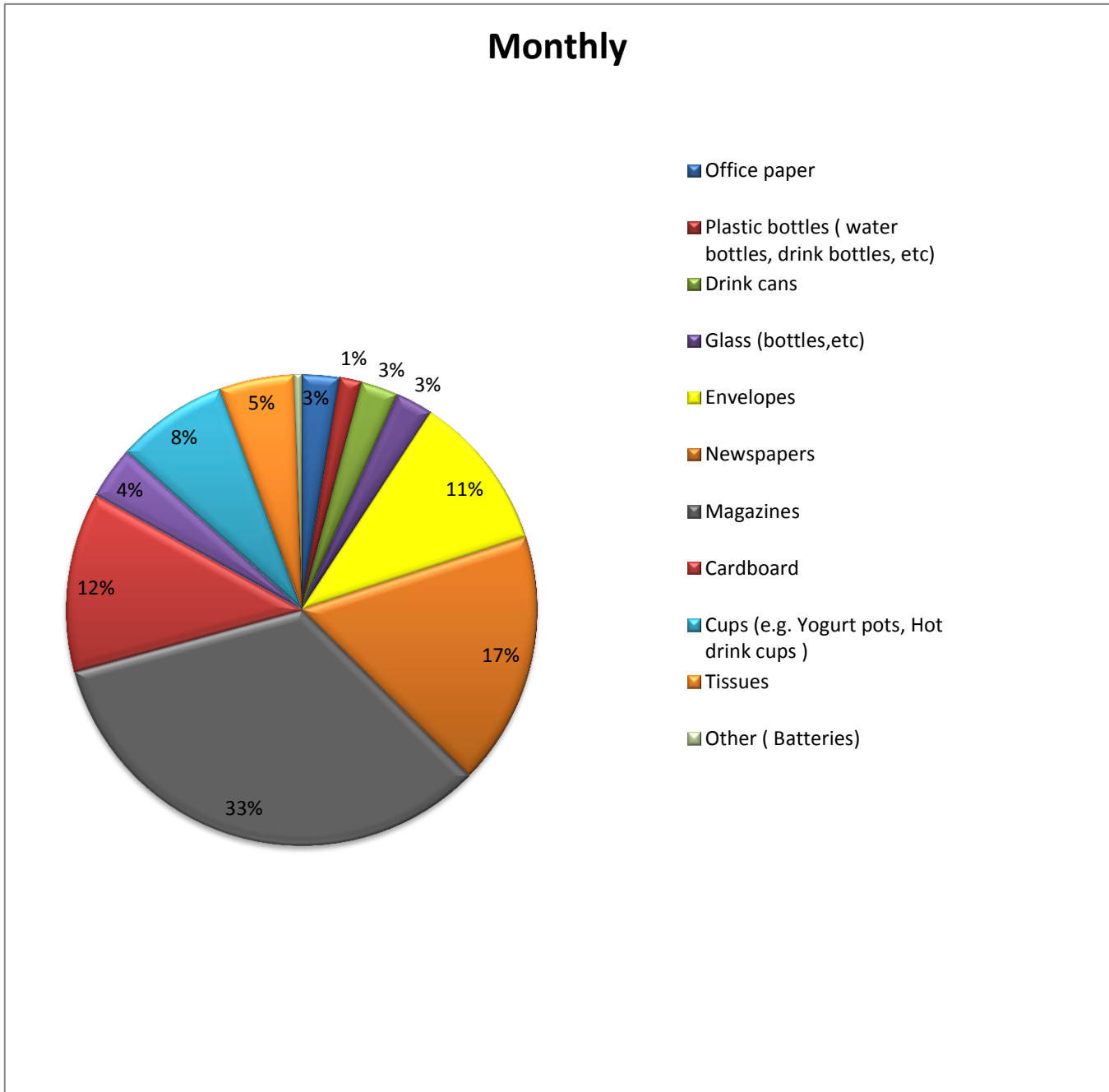


Figure 4.25: Monthly Percentage at which respondents put waste streams listed in their office bin.

- **Awareness**

There is a low level of awareness of the final disposal destination of waste from office bins. A majority of 60% of the respondents are not aware of what happens to their waste while only 40% of the respondents know. From the respondents who are aware of what happens to their waste, 71% of the respondents think that the waste is landfilled and 24% think it is recycled.

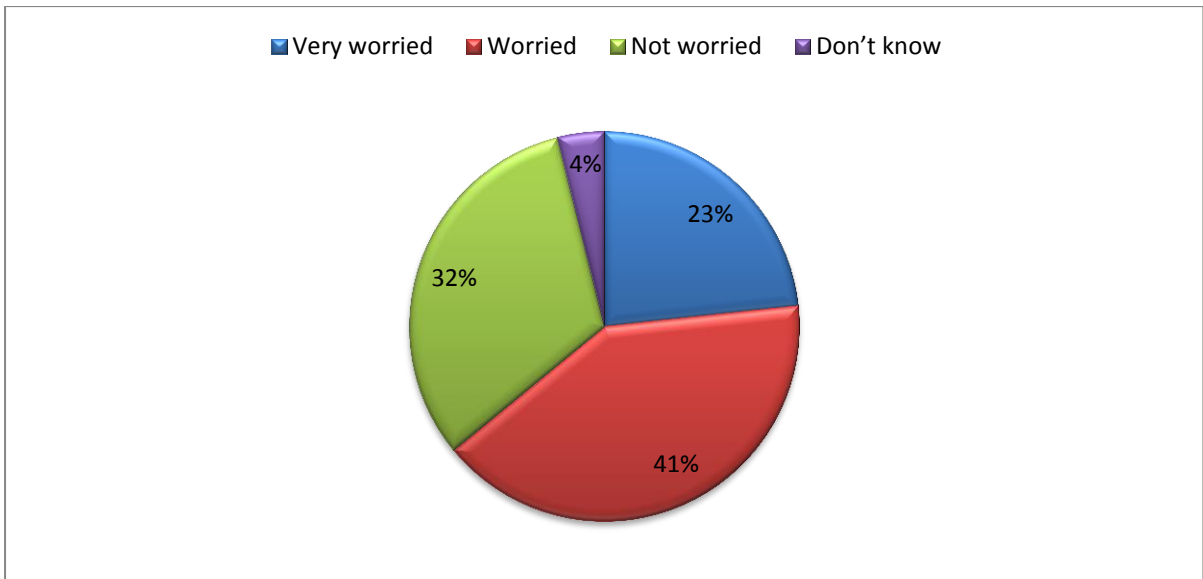


Figure 4.26: Number of people who are concerned about the current waste disposal.

In figure 4.26 above, 32% of the respondents are not worried about what happens to their waste.

Having asked about the awareness and the concerns of waste disposal, the questionnaire further asked how frequently sources of information on office waste management is received. The source that provides the most information is shown in figure 4.27 below.

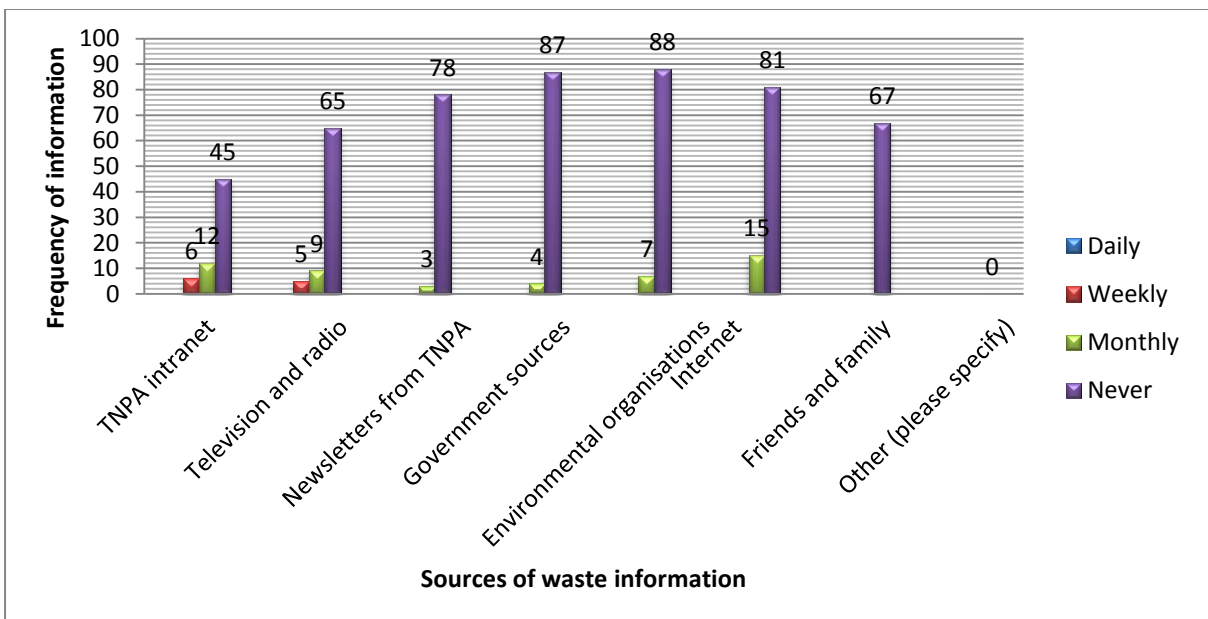


Figure 4.27: Frequency at which information on waste is received through the various sources.

From figure 4.27, only 3 people have read information regarding waste from TNPA newsletters, and 18 through the TNPA intranet. From the figure 4.27 above it can be noted that there isn't sufficient information/awareness on waste management happening on a daily, weekly or monthly basis. From the above figure 4.27 it can be noted that only 21 respondents have received any information from internal communications.

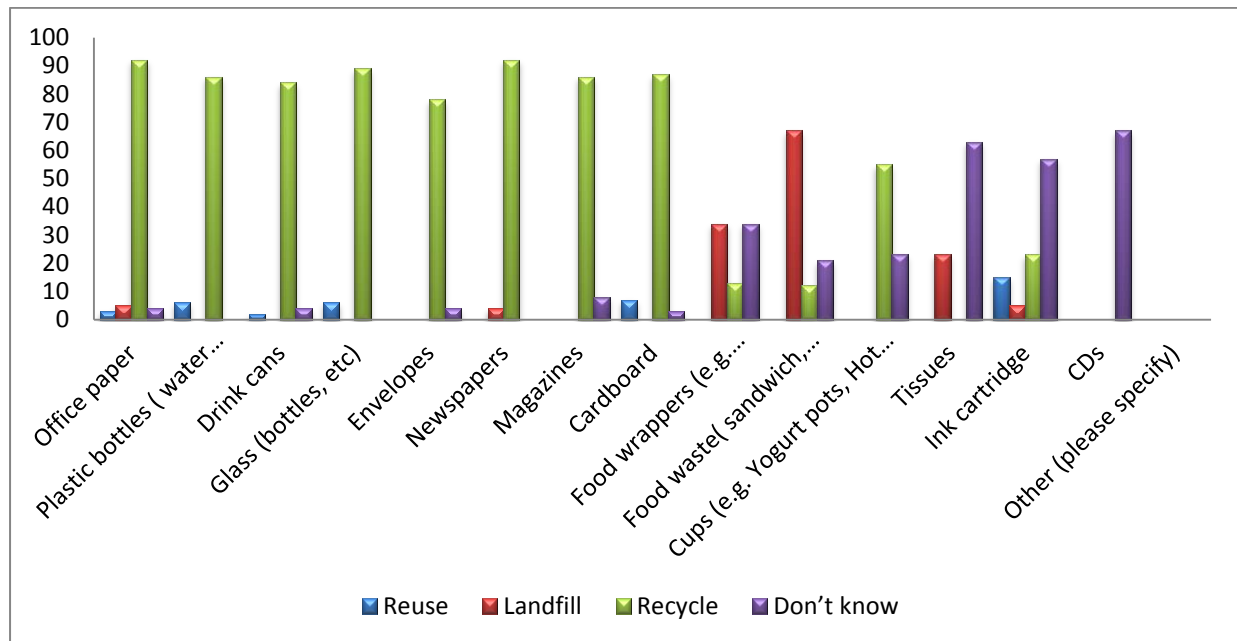


Figure 4.28: Preferred or best option for managing the wastes choice of different types of office wastes.

From figure 4.28, most people believe in recycling. Between 57 and 67 people do not know the best disposal method for CDs and Ink cartridges. Sixty seven people suggested composting for food waste. The following information was gathered about the key barriers to managing waste in the offices:

- Resistance to culture change of staff;
- Lack of knowledge and awareness on waste;
- Lack of recycling facilities and only one bin is provided for all waste in offices
- Staff claim it is time consuming to segregate the waste streams;
- It was also perceived that segregation will require more domestic staff and hence increased cost;
- Cross contamination of waste streams; and finally
- Lack of policies/procedures.

Answers received concerning how these barriers could be overcome are as follows:

- Educating staff;
- Providing recycling facilities and making segregation process easier;
- Increasing staff awareness;
- Providing incentives;
- Using 'green' materials to reduce waste in the first place; and
- Providing office policies.

4.4.3 IDENTIFICATION OF ENVIRONMENTAL CHAMPIONS

The last part of the questionnaire aimed at identifying environmental champions. An environmental champion will encourage colleagues to:

- Use appropriate bins for waste
- Provide feedback to the organisation managing the waste for TNPA RCB and,
- Provide a local point for questions and comments.

A total 68 % of the respondents opted not be an environmental champion and a total 32% of respondents are willing to be an environmental champion.

CHAPTER 5

DISCUSSION

5. DISCUSSION

In this chapter all the findings are discussed and presented in four parts:

- Current waste management practices;
- Waste audit;
- Waste compliance audit;
- Questionnaire.

The limitations of the methods used and analysis performed are discussed in Section 5.4

5.1 CURRENT WASTE MANAGEMENT PRACTICES

TNPA has a responsibility to fulfil its duty of care (Ports Act, 2005 and NEMA s28) to employees and the general public. The environment policy also gives effect to the duty of care obligation on TNPA (TNPA Port of RCB Environmental policy, 2013). After the analysis of information gathered from the interviews, questionnaires, office activities and materials used, it was found that:

- Current practices for the management of general waste streams in offices do not fulfil the principles of the waste hierarchy. Apart from office paper none of the other general waste streams are being recycled.
- Other general waste streams such as cans, plastic, food, glass are not segregated. These waste streams have the potential to be recycled but are not being recycled.
- Ink cartridges are managed well. The emptied ink cartridges are stored in designated receptacles and removed by supplier. The ink cartridges are reused thereby fulfilling the principles of the waste hierarchy.
- Hazardous waste is being well managed in terms of the cradle to grave principle. The wastes are stored in labelled waste receptacles until it is collected by the waste service provider. The TNPA RCB environmental department contacts the waste service



provider to collect and dispose the waste. The waste service provider supplies TNPA RCB environmental department with a disposal certificate to confirm disposal of waste at the appropriately designated landfill site. In terms of the principles of the waste hierarchy which states landfilling should be the least preferred option, the TNPA RCB does not apply that principle when dealing with hazardous waste. There has been no noticeable attempt to explore other means to manage hazardous waste.



- E-waste which included screens, keyboards, plugs, cables is poorly managed, it is currently stock piled and no disposal plan exists. There has been no noticeable attempt to find a service provider to remove the E-waste.
- Fluorescent tubes are managed well. Fluorescent tubes are stored in designated marked waste receptacles. The fluorescent tubes are collected as and when required by the contracted waste service provider. The TNPA RCB electrical department notifies the environmental department to contact the service the provider to remove and dispose of the fluorescent tubes.
- The operations element of galley waste is well managed at the TNPA RCB. TNPA RCB was found to be adhering to the requirements of the TNPA NWMS regarding galley waste management.
- The financial element of galley waste management should be improved. The current tariff costs imposed on the vessels covers 5% of the total cost for the removal and disposal of galley waste. This results in TNPA RCB paying for 95% of the total cost for the removal and disposal of this waste even though TNPA RCB are not the producers of galley waste but merely the facilitators of the waste service. During the waste audit it was noted that the TNPA RCB environmental team were using budget designated for other environmental functions to manage the galley waste. The tariff cost should reflect the true cost associated in collecting and disposing of galley waste at Shongweni landfill (located 260kms away from TNPA RCB) site.
- Waste paper makes up 18% (74kgs) of the total general waste produced by TNPA RCB. The possible reason for this would be that not all printers have been set to print on both sides. As a result most documents are printed on single pages. This results in paper wastage and hence does not meet the 'REDUCE' principle of the waste


hierarchy. However, some official documents such as monthly reports are best printed on single sides.

The Table 5.1 below provides an estimate on the costs to establish a Waste Recycling Programme for the TNPA RCB based on the findings from the research. TNPA RCB will have to partner with recycling contractors to take recyclables for free. The researcher has identified recyclers that have the potential to implement the recycling programme (Rogoff, 2013).

Table 5.1: Estimated Cost of implementing a Waste recycling programme for the TNPA RCB

Types of bins	Reasoning for waste receptacles	Pictures	Quantity	Cost	Total cost
Desk side bins	<ul style="list-style-type: none"> • Desk side bins will be made available to those that have their closed offices. • Desk side bins are small and don't take space in an office. • Made from 100% recyclable polypropylene 		100	R 69 each.	R 6900
Triple Recycling Collection Cart	<ul style="list-style-type: none"> • This high capacity cart enables multi-stream sorting for efficient, cost-effective waste collection. • Cart carries 3 high-capacity vinyl bags • PVC lined, leak-proof vinyl bag with zipped front access makes waste removal easier (bags sold separately). • Each bag holds up to 128.7 Litres, reducing the frequency of trips to empty waste and improving productivity. 		10	(Triple Recycling Collection Cart) R 3 623 each R 36230 (Set of 3 vinyl bags: blue, red, green) R 1 322 R13220	R 49450

Recycling Igloo	<ul style="list-style-type: none"> The igloo will serve as a storage/collection point for the waste from TNPA Buildings. You are able to throw your recyclable into one of the three openings and these recyclables are directed into either a 1-ton capacity bulk bag or 3 separate 210 litre drums (available separately). Importantly, these recycling igloos can be emptied by all recycling collectors, as it only requires manual handling to empty, by either using the top or the front openings 		20	R 5544 each	R 110880
Custom-made Leather-touch Recycling Bin Range	Made locally from recycled and recyclable ABS (polystyrene) plastic (and not made of leather!), these custom made recycling bins come in black and are printed with the waste names, as well as TNPA corporate logo at no additional cost.		20	R 2 077 each	R 41540
Total cost of infrastructure required to establish a Recycling programme at TNPA RCB					R208770

<p>Mobile Composting Unit</p>	<ul style="list-style-type: none"> • The MCU is a vessel composting bin that bulks and manages organic waste. • Organic waste is placed into the MCU, which is then closed (via a tarpaulin cover) and air is pumped through the bin, initiating the composting process, whilst removing odors and bacteria. • Bio-filter supplied (comprises of special compost mixture). • Applications include food waste. • By converting the waste to compost in the MCU, methane (21 times greater impact on global warming than carbon dioxide) production is reduced. • Maintenance contract included • 3 year rental contract Standard size is 6m³. 		<p>2</p>	<p>R1500 per month rental.</p>	<p>R 3000</p>
-------------------------------	--	--	----------	--------------------------------	----------------------

5.2 WASTE AUDIT OUTCOMES

The audit established a baseline indicator from which the effectiveness of recommended techniques, and future analysis, can be gauged. It also provided an opportunity to know the types, the quantities of wastes and also how much waste could be diverted from landfill. Clearly, it is very important to know what materials are present in the waste stream and in what proportions, before any plans are made to introduce best available techniques. The waste materials within the office waste fall into three broad categories (Lombard *et al.*, 2009):

1. Dry recyclables-paper, cardboard, glass, plastics, etc.
2. Organic material food waste;
3. Miscellaneous materials.

The audit data revealed that the largest contributor of office waste by weight is office paper and food wastes both at 28% each. The most desirable option in the waste hierarchy (figure 2.2) is to reduce waste production and TNPA RCB should focus on reducing these dominant streams.

The use of newspapers and magazines (13% of the waste) is also high. This is due to the fact that TNPA receives a sponsored newspaper. TNPA RCB should recycle these newspapers or request fewer copies. The fewer copies can be placed at strategic positions i.e. communal staff area and waiting areas.

The total mass of waste estimated per year (250 working days 2014 x estimated waste per day) that could be diverted from landfill through recycling is 8470 kg including 2855 kg of office paper, 1277 kg newspapers and magazines, 712 kg of aluminium drink cans, 850 kg of recyclable plastic and the composting of 2775 kg of food. This mass represents the minimum since there is a possibility of an increase in subsequent years. Table 5.2 below-indicates the estimated average of recyclable waste generated at TNPA RCB.

Table 5.2: Average recyclable waste generated at TNPA RCB per year.

Waste stream	Mass (kg/10 day audit period).	Waste (kg/ day)	Waste Avg (kg/250 day) generated per year (250 working days 2014)
Food waste	111	11	2775
Cans (beverage, aluminium).	28	2.8	712
Recyclable plastic	34	3.4	850
Paper	114.2	11.4	2855
Newspaper and magazines	51	5	1277
Tissue	23	2.3	580
Glass	7.6	0.76	190

The baseline information from the audit demonstrates that there are waste streams such as office paper, newspapers and magazines, A4 ream cardboard, glass, plastic bottles, cans and food that can be diverted from landfill by means of reduction, reuse or recycling. Reduce, reuse, recycling, and any other kind of revalorization of waste designed to return waste to the production cycle have thus become more and more commonplace. However it is not evident at TNPA RCB. Applying these ‘3Rs’ – reduce, reuse and recycle (Lombard *et al.*, 2009) shown in the waste management hierarchy in figure 2.1 of chapter two, efforts could be made to reduce the use of office paper, newspapers and magazines and envelopes. Recommendations on these are given in chapter 6. Where reducing is not possible, waste management best practise indicates that identified waste streams such as plastic bottles, cans and food which could be diverted from landfill can be recycled (CSIR, 2011).

Four basic requirements need to be in place before materials recycling can occur successfully. These are

1. There must be reliable supply of suitable waste materials;
2. There must be means to collect and transport these materials for reprocessing;
3. There must be means to reprocess into suitable raw materials and products;
4. There must be suitable markets for products produced by the recycling process (CSIR, 2011).

5.3 WASTE COMPLIANCE AUDIT

In order to identify an organisations' adherence to regulatory requirements it is necessary to conduct a waste compliance audit based on legal and physical adherence. Compliance to Environmental legal requirements is one of the critical phases identified in the TNPA Waste Management Strategy, 2009.

The general impression gained during the waste compliance audit was that TNPA RCB was partially compliant with the International Legislation and National obligations. TNPA RCB was found to be non-compliant in a number of areas within the TNPA Waste Management Strategy.

Waste management procedures need to be reviewed, as many of the current waste practices are insufficiently documented, including a lack of clearly defined roles and responsibilities by management and staff and what was observed for certain activities on site. The records found at the environmental department were not correctly stored and required processing to ensure correct data representation thus introducing some biases or compromising reliability.

TNPA RCB WMP is not aligned to the TPNA WMS nor the requirements of the National Environmental Management: Waste Act (2008) and current waste legislation.

Some of the non-compliance issues identified during the audit include failure to comply with international agreements such as the Stockholm Convention 2001 i.e. TNPA staff was not aware of any POPs being generated in the port. POPs emanate from a variety of industrial processes located within TNPA RCB and can be found in electrical transformers, and capacitors, and as additives in paint, carbonless copy paper, and plastics. TNPA SHEQ department has not ensured that POPs have been phased out and preventing their import or export. Non - compliance with national legislation such as the National Ports Act (Act 12 of 2005) e.g. the RCB does not currently have a Ballast Water Management plan. The relevant plan should list all applicable legislation and define roles and responsibilities for managing ballast water record keeping. The plan should describe the requirements for ballast water exchange. The ballast water management plan will need to be aligned to the South African Maritime Ballast Water Management Bill when this is promulgated.

A key issue is that the WMP has no comprehensive implementation plan making it difficult to measure the successful implementation of the plan. The development of an implementation or action plan is a critical part of the Industry WMP as it defines its success or failure. Once a

preferred option has been agreed upon and accepted by all relevant parties, including management at the decision-making level, a plan must be developed to implement these options. The plan should consist of a number of projects, aimed at achieving the identified goals, objectives, targets and activities with defined budget provisions and organisational responsibilities (DEADP, 2011).

The implementation plan may address, amongst others, the following issues (DEADP, 2011):

- A list of all options, goals and objectives considered and agreed upon for implementation;
- A breakdown of all activities per objective with clear target dates by which such activities will have to be completed;
- A breakdown of financial requirements for each activity;
- Institutional and organisational arrangements. This may include clarity regarding responsibilities for the organisation, planning and implementation of activities to achieve objectives;
- A schedule for implementation;
- Highlights regarding uncertainties (i.e. risks and challenges) likely to affect the achievement of goals and objectives;
- Strategies to address potential risks; and
- Indications of returns on investment.

General housekeeping on site is very poor in certain areas, particularly the marine storage area. The housekeeping issues range from litter on site, cross contamination of waste in waste receptacles to bunded areas for chemicals/oils are not properly maintained.

Compliance monitoring and enforcement of waste requirements is not effectively executed by TNPA RCB Environmental department. Tenants/contractors of the port are not being thoroughly audited against the applicable waste legislation and TNPA RCB WMP. TNPA RCB SHE department should monitor contractors working on site to ensure they are complying with the environmental management programme.

Waste information management in the TNPA RCB needs to be improved. It was evident on site that tenants and TNPA are not freely sharing records on waste generation and disposal. As per contractual conditions with TNPA RCB all tenants are required to provide waste generation to TNPA RCB as and when required. TNPA RCB is currently developing a consolidated waste information system, this system should improve record keeping. This

Waste information system is part of TNPA Head office initiative to enable the ports to easily manage their data.

The NEM: WA lists the different sections of the waste act where-in non-compliance constitutes an offence. The penalties for each offence are set by the Magistrate, however, the Act gives the maximum of R10 000 000 or maximum of 10 years imprisonment or both. Penalties vary depending of the extent and severity of the offence.

1. Any person that commits an offence in terms of section 15, 16(1), of the act will be liable to a fine of not exceeding R10 000 000.00 or imprisonment for a period not exceeding 10 years;
2. any person that commits an offence in terms of section 21, 22(1), 24, 27 will be liable to pay a fine not exceeding R5 000 000.00 or imprisonment not exceeding 5 years;
3. any person that commits an offence in terms of section 67 (m) will be liable to a fine or to imprisonment for a period not exceeding six months or to both a fine and imprisonment; 47
4. any person who is found guilty of an offence and who continues to commit that offence is liable on conviction to a fine not exceeding R1000 or imprisonment for a period not exceeding 20 days.

5.4 QUESTIONNAIRE OUTCOMES

The influence of human activities on categories of waste put into the office bin was confirmed after the analysis of the questionnaire. Pilar (2003) suggested the use of a questionnaire to establish likely links between environmental awareness and attitudes relating to how waste is managed; and to identify possible barriers and solutions to managing waste more sustainably. Monahan (1990) proposed using available industry information and a questionnaire survey to analyse the generation, type and composition of waste. The number of questionnaires sent out was 397 and the number returned was 103. The questionnaires which were not returned might be due to apathy or busy schedules of some staff.

It can be deduced that paper is a key material used in offices due to the high percentage (56%) put into bins daily and it is confirmed by the relationship between the daily input and the total amount found in the waste stream (111 kg, 28%); which is the second highest. Further analysis shows that 40% of staff do not know what happens to their waste and have

little or no information on office waste. These answers received from the questionnaire reveal that training and staff awareness is needed for the development of new strategies. Recycling was preferably selected as the option for managing all the waste streams shown in figure 4.29, supporting the claim that recycling is one of the most sustainable and most effective ways to involve staff to become aware of environmental issues.

5.4.1 STAFF PARTICIPATION

Staff participation is essential for internal waste management (Glasson *et al.*, 1999). This can be achieved by establishing a dialogue between top management, staff and waste contractors. Communication amongst staff is vital in the success of implementing sustainable techniques of waste disposal. Internal newsletters, presentations, stickers and posters are ways new initiatives are communicated in large organisations (Chung, 2007). These forms of communication need to be clear (so there is no misinterpretation), concise, continuous and connected so it makes sense to the staff.

Top management commitment of TNPA RCB and all staff are strongly required to ensure success and efficient running of office waste reduction and recycling. This will not only eliminate the issue of apathy but also increase morale.

CHAPTER 6

CONCLUSIONS, RECOMMENDATIONS, LIMITATIONS AND FURTHER

SUGGESTED RESEARCH

6.1 CONCLUSION

The case study of TNPA RCB emphasises the need to deal with waste more sustainably. The conclusions of the project are based on the data and analysis presented in sections 4 and 5. These are that:

- The general impression gained during the audit was that the Port of RCB was partly compliant with the International Legislation and National obligations. Non-compliance with International Legislation includes Rotterdam Convention 1998, Montreal Protocol 1987, Stockholm Convention 2001, The Minamata Convention on Mercury 2013, and the International Trade Administration Act (Act 71 of 2003).
- TNPA RCB was found to be non-compliant in a number of areas with the TNPAWMS (Appendix 2). Non-compliance with TNPA National Ports Authority WMS includes Roles and Responsibilities, Storage and Handling of Waste on Site, Transportation of Waste On and Off Site, Disposal, Education, Awareness and Information Sharing.
- Office papers, newspapers, magazines, A4 reams boxes and other smaller boxes, recyclable plastic bottles , glass, cans and envelopes dumped into office bins can be diverted from landfill and sent for recycling.
- TNPA RCB is not recovering adequate amounts of money for the provision of the galley waste service. TNPA RCB spends R 1 408550.51 on the provision for galley waste skips but only recovers R 77420 through the Ports Tariff system. It is recommended that TNPA RCB investigate this further to ensure financial savings are realised as well as ensure that sustainable waste management practices are followed.
- Financial savings could be made by employing the three R's – reduce, reuse and recycle in the waste management hierarchy, and where these are not feasible, to optimise the final disposal. Therefore primary importance should be given to recommendations implying reduction, followed by reuse and then recycling.

- The questionnaire revealed that staff members are not aware of issues relating to their waste. Therefore the role of communication and staff awareness is of vital importance since staff participation is most likely to influence the outcomes of these new strategies.

6.2 RECOMMENDATIONS

Recommendations are given based on the waste management hierarchy using the three ‘R’s – reduction, reuse and recycling, with the last alternative should be landfilling. Compliance to the IWMS, international and national regulations, is to be achieved within timeframes determined within the scope of the strategies to be determined from this report.

6.2.1 WASTE MANAGEMENT ISSUES AT TNPA RCB

The following are some general recommendation:

- TNPA RCB needs to review and update the following sections of the waste management strategy:
 - PART 1: GENERAL ASPECTS OF WASTE MANAGEMENT GENERATED BY TNPA AND OTHER STAKEHOLDERS
 - Section 2. Roles and Responsibilities;
 - Section 5. Port Waste Management Plan;
 - Section 7. Storage and Handling of Waste on Site
 - Section 8. Transportation of Waste On and Off Site
 - Section 9. Disposal
 - Section 10. Education, Awareness and Information Sharing
 - Section 11. Monitoring and Measurement/ Compliance and Enforcement
 - Part II: SPECIFIC ASPECTS OF MANAGEMENT OF WASTE GENERATED BY VESSELS
 - Section 1. TNPA aims regarding waste generated by vessels
 - Section 6. Port Waste Management Plan
 - Section 10. Waste Stream Analysis
 - Section 11. Record Keeping
 - Section 12. Compliance with Enforcement Plan
 - Section 13. Terminals

- TNPA RCB needs to formalise their waste collection areas for both hazardous and general waste (i.e. according to waste management specifications)
 - Winning support from top management by emphasising the potential cost savings of sustainable waste management. This can be achieved by awareness through regular meetings, measurement and reporting of waste data.
 - Leading by example (Environmental Department) is one way sustainable techniques can be implemented.
 - Suggestions for the waste separation and management thereof could be: transparent polythene bags could be used for collecting materials being diverted from landfill and black polythene bags for other waste streams. This can be achieved once a recycling programme is in place and the correct waste receptacles are available to the TNPA staff.
 - Real cost savings resulting from diverting waste from landfill could be communicated amongst to other departments to strengthen their impetus towards recycling;
 - The four 'C's, communication, consultation, cooperation and coordination need to be addressed;
1. Sustainable waste management practices must be a top to bottom effort. Communication will be needed between staff and management, between office staff and cleaning staff.
 2. Consultation concerning materials being diverted from landfill must be displayed pictorially.
 3. Everyone needs to cooperate especially with sorting out waste types such as office paper. Cooperation can be achieved by celebrating every milestone achieved, large or small. This allows people to recognise that progress is being made, and focus on the next step.
 4. TNPA RCB must coordinate with environmental champions to devise communication systems, motivation, provide feedback and measure its effectiveness.

- Promotion of environmental champions to encourage colleagues on the impacts of correct and sustainable waste management;
- Review and monitor types and sources of waste produced by collecting information on quantities involved and the associated costs. This can be achieved by conducting annual waste audits;
- Generate waste data and prioritise areas where biggest savings can be made;
- Identify waste minimisation techniques and setting up internal waste management policy with clear objectives and realistic targets to be implemented in all offices;
- Review progress against set targets. This should be conducted by senior management, at planned intervals to ensure continuing effectiveness and suitability. Reviews will assess opportunities for improvement or change. Internal audits can assist with the senior management reviews;
- Provide feedback on achievements to management and TNPA staff. This can be done bi- monthly or quarterly;
- Education of staff members to proceed with posters marketing the importance of the three R's - reduce, reuse, recycle;
- Establish a 'Green Hotline', so that staff suggestions for ways of improving the new strategies, either by phone or through their personal computer's electronic mail service, could be recorded and responded to;
- Purchase and distribute appropriate containers for the site's new recycling needs;
- Raise environmental awareness through workshops, meetings, activities;
- Use transparent polythene bags for office waste.

6.2.2 WASTE REDUCTION RECOMMENDATIONS

Waste reduction initiatives recommended are as follows:

- Reduce the use of paper by printing and photocopying on both sides, setting print out to 12pt or less;

- Provide quick and easy access to information electronically to reduce paper requirements and increase the use of email while discouraging the printing of messages;
- Minimise the use of polystyrene by requesting the canteen to use recyclable friendly material;
- Share newspapers amongst staff or subscribe and read on-line;
- Avoid over subscription of trade magazines, cancel duplicate issues.
- Oils and other consumables etc. must be effectively managed for efficiency optimisation. This requires training on engineering staff for prudent use of resources.

6.2.3 WASTE REUSE RECOMMENDATIONS

Waste reuse initiatives recommended are as follows:

- Reuse scrap paper for printing draft copies, internal notices and for making note pads;
- Reuse envelopes by purchasing envelopes designed for internal use only, and which could be circulated several times. Internal envelopes should not have a sticky seal so that after its useful life it can be disposed appropriately;
- Reuse cardboard boxes internally to store materials;
- Reuse water bottles by not purchasing new ones all the time (also to have “sports or running water bottles” to top up).

6.2.4 WASTE RECYCLING RECOMMENDATIONS

Recycling extends the time over which consumables and products which are no longer serviceable are used. Waste recycling initiatives recommended are as follows:

- Introduce recycling collection points on each building,
- Ensure office paper, newspapers and magazines, plastic bottles, small cardboards, which cannot be reused are recycled;
- Review of all purchases to minimise the acquisition of products that are difficult to be recycled. Implement a green procurement program at the TNPA RCB to source only environmentally friendly products and services.

- Identify local food recycling program to ensure food wastes are not landfilled.

6.3 LIMITATIONS AND FURTHER SUGGESTED RESEARCH

The research was focused on waste management practices at TNPA RCB.

Limitations in the method and analysis are as follows:

- The waste audit of hazardous waste streams was only based on records provided not site inspection due to the unsafe nature of the waste stream.
- A large portion of the DWAF Minimum Requirements has been replaced by the Waste Classification and Management Regulations. The site was not audited in terms of these Regulations.
- The waste was collected during 10 days, however the aim of the project was not to quantify waste composition on a daily basis but to obtain baseline data which will be useful for future work.
- The response rate for the questionnaires could have been higher than 26% if the questionnaire was administered on a one-to-one basis. Although the response rate was 26% the researcher did get response from all levels of the business with 103 returned questionnaires.

Suggested further research is as follows:

- Research for the development of a waste minimisation plan for TNPA RCB: status quo and waste minimisation options report. Report to include:
 - Identification of local municipal recovery initiatives;
 - Identification industry recovery initiatives;
 - Identification private initiatives; and
 - Identification of waste minimisation options.

REFERENCES

ABP Research (1999). Good practice guidelines for ports and harbours operating within or near UK European marine sites. English Nature, UK Marine SACs Project.

Bailey, D., Plenys, T., Solomon, G. M., Campbell, T. R., Ruderman Feuer, G., Masters, J., & Tonkonogy, B. (2004). *Harboring pollution – The dirty truth about U.S. ports*. Retrieved from <http://www.nrdc.org/air/pollution/ports1/ports.pdf>. Accessed: March 2013.

Ball, J. (2006). Waste management in developing countries: Seven characteristics and seven principles. Waste 2006 Conference, Statford-upon-Avon, Warwickshire, UK.

Bosman, C. (2009). Integrated Waste Management. In Strydom HA, King ND (Eds): *Environmental Management in South Africa*. Cape Town: Juta Law.

Bouwman, H. (2004). South Africa and the Stockholm Convention on Persistent Organic Pollutants. *South African Journal of Science*, Volume 100, Pages 323 - 328.

Bryman, A. (2004). *Social Research Methods* (2nd edition). Oxford: Oxford University Press.

Burns, R.B. (2000). *Introduction to research methods*. 4th ed. London: SAGE Publications.

Cagno, E, A Di Giulio and P Trucco (1999), "A methodological Framework for the Initial Environmental Review (IER) in EMS Implementation", *Journal of Environmental Assessment Policy and Management*, Volume 1(4), Pages 505-532.

Chung, S.S. & Leung, M.M. (2007). The value-action gap in waste recycling: The case of undergraduates in Hong Kong. *Environmental Management*, Volume 40 (4), Pages 603-612.

Constitution of the Republic of South Africa. (1996). Bill of Rights. Pretoria.

CSIR. (2001). Guidelines for Human Settlement Planning and Design Volume 2. Pretoria.

CSIR. (2011). *Municipal waste management – good practices. Edition 1*. CSIR, Pretoria.

Davidson, I. C., & Simkanin, C. (2012). The biology of ballast water 25 years later. *Biological invasions*, Volume 14(1), Pages 9-13.

DEA. (2011a). Department of Environmental Affairs. National Waste Management Strategy. Pretoria.

DEADP. (2011). Department of Environmental Affairs and Development Planning .Industry Waste Management Plan Guideline. Cape Town.

DEA. (2012a). Department of Environmental Affairs: National Waste Information Baseline Report. Pretoria.

DEA. (2012b). Department of Environmental Affairs: National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants. Pretoria.

DEAT. (2009a). Department of Environmental Affairs and Tourism. National Waste Management Strategy- Phase 2 Research. Summary of key strategic issues to inform NWMS. Pretoria.

DEAT. (2009b). Department of Environmental Affairs and Tourism. Addressing challenges with waste service provision in South Africa. Waste sector challenges and vision report. Pretoria.

DEC, NSW. (2006). Department of Environment and Conservation, New South Wales. Guidelines for the NSW Site Auditor Scheme (2nd edition).

Derraik, J. G. (2002). The pollution of the marine environment by plastic debris: a review. *Marine pollution bulletin*, Volume 44(9), Pages 842-852.

DWAF. (1997). Department of Water Affairs and Forestry. Waste Management Series. Towards Formulation of a Waste Management Strategy for South Africa Second Draft, November 1997. Pretoria.

www.ewasa.org: Accessed: 4th May 2015.

Farrington, J. W. (2014). Oil Pollution in the Marine Environment II: Fates and Effects of Oil Spills. *Environment: Science and Policy for Sustainable Development*, Volume 56(4), Pages 16-31.

Fenco Maclaren Inc. & Angus Environmental Inc. (1996). Waste Audit User's Manual, A comprehensive Guide to the Waste Audit Process. Canadian Council Ministers of the Environment.

Fleisher, J. M., Fleming, L. E., Solo-Gabriele, H. M., Kish, J. K., Sinigalliano, C. D., Plano, L., ... & Backer, L. C. (2010). The BEACHES Study: health effects and exposures from non-point source microbial contaminants in subtropical recreational marine waters. *International journal of epidemiology*, Volume 39(5), Pages 1291-1298.

Galgani, F., Hanke, G., Werner, S., & De Vrees, L. (2013). Marine litter within the European Marine Strategy Framework Directive. *ICES Journal of Marine Science: Journal du Conseil*, Volume 70(6), Page 1055-1064.

GESAMP. (2001). Protecting the Oceans from Land-based Activities - Land-based Sources and Activities Affecting the Quality and Uses of the Marine, Coastal and Associated Freshwater Environment, GESAMP Reports and Studies 71.

Goldblatt, M. (2009). Macroeconomic trends, targets and economic instruments.

Available:http://wastepolicy.environment.gov.za/sites/default/files/Macroeconomic_trends_targets_economic_instruments.pdf Accessed: 12 February 2013.

Hall, K. (2000). Impacts of Marine Debris and Oil. *Economic & Social Costs to Coastal Communities*. Publication of Kommunenes Internasjonale Miljøorganisasjon (KIMO).

<http://www.kimointernational.org/WebData/Files/Karensreport.pdf> Accessed: 18 February 2013

Karani, P. & Jewasikewitz, S. M. (2007). Waste management and sustainable development in South Africa. *Environment, Development and Sustainability*, volume 9 (2), pages 163-18.

Lombard, R., Lombard, J., Lombard, R. & Van der Merwe, M. (2009). Sustainable Waste Management Guideline. Ethekwini Municipality.

Available: <http://www.imaginedurban.org/Pages/Guidesandmanuals.aspx> Accessed: November 2012

MARPOL. (1973). Marine Pollution Convention and associated regulations. Available:

[http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-\(marpol\).aspx](http://www.imo.org/about/conventions/listofconventions/pages/international-convention-for-the-prevention-of-pollution-from-ships-(marpol).aspx) Accessed: November 2012

Misra, V. & Pandey, S. (2005). Hazardous waste, impact on health and environment for development of better waste management strategies in future in India. *Environment International*, Volume 31, Pages 417-431.

Mohee, R., Surroop, D., Mudhoo, A., & Rughooputh, B. K. (2012). Inventory of waste streams in an industrial port and planning for a port waste management system as per ISO14001. *Ocean & Coastal Management*, Volume 61, Pages 10-19.

Monahan, D, J. (1990). Estimation of Hazardous Wastes from Employment Statistics: Victoria, Australia. *Waste Management and Research*, Volume 8, Pages 145-149

Mora, E., Orejas, J. M., Subirats, A., Ibáñez, S. & Alvarez, P. (2005). Development of a system of indicators for sustainable port management. *Marine Pollution Bulletin*, Volume 50(12), Pages 1649-1660.

Mouton, J. (2001) *How to succeed in your Master's and Doctoral studies: A South African Guide and Resource Book*. Pretoria: Van Schaik.

Ng, A. K., & Song, S. (2010). The environmental impacts of pollutants generated by routine shipping operations on ports. *Ocean & Coastal Management*, Volume 53(5), Pages 301-311.

Oelofse, S.H.H. & Godfrey, L. (2008). Towards improved waste management services by local government – A waste governance perspective. CSIR Conference 2008.

Olson, P. H. (1994). Handling of waste in ports. *Marine pollution bulletin*, Volume 29 (6), Pages 284-295.

OSPAR. (2009). *Marine litter in the North-East Atlantic Region: Assessment and priorities for response*. London, United Kingdom, Page 127.

Palys, T. & Atchinson, C. (2008). *Research Decisions: Quantitative and Qualitative Perspectives*, Fourth Edition. Toronto: Thomson Nelson.

Payne, S. (1999). Interview in Qualitative Research. In Memon A & Bull R: *Psychology of Interviewing*. Chichester: Wiley. Pages 89-102.

Pilar, L, B González-Torre, Adenso-Di´aza & Alex Ruiz-Torres. (2003). "Some comparative factors regarding recycling collection systems in regions of the USA and Europe", *Journal of Environmental Management*, Volume 69, Pages 129-138.

Purnell, G. (2009). National Waste Quantification and Waste Information System.

Available: <http://www.wastepolicy.co.za/wasteresearch> Accessed: 10 February 2013.

Rajput, R., G. Prasad, and A. K. Chopra. (2009): "Scenario of solid waste management in present Indian context." *Caspian J. Env. Sci* 7.1, Pages 45-53.

Republic of South Africa.(1996). Constitution of the Republic of South Africa. Act 108 of 1996. Pretoria: Government Printers.

Republic of South Africa. (2008). National Environmental Management: Waste Act, Act 59 of 2008. Pretoria: Government Printers.

Republic of South Africa. (1998). National Environmental Management Act, Act 107 of 1998. Pretoria: Government Printers.

Republic of South Africa. (2005). The National Ports Act, Act 12 of 2005. Pretoria: Government Printers.

Republic of South Africa. (2005). Port Rules in terms of Section 80 (2) of the National Ports Act, Act 12 of 2005.

Rogoff, M.J. (2013). *Solid Waste Recycling and Processing*. 2nd Edition .Waltham. USA.

SABS. (2012). South African Bureau of Standards, ISO 14001 audit report. Port of Richards Bay.

Savage, D. (2009). Cooperative Governance, Local Government and the Waste Planning System. Available: <http://www.wastepolicy.co.za/wasteresearch/> Accessed: 10 February 2013.

Swamy, Y. V. (2012). Solid and hazardous waste management practices onboard ocean going vessels: a review. *Journal of environmental science & engineering*, Volume 54(1), Pages 162-174.

Tchobanoglous, G. & Kreith, F. (2002). *Handbook of solid waste management 2nd edition*. New York: McGraw-Hill Book Co.

Townsend, F. (2003). *Impact: Economic Strengths of Zululand*. Norma Beyl and Associates, Durban.

TNPA, NWMS. (2014) Transnet National Ports Authority, National Waste Management Strategy.

TNPA, WMP. (2012). Transnet National Ports Authority, Waste Management Plan. Port of Richards Bay.

TNPA, WDL. (2012). Transnet National Ports Authority, Waste Disposal Licence Conditions.

Transnet, LTPF. (2012). Transnet. Long Term Planning Framework.

UNCTAD. (2009). United Nations Conference on Trade and Development. Review of Maritime Transport.

UNEC. (2014). United Nations Economic Commission. European Agreement concerning the International Carriage of Dangerous Goods by Road (ADR 2015).

UNEP. (2006a). United Nations Environmental Programme. Feasibility study on the sustainable management of Marine Litter.

UNEP. (2006b). United Nations Environmental Programme. Marine Litter in the Wider Caribbean. Report of UNEP Caribbean Environment Programme and UNEP Regional Seas Programme and UNEP GPA.

White paper on integrated pollution and waste management for South Africa.(2000). A policy on pollution prevention, waste minimisation, impact management and remediation. Government Gazette Vol. 417, No. 20978, 17 March 2000. General Notice 227 of 2000.

Wenning, R. J., Apitz, S. E., Baba, A., Citron, M., Elliott, K., Al-Halasa, N. & Rutjes, R. (2007). Understanding environmental security at ports and harbors. In *Managing Critical Infrastructure Risks* (pp. 3-15). Springer Netherlands.

Wepener, V., & Vermeulen, L. A. (2006). A note on the concentrations and bioavailability of selected metals in sediments of Richards Bay Harbour, South Africa. *Water SA*, 31(4), Pages 589-596.

Wolska, L., Mechlińska, A., Rogowska, J., & Namieśnik, J. (2012). Sources and fate of PAHs and PCBs in the marine environment. *Critical Reviews in Environmental Science and Technology*, Volume 42(11), Pages 1172-1189.

Wooldridge, C. F., McMullen, C. & Howe, V. (1999). Environmental management of ports and harbours—implementation of policy through scientific monitoring. *Marine Policy*, Volume 23(4), Pages 413 – 425.

Zobel T. & Burman J,O. (2004). Factors of importance in identification and assessment of environmental aspects in an EMS context: Experiences in Swedish organizations. *Journal of Cleaner Production*. doi:10.1016/s0959-6526(02)00167-1

Mosidi Makgae (2011). Key Areas in Waste Management: A South African Perspective, Integrated Waste Management - Volume II, Mr. Sunil Kumar (Ed.), ISBN: 978-953-307-447-4, InTech, Available from: <http://www.intechopen.com/books/integrated-waste-management-volume-ii/key-areas-in-waste-managementa-south-african-perspective>

APPENDIXES

Appendix 1: TNPA Port of Richards Bay, Waste Management Plan 2012.

Appendix 2: TNPA Waste Management Strategy.

Appendix 3: Copy of questionnaires administered for responses.

Appendix 4: Galley waste recommendation issued by Department Of Agriculture.

Appendix 5: National Ports Act, 2005.