TOWARDS AN INTEGRATED SOLID WASTE MANAGEMENT STRATEGY FOR THE ROBBEN ISLAND MUSEUM

BY: NOLUBABALO SIDZUMO

February 2000

A dissertation submitted to the Department of Environmental and Geographical Science, University of Cape Town, in partial fulfilment of the requirements for the Masters of Philosophy Degree in Environmental Science.

TABLE OF CONTENTS

Acknowledgements i

Executive Summary ii

CHAPTER 1 INTRODUCTION

1.1 Introduction 1

1.2 Approach to the study 1

1.3 Strengths and limitations of the study 3

1.4 Essential Definitions: 4

1.4.1 'Environment' 4

1.4.2 'Sustainability' 5

1.4.3 'Waste' 5

CHAPTER 2 BACKGROUND INFORMATION TO THE STUDY AREA

2.1 Map showing the location of the Robben Island 7

2.2 Historical background of Robben Island 8

2.2.1 Vision and mission statement of the Robben Island Museum 10

2.3 Geology of Robben Island 11

2.4 Ecology of Robben Island 11

2.5 Current solid waste management practices on Robben Island 13

2.5.1 Introduction 13
2.5.2 Sources and types of waste collected 15
2.5.3 Separation and Transformation of waste 21
2.5.4 Recycling 21
2.5.5 Solid Waste Disposal 22

CHAPTER 3 LITERATURE REVIEW

3.1 Historical background to solid waste management 23

3.2 Environmental Impacts of Solid Waste 25

3.2.1 Human Impacts 26
3.2.2 Impacts on the Natural Environment 26

3.3 What is Solid Waste Management 27

3.3.1 Physical Transformation 28
3.3.2 Chemical Transformation 29
3.3.3 Biological Transformation 30

3.3.4 The Relevance of Waste Transformation 31

3.4 International Trends in Waste Management 31

3.5 The National Situation on Waste Management 35

3.6 What is Integrated Solid Waste Management 39

3.7 Review of the South African Legislation and Policy on Waste Management as applicable on Robben Island. 43

3.7.1 The Constitution of the Republic of South Africa (Act No. 108 of 1996) 44
3.7.2 Environment Conservation Act No. 73 of 1989 46
3.7.3 The National Environment Management Act, No. 107 of 1998 48
3.7.4 The Health Act 63 of 1977 49
3.7.5 The National Water Act No. 36 of 1998 51
3.7.6 The Draft White Paper on Integrated Pollution and Waste Management 52
3.7.7 The National Waste Management Strategies and Action Plans, Volumes 1 & 2 53

CHAPTER 4 RESEARCH METHOD

4.1 Introduction 56

4.2 Sampling Method 56
4.2.1 Target population 56
4.2.2 Sample selection 57

4.3 Instrumentation 58

4.4 Procedure 60

4.4.1 Interviews 60
4.4.2 Waste Audit 61

4.5 Data Analysis 61

CHAPTER 5 RESULTS AND DISCUSSION

5.1 Survey Results 62

5.2 Waste collection Results 69

5.3 Secondary Data Results 72

CHAPTER 6 CONCLUSIONS

6.1 Perceptions of waste and litter on Robben Island 77

6.2 Recycling and separation of waste 77

6.3 Fieldwork results 78

6.4 Secondary data 78

CHAPTER 7 RECOMMENDATIONS

7.1 Introduction 79

7.2 Implementation of the Integrated Waste Management Strategy 79

7.3 Education and raising awareness of the Robben Island Personnel 81

7.4 Recycling 82

7.4.1 Paper recycling 83

7.4.2 Plastic recycling 85

7.4.3 Can recycling 86

7.4.4 Glass recycling 86

7.4.5 Composting of organic waste 87

7.4.6 Waste Incineration 90

CHAPTER 8. SUGGESTED PLAN OF ACTION FOR IMPLEMENTING AN INTEGRATED SOLID WASTE MANAGEMENT STRATEGY ON ROBBEN ISLAND 91

9. REFERENCES/BIBLIOGRAPHY 104

10. PERSONAL COMMUNICATION 110

11. APPENDICES 111

LIST OF ILLUSTRATIONS

LIST OF TABLES

Table 3.1	Distribution of waste and tonnes produced in South Africa per year	36
Table 5.1	Participants' reasons for not separating waste at source	68
Table 8.1	Recommendations on the implementation of the Integrated Solid Waste Management Strategy on Robben Island	93

LIST OF FIGURES

Figure 3.1	Principles of integrated solid waste management	42
Figure 5.1	Participants' level of employment	63
Figure 5.2	Average quantity of waste generated on Robben Island from 22 June to 8 July 1999	70
Figure 5.3	Average quantity of waste (in kilograms) collected on Robben Island between June 22 and July 8, 1999	71
Figure 5.4	Average number of refuse bags generated per department on Robben Island over four seasons	72
Figure 5.5	Average number of bags collected per department, November 1997 to January 1998	74
Figure 5.6	Average number of bags collected	

per department, May 1998 to July 1998 74

Figure 5.7 Average number of refuse bags collected per department, November 1998 to January 1999 75

Figure 5.8 Average number of refuse bags collected per department, May 1999 to July 1999 76

ACKNOWLEDGEMENTS

I am indebted to my supervisors, Prof. Francois Odendaal for his assistance in getting the project started in spite of all the difficulties that we encountered as well as his advice through out the whole process and Lynton Burger for his great suggestions, editing and support. The assistance provided by the environmental officer on Robben Island, Mario Leshoro, in locating most of the participants on Robben Island, supplying me with the secondary data and taking me around the island whenever I needed to is greatly appreciated. I would like to thank all the people from Robben Island who participated in this project and those from other companies who were interviewed for this project.

I am pleased to acknowledge the financial assistance provided by the Centre for Science Development (CSD), University of Cape Town and the Daimler Benz Postgraduate Scholarship towards this research process. Nevertheless, the opinions expressed in this thesis are those of the author and not necessarily of the above sponsors.

Lastly, I thank God Almighty for guiding my way, watching over me and seeing me through difficult and bad times as well as through good times.

This project is dedicated to the two wonderful people in my life, my husband, Nkosinathi and my son Buhle. Thank you very much for your undying love and support.

EXECUTIVE SUMMARY

This study assesses the process of solid waste management, from generation to disposal, on Robben Island. The major objectives of this research were the following:

- To assess the quantity and the type of solid waste generated on Robben Island;
- To investigate the areas where waste is generated;
- To assess current waste management practices that are undertaken on Robben Island; and
- To assess the level of understanding, the attitudes and the behaviour of people working and residing on Robben Island with regards to waste management issues.

As a popular tourist destination site, the researcher took into consideration during the investigation that, waste quantities generated on Robben Island might vary from season to season depending on the number of tourists visiting the island per season.

The European settlers were the first to inhabit Robben Island, which is situated in Table Bay, about 11 kilometres from the Cape Town harbour. These settlers sailed passed the Cape on their way to the West Indies and therefore, used the island as a stopping station in order to provide themselves with fresh food supplies. Robben Island has since been used by the South African government for many activities such as, the leper colony, mental asylum, military camp and lastly as a high security prison for the detention of political activists who resisted the South African Government's apartheid rule.

It was in 1996, after the release of the last political prisoners when the management of Robben Island was transferred from the Department of Correctional Services to the Department of Arts, Culture, Science and

Technology. Since then Robben Island has been declared a National Heritage Site, a National Monument and a Cultural Site.

During the investigation process, it was found that solid waste management on Robben Island falls under the jurisdiction of three departments. The National Department of Public Works' garden section is responsible for refuse removal and disposal which includes the collection of waste from all the areas where waste is generated on the island to its disposal by incineration. The Environmental Section of the Heritage Department together with the Department of Estates and Services jointly fulfil the administrative duties of solid waste management for the entire island.

During the research fieldwork, it was found that, on average, each department where waste is collected on Robben Island produced about 27 kilograms of solid waste per week. Most of this waste was generated by the private houses and the Robben Island kitchen followed by the similar amount collected from the harbour and the administration offices. The private houses and the kitchen produced mainly organic waste while the harbour and the administration offices' waste constituted mainly paper.

According to the survey results, 49 % of the respondents interviewed were general employees with only 3 % of them being top managers. Fifty nine percent (59 %) of these respondents identified a problem of litter lying around the island. However, of this 59 %, half considered the problem to be caused by lack of proper litter bins. Also, lack of education and responsibility from top management to the lowest levels of employment was identified as another aspect contributing to the problem of inadequate management of solid waste on Robben Island.

There is a small amount of recycling taking place on Robben Island. Only cans and glasses or bottles are separated from the rest of the waste for recycling. Nevertheless, this separation only takes place at the disposal site before the

incineration of waste and no separation is done where waste is generated. Eighty-two percent (82 %) of the respondents admitted that they were not separating waste in their offices. Of the 82 %, 59 % believed that they did not have to separate waste that is produced in their offices as it is separated at the disposal site before incineration.

Incineration of waste on Robben Island is not recommended and is considered neither environmentally nor economically beneficial for the Robben Island Museum. It is considered to have significant negative impacts on the natural environment of the island such as aesthetic impacts, air pollution, etc.

Therefore, it is recommended that, Robben Island develops and implements an integrated solid waste management strategy. However, it has been pointed out that, the sustainability of this strategy depends on the proper education of the staff and residents of the Robben Island Museum who are the generators of this waste regarding waste issues and their management.

Proper and effective recycling of all recyclable materials is also recommended as an efficient method in which solid waste can be properly managed on Robben Island. This recommendation considers the quantity and the types of waste generated on the island as well as the environment in which this waste has to be disposed. The management of solid waste on Robben Island must be made compatible with its status, as a National and World Heritage Site.

CHAPTER 1

1.1 INTRODUCTION

Robben Island Museum (RIM) is one of the popular tourist destination sites in Cape Town, South Africa. The museum is under the jurisdiction of the Department of Arts, Culture, Science and Technology (DACST). As a recently established tourist destination site with National and World Heritage Site status, solid waste management is one of the integral management issues requiring commitment and dedication.

This study is therefore about the development of an integrated solid[1] waste management strategy on Robben Island. However, for this strategy to be effective, it is important that information on the sources and the types of wastes generated on Robben Island is known. Therefore, the fieldwork that was undertaken involved an assessment of how much and where waste is generated on Robben Island. The manner in which solid waste is managed on the island and the attitudes to waste by the people working and living on Robben Island were also assessed.

1.2 APPROACH TO THE STUDY

The approach adopted in the study is based on the researcher's understanding of the importance of the role played by the people in any environment where waste is generated, and therefore, needs to be managed. For example, the quantity and the type of waste that needs to be considered for collection and disposal depends largely on the kind of waste that is generated and the various kinds of transformation processes[2] employed in that particular environment. In actual fact, waste management involves, to a

[1] Solid waste in this study includes office waste such as papers and other forms of office waste and domestic solid waste produced in the kitchen, private houses and other places that accommodate overnight visitors.

[2] Transformation processes refer to the various changes undergone by waste from the source

greater degree, management of the people generating waste as well as the kind of environment in which waste has to be disposed.

Therefore, in this study area, people considered to be playing a central role are those working and staying on Robben Island. Also, as a popular tourist destination site, it is assumed that waste generation on Robben Island would show significant trends that would vary according to seasonal differences attributed to increased influx of tourist visiting the Island during certain seasons compared to other seasons.

The researcher also conceptualised the study with an understanding that, some kind of waste sorting and recycling initiatives have been initiated on Robben Island. Alas, these initiatives have not been successful regarding increasing the level of awareness of the Robben Island staff and residents as well as increasing the level of recycling on the Island. The reason for these unsuccessful campaigns has been apportioned to *inter alia,* lack of co-operation from the Robben Island personnel, both residents and staff (Mario Leshoro, personal communication). Also, the researcher understands that, any proper understanding of waste management practices involves an understanding of its various aspects which include:

- The kind of environment where waste is generated and requires proper disposal;
- The quantity and type of waste generated; and
- Who generates waste and what does that person understand about waste management.

---

through to its final treatment. These changes can be physical, biological or chemical.

1.3 STRENGHTS AND LIMITATIONS OF THE STUDY

1.3.1 STRENGTHS

The target population, which included the staff and the residents of Robben Island, was not very big. Therefore, selection of a representative sample was small enough for the survey to be completed within a short period of time of about six (6) weeks.

The Eco-log pamphlet that is regularly completed by the Staff of the Public Works Department responsible for refuse removal on Robben Island provided valuable secondary data. These data, although they have shortcomings in the manner in which they have been completed, have provided relevant material for the assessment of the types and sources of waste presently managed on Robben Island.

1.3.2 LIMITATIONS

Robben Island's refuse removal is under the jurisdiction of the National Department of Public Works' garden section. On investigation, it was discovered that there is not much clarity regarding their waste management practices and the legal requirements. Therefore, it was difficult to establish whether the management of solid waste on Robben Island was in contravention with any national or provincial statute. In other words, neither the Cape Metropolitan Council's by-laws nor any of the Western Cape's Local Councils' by-laws on solid waste management apply to Robben Island's solid waste management.

According to the literature, different waste trends exist in any tourist destination site as a result of fewer visitors visiting the Island as well as the number of activities taking place on the Island during different seasons of the year. Nevertheless, fieldwork for this study was only undertaken over a short

period of time, which was during the winter season. Hence, the data may not reveal certain solid waste trends. The secondary data that are regularly collected on the island are therefore used in order to establish if there are any trends in solid waste generated during the two important holiday seasons of the year, that is summer and winter.

Furthermore, the scope of this study is only on solid waste management on Robben Island. Therefore, the assessment of the management practices is only concentrated on solid waste that is generated on the island and how that can be minimised and disposed of in an environmentally and economically acceptable manner. The study excludes other forms of waste that are managed on Robben Island. Furthermore, Robben Island's suppliers of goods are not investigated for their packaging and how that can be minimise in order to ultimately reduce waste coming to the island. Instead, it has been recommended that Robben Island management considers minimising packaging materials transported to the island by buying material that is packaged in bulk.

1.4 ESSENTIAL DEFINITIONS

This section contains definitions of the major concepts used in this document. These concepts include environment, the concept of sustainability and waste.

1.4 1 'ENVIRONMENT'

The researcher adopted a holistic view of the term environment as it is defined in the IEM guidelines (1992). According to these guidelines, environment is defined in its broad sense to include the biophysical, socio-economic, cultural and political components of any surrounding. Therefore, reference to the term 'environment' in the whole document takes into account the adopted definition as a frame of reference.

Furthermore, in order to come up with waste management recommendations that are sustainable, all the above mentioned components of the term 'environment' have to be considered before any of the recommended interventions are implemented.

It is a global initiative to ensure that any environmental development or improvement is done in a sustainable manner in order to ensure that the development benefits both the present and the future generations. It is therefore, imperative that in any attempt to develop or improve the environment, interested and affected people forming the social aspect of the environment are considered and given an opportunity to play a central role so as to ensure ownership and thus sustainability of that particular activity.

1.4.2 'SUSTAINABILITY'

Sustainability refers to development initiatives that are aimed at improving the quality of human life whilst living within the carrying capacity of the supporting ecosystems. According to John Yeld (1997), sustainability in development refers to development attempts to meet the basic needs and aspirations of all humans without compromising those of future generations through seeking to harmonise the social and economic objectives with ecologically sound management. Furthermore, this development should involve eliminating (as far as possible) human poverty and hardship, reducing unnecessary and wasteful consumption patterns, and managing wisely ecosystems and ecological processes which produce and maintain the clean air, water and soil on which all human life ultimately depends. Hence, for any waste management strategy to be effective and sustainable, all these aspects have to be considered in an integrated manner.

1.4.3 'WASTE'

The Environment Conservation Act No. 73 of 1989 defines waste as:

'Any matter, whether gaseous, liquid or solid or any combination thereof which is from time to time designated by the Minister by notice in the *Gazette* as an undesirable or supefluous by-product, emission, residue or remainder of any process or activity' (Environment Conservation Act, No. 73 of 1989).

'An undesirable or superfluous by-product, emission, or residue of any process or activity which has been discarded, accumulated or stored or is useless and unwanted for the purpose of discarding or processing. It may be gaseous, liquid or solid or any combination thereof and may originate from a residential, commercial or industrial area and may include but not be limited to rubbish, garbage, builder's rubble, garden refuse and food waste. The fact that the waste or a constituent of the waste may have value or other use, does not exclude it from this definition' (Provincial Gazette No. 5362, Friday, 25 June 1999).

Due to the constraints imposed by time, this project only focuses on the solid waste part of the above definitions. This solid waste constitutes the residential or domestic waste, office waste and builder's rubble generated by building contractors engaged in the maintenance, rehabilitation and upgrading of certain structures of the Robben Island Museum. Tourism waste is not separated from the office waste as it is often mixed with the office waste because of the route that tourists take during their visit.

CHAPTER 2

2.1 BACKGROUND INFORMATION TO THE STUDY AREA

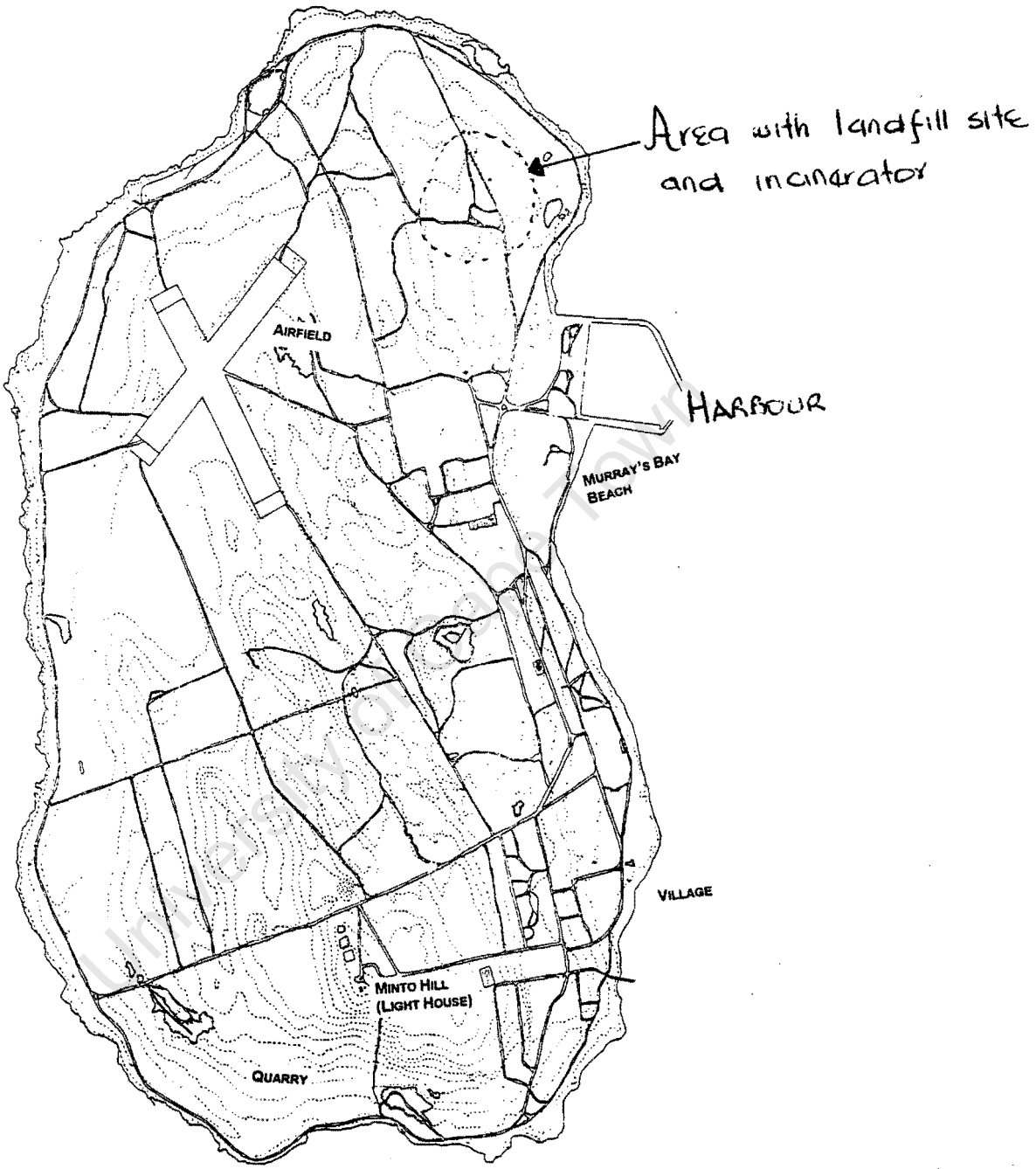

Fig.2.1 Map of Robben Island

Adopted from the Robben Island Museum's Tourism Potential and Carrying Capacity Study.

2.2 HISTORICAL BACKGROUND ON ROBBEN ISLAND

Robben Island, meaning the '*Seal Island',* which is often called *'the Island of Makana,'* is situated at the south western tip of South Africa, in Table Bay, Cape Town. This Island lies at a distance of about 11 kms from the Cape Town Harbour, about 9.3 kms north of Green Point and 7 kms west of Bloubergstrand. Robben Island covers about 574 hectares (Hill and Theron, 1990). The highest point on the island is about 24-30 meters above sea level with a long axis of about 3.5km running from North to South and a width of about 1.8km (see figure 2.1 above). The Island is surrounded by the cold Atlantic Ocean, with no protection from the Cape's strong north-westerly winds that constantly sweep across the Island's rocky surface (Hutton B, 1994).

The social history of Robben Island is very important when one attempts to understand its ecological and environmental situation. Robben Island has been inhabited since the 15th century when it was first occasionally visited by the European explorers. These sailors, who were on their way to the West Indies, stopped at the Cape to get fresh provisions such as fresh meat, vegetables and water. Some of them traded beads, spices and metals with the Khoisans who were living at the Cape, in return for cattle and sheep, while others preferred to stop on Robben Island. Those who stopped on the Island survived by hunting penguins, seals and tortoises for food (Hutton, 1994).

During the time of the 15th century, European settlers used the Island as a refreshment station because it was uninhabited and they preferred to avoid encounters with the Khoikhoi people. This was caused by the fighting that occurred between the settlers and the Khoisan people as some of the European settlers did not bother to trade with the Khoisans for their cattle but shot the cattle on sight. Since that time, the Island has been used for various purposes such as a pantry, a hospital, a mental asylum, a military camp and

as a political prison. In the last four centuries, from 1500 - 1900 years, the prisoners and exiles detained on Robben Island included slaves from Angola, West Africa, princes from the East, local chiefs who resisted British colonial rule, lepers, the mentally disturbed, some common criminals and most recently the political opponents of the apartheid government. However, through all these years, Robben Island has always been property of the state with its management and control changing according to the change in its use at any particular time.

The first prisoners on Robben Island are said to have been abandoned by a Portuguese ship as early as 1525. The Island was then used as a prison until the beginning of the 18th century when it was converted to accommodate a hospital for lunatics, lepers and the chronically ill. Round about the time of the Second World War, Robben Island was taken over by the Defence Force and transformed it into a heavily defended military base. It was later used by the navy as a training centre.

In the early 1960's, when the resistance against the apartheid rule increased, Robben Island was taken over by the apartheid government to be used as a prison in order to silence their political opponents. From 1961 until 1991 when the last political prisoners were released, over three thousand black male activists were held on Robben Island, South Africa's most notorious high security prison. The Common Law criminals who were also held on Robben Island, separate from the political prisoners, left the island in 1996 after which the island was then open to the public for visitations.

After a long period of intense discussions among the ex-political prisoners, the South African government and the business sector, Robben Island (including the 1NM marine zone), was then declared a *'national monument, national museum and a national heritage site'* under the jurisdiction of the Department of Arts, Culture, Science and Technology.

2.2.1 Vision and Mission Statement of the Robben Island Museum

After the declaration of Robben Island as a site museum, the management of Robben Island Museum adopted a vision to operate the island as a 'living museum' that aims to develop Robben Island as a national and international heritage and conservation project for the new millennium. Its resources and activities would then be managed in a manner that strives to maintain the unique symbolism of the island, nurtures creativity and innovation and contributes to socio-economic development transformation of the South African society and the enrichment of humanity (Saatchi and Saatchi, May 1999).

The mission of the Robben Island Museum focuses on four core essences. These essences are:

- Maintaining the political and universal symbolism of Robben Island;
- Conserving and managing the natural and cultural heritage and resources of Robben Island;
- Promoting Robben Island Museum as a platform for critical debate and life long learning; and
- Managing Robben Island in a manner that promotes economic sustainability and development.

Robben Island Museum has recently obtained a World Heritage Status after the management's submission of the application in Moscow, in July 1999. This status affords protection and conservation of Robben Island's irreplaceable possessions, both natural and man-made, for the whole nation and its entire mankind from both the national and the international community.

2.3 GEOLOGY OF ROBBEN ISLAND

Millions of years ago, Robben Island was connected to the mainland, that is, Bloubergstrand by a ridge of land. The island is actually the summit of an ancient submerged mountain that is linked by an undersea saddle across to Blouberg. Minto's Hill, on the southern coast of Robben Island, where the light house is located to date, is the actual summit of the submerged mountain (Hill & Theron,1990).

The Tygerberg Formation (ancient Malmesbury Shale) forms the underlying strata of the rocky coastline of Robben Island. This rock formation is similar to the one found on the mainland with only a difference on the stratification where Robben Island tends to be nearly horizontal and gently undulating (Hill and Theron, 1990). On this strata lies thick limestone and calcrete deposit that is covered by windblown sands and shell fragments. Thin quartzitic sandstone impurities in the rock give rise to the whitish marbled effect which characterises the island. The slate and the limestone have been quarried for buildings on the island and on the mainland since the middle of the 1600's. The only beach on Robben Island is found on the western side near Murray's Harbour.

2.4 ECOLOGY OF ROBBEN ISLAND

According to the recent studies on the flora and fauna of Robben Island, undertaken by Cape Nature Conservation, vegetation and animal life of the island have been greatly modified by the influence of human beings who have inhabited the island in the past four hundred (400) years. The English captain, Sir James Lancaster is recorded as the first to introduce domestic animals on Robben Island in 1601. Since then, there has been extensive breeding of domestic animals such as sheep and cattle. This breeding of domestic animals also dates back to the time of the European settlers. European settlers used to leave sheep that they traded with the Khoisan on the island to breed so

that they could provide fresh meat for passing sailors (Hutton, 1994). These domestic animals have had major impacts on wildlife, especially sea birds breeding on the island. Also, there was intensive grazing by the sheep, goats and rabbits.

Alien plants, which had been brought to the island, have highly impacted on the growth of indigenous plants. These alien plantations have threatened indigenous species and the overall ecological integrity of the island.

Nevertheless, exotic trees that appear on Robben Island are used by birds as nesting areas. This particular use of these trees has raised and continue to raise a lot of questions when decisions about the removal of these trees are considered.

Robben Island has similar vegetation to that of the mainland, such as, the Strandveld of the West Coast, from Cape Point to the Oliphants River. However, this vegetation has been significantly disturbed by the built environment and extensive plantations of shrubs and exotic trees which were planted in order to provide shade for the lepers. Also, the spectacular veld flowers which are typical of the West Coast also occur on Robben Island during spring season. Nevertheless, the vegetation of Robben Island is exposed to a fairly severe maritime environment (Hill and Theron, 1990).

According to the document by Cape Nature Conservation, indigenous fauna appears to have been of limited diversity but of great quantity. Animals found on the island include seals, penguins and mole snakes. There were also breeding colonies of Pelicans and Duikers. However, seals, penguins and penguin eggs were used as a vital source of diet by the early settlers and that lead to the penguin populations becoming endangered.

Another animal species that occur on Robben Island include about 12 terrestrial mammal species endemic to Southern Africa and a total of about

127 bird species. There are two species of amphibians, eight lizards and geckos, three species of snakes and one species of tortoise inhabiting Robben Island. Other species that occur on the island in increasing numbers are small herds of bontebok, springbok, steenbok, fallow deer, eland and ostriches. Submarine flora and fauna that appear within the one nautical mile perimeter includes a number of protected species such as Abalone and Rock Lobster.

Many bird species used the island for breeding and resting including some birds from the mainland such as cattle egrets and black crowned night herons that breed on the island in large colonies. Among the bird colonies breeding on the island is the penguin colony of which there are about 3000 on the island. This also includes the African penguin, which is a flightless sea bird endemic to the coast of Southern Africa. The Cape Jackass penguin was one of the abundant species on Robben Island in the 17th century but was eliminated by human activities later. Nevertheless, by 1983, the penguins had re-established themselves as a breeding colony as well as the African Oystercatcher which is currently on the list of endangered species.

In the last three years there has not been any control of the feral cats on the island and as a result, the African penguin breeding on Robben Island has been reported to have been severely reduced by *inter alia* feral predation (Marcel Kroese, personal communication).

2.5 CURRENT SOLID WASTE MANAGEMENT PRACTICES ON ROBBEN ISLAND

2.5.1 INTRODUCTION

Although Robben Island has been declared a National Heritage, National Monument and later World Heritage Site under the administration of the Department of Arts, Culture, Science and Technology, certain activities taking place on the island are regulated and controlled by the National Department

of Public Works (PWD). The Department of Public Works is subdivided into two sections namely, the building and the garden sections. The building section is responsible for the overall maintenance of all the buildings on the island. The activities of this section include renovations, paintings and the collection and disposal of the builder's rubble that result from these activities. The garden section is involved in activities such as the collection, some degree of processing, transporting and disposal of solid waste from all the offices and the houses on the island. Three PWD personnel carry out these activities. One drives the pick-up truck that collects the waste from all the various sources and the other two men who pick up the waste bags from the bins in the office areas, the houses and the sidewalks around the island.

In this context, solid waste comprises all the waste arising from human and animal activities that are normally solid in texture and discarded as useless or unwanted (Tchobanoglous, Theisen and Vigil, 1993). Therefore, for proper development of an effective solid waste management strategy, it is essential to identify and understand the various important aspects of the whole process such as, the sources, quantities and the types of waste generated in the region concerned. The initial step in this study is therefore to identify these aspects, from collection to final disposal.

All the offices on Robben Island are provided with two waste bins, one is the normal metal bin for all the general waste and the other is the Sappi waste paper bin that is meant to collect waste paper for recycling. Initially, these paper bins were provided by the Sappi company free of charge. Due to their improper use, they are now currently provided at a minimum charge, not only for Robben Island but for other places in the country as well. Also, Robben Island Museum does not recycle paper that is collected from the various offices. This is partly because waste is normally not separated from the sources where it is generated instead at the disposal site at which stage the paper is not worth recycling due to its quality at the time when it reaches the disposal site.

On Robben Island, waste is collected every Mondays and Thursdays from all the different sources. The three-ton truck that collects waste from all the different sources, take it to the landfill site on the northern side of the island. At this site, waste is first separated into bottles, cans or tins and the rest, which is a mixture of paper and food or organic waste. Cans and bottles are kept separately in the big chick containers which are later taken to the mainland by the cargo boat for recycling. The remaining waste that is a mixture of paper and food is then burnt in refuse bags in the incinerator(see appendix 2).

The following section describes the various areas where waste is collected together with the types of waste generated or collected from those particular departments. The information presented in the section below regarding the activities that take place on Robben Island was obtained from either the managers of the specific departments, supervisors or foremen.

2.5.2 SOURCES AND TYPES OF WASTE COLLECTED (*WHAT IS IT AND WHERE IS IT COMING FROM?*).

The Harbour

There are many activities that take place on the harbour other than the control and management of arriving and departing boats, which is done in the *harbour office*. The other part of the harbour office is the *tour information office*, which is involved with monitoring the activities of the tour guides and other administration work of the tours department. Waste generated in these two offices comprises mainly paper.

The *waiting room* accommodates tourists while waiting for their departing boats. Most of the waste that is generated in this room is that left by tourists, such as snack wrappings, cool-drink cans and bottles. The amount however, depends on the season as the number of tourists visiting Robben Island varies

between the summer and winter seasons. However, this waste is mixed on disposal into the wily bins. Hence, the difficulty in determining exactly how much of it is generated by tourists.

There is also a *workshop* and the *store-room* that are controlled and managed by the harbour master. The workshop keeps a lot of metal material that is taken out of the boats and used paints that are stored for re-use in other activities. Waste that comes out of the workshop is mainly metal material that is finally disposed off in the big metal containers that are later taken to the mainland by the cargo boat (see appendix 2). The Blouberg Municipality trucks then take these containers from the Cape Town harbour for disposal.

The *store-room* keeps unused paint and other cleaning materials namely, the Equasolv for washing oily stuff in the boats. Oil cans are put in the chick containers also kept in the store-room and disposed off in the landfill site that is located on south-western side of the prison (see appendix 2).

The *curio shop* generates mainly cardboard, plastic wrappings, paper and till slips. Empty cardboard is kept outside the shop next to the rubbish bins for collection. The rest of the waste material is disposed in black refuse bags that are put in the wily bins outside the shop. This material is also not separated before it goes outside into the wily bins.

The Kitchen

The kitchen is composed of six staff members, namely, two cooks, two cleaners, one waiter and the supervisor. The administration of the kitchen falls under the Robben Island Museum, however, all the staff is employed by the Metro Company. The Metro Company also provides the staff that cleans all the offices on Robben Island. The kitchen operates from half past seven (07H30) in the morning to fifteen minutes past seven (19H15) in the evening. It serves breakfast, lunch and dinner to Robben Island residents and to

overnight visitors. The kitchen also caters for other events such as workshops and conferences that take place on the island. Daily tourists do not have access to the kitchen. The amount of waste that is generated in the kitchen also varies during the two holiday seasons. For example, in summer, there are many activities taking place on the island and also many tourists visiting and staying overnight compared to the winter period and therefore more waste coming out of the kitchen. The kind of waste that is generated in the kitchen is composed of mainly organic food waste.

The Robben Island Shop

This supermarket caters for the Robben Island residents. This supermarket is owned by the Robben Island Museum and also gets its budget from the museum. The kind of waste that is generated in this shop is comprised mainly of packaging material and cardboard boxes.

The Workshop

The *workshop* is involved in the maintenance and repairs of all the Robben Island Museum vehicles. The bulk of the waste that comes out of this workshop is mainly motor oil, drained out of the vehicles during maintenance. This oil is collected and kept in drums which are taken by the cargo boat every three months to the Cape Town harbour. Some of the oil is given to the PWD staff that works at the incinerator site to be used for starting the fire that burns out waste.

Another kind of waste generated from the workshop includes a certain amount of steel. This steel is taken out of broken down vehicles. Most of the steel is re-used in the maintenance and repair of other vehicles while the rest that cannot be re-used is taken to the dumpsite on the south-western part of the prison.

There is also a certain amount of toxic waste that comes out of this workshop, such as, the dust off the break shoes of vehicles. This kind of waste is mainly composed of asbestos. According to the foreman who was interviewed regarding the activities of this workshop, there is no specific procedure regarding its disposal. However, there are certain requirements for the workers working with this material. Although the workshop does not have a *'Waste Manifest'*, the workshop is periodically monitored for the handling of this dust by the workers.

'A waste manifest is a document that is required by law to be completed by the generator, the transporter and disposer of hazardous waste'. It is mainly used to control hazardous waste and to ensure that there is no unauthorised transfer or escape of this dangerous waste (Parliament Monitoring Group 105, January, 1999).

Workers working with the dust off the break shoes of vehicles are required to:

- Make the dust wet before working with it;
- Wear protective clothing such as gloves, overalls and masks.

Other areas where waste is collected are:

- *The Single Quarters,* which are self-catering apartments that accommodate some of the Robben Island Museum staff living on the Island;
- *The Guest House,* accommodates overnight visitors and sometimes has activities taking place;
- *The John Craig Hall,* also accommodates some activities and overnight visitors;
- *The Light House,* is operated by Spoornet staff and its offices generate mostly paper waste;
- *The prison,* which has mainly exhibitions and some of the tours offices;

- *The Clinic,* was operating as a clinic under the Correctional Services period and is now an office area for the island's security company;
- *The Village Houses,* where some of the Robben Island Museum staff are accommodated;
- The Administration Offices;
- The Logistic Offices;
- Robert Sobukwe House;
- The Laundry;
- Alfa One;
- Alfa Two;
- The Club;
- Offices of the Education Department;
- Offices of the Tours Department;
- The Power Station; and
- The Litterbins that are located on the road around the island.

Cleaning of all the offices and most of these departments, excluding the private houses in the village is provided by the staff from the Metro Cleaning Company. During the interview sessions some subjects or respondents highlighted their efforts to separate waste coming out of their offices. However, their efforts were destroyed by the tendency of the cleaning staff to mix everything coming out of the two bins in the office in one refuse bag.

Construction waste

There is continuing construction work taking place on Robben Island. In some areas it is already taking place namely, *the Leper Church* and in some areas it is still under planning, for example, the renovation of the *prison.* It involves, in some areas, rehabilitation of old buildings and in others, maintenance and repair of the wears and tears. This kind of work is either done by outside companies that are contracted by the Robben Island Museum or by the Public Works Department which is responsible for the maintenance and repairs of

Robben Island buildings. According to the Director of the Estates and Services Department, Mr. Ashley Forbes, the outside contractors are responsible for the disposal of the waste that they generate during their operations. In other words, outside contractors are required not to leave any of their waste on the island at the end of their operations. However, this does not always happen as some of the waste is usually disposed of at the landfill or scrap site on the south-western side of the prison. Also, PWD disposes some of the scrap waste from their activities at the same site.

The composition of this waste is mainly tins of paint, rusted fences and gates and other scrap metal collected all around the island including the village (see appendix 2). Also, waste that has accumulated on this site includes waste that was dumped during the period of the Correctional Services. According to Mr. Forbes, and Ms. Pastor, Director of the Heritage Department, there are plans to remove all the scrap from this area. Nevertheless, any clearing will have to be done in a carefully considered manner as some of the things that are dumped at this site are thought to have some archaeological significance that could be relevant to the history and heritage of the island.

Yard Waste

Cleaning of yards in the village houses and the office buildings is also done by PWD's garden section. However, not many office buildings have any grass or shrub cover that requires regular cutting or trimming. Most office buildings on the island have hardened surfaces and others have pavements made of gravel with grass patches along the sides of the pavements. Therefore, most of the yard waste comes from the houses in the village.

Yard waste is composed of grass clippings, leaves, bush clippings and tree prunings. This waste is not composted and is normally discarded separately to the rest of the solid waste by just dumping it on the south-eastern side of the Island.

2.5.3 SEPARATION AND TRANSFORMATION OF WASTE (*HOW IS IT MANAGED?*).

After collection, on Monday and Thursday afternoons, all the waste is taken out of the refuse bags and separated according cans, bottles, cardboard and a mixture of plastic, paper and food or domestic waste. Cans and bottles are put in two separate chick containers that are randomly taken to the mainland by the cargo boat for recycling. Cardboard is kept in a separate room next to the incineration site that keeps all the cardboard for an indefinite period (see appendix 2).

2.5.4 RECYCLING

In 1997, the Environmental Division of the Heritage Department initiated a recycling strategy. This strategy involved the completion of the Eco-log by the PWD staff members involved in waste collection and disposal (see appendix 3, the eco-log form). This form listed the areas where waste is collected together with recyclables that were recovered, the number of bags that were disposed by burning in the incinerator. This initiative also involved the labelling of bins demonstrating recyclable material which was intended to raise awareness regarding waste recycling to the Robben Island staff and residence.

However, there is at this stage only a minimum amount of recycling taking place on Robben Island. This only involves tins/cans and bottles that are taken to the mainland every three months. Cardboard is also kept, supposedly for recycling, however, there is no established procedure as to the manner in which this cardboard will be recycled. As a result, cardboard is kept in the room next to the incineration site for an indefinite period.

2.5.5 SOLID WASTE DISPOSAL

On Robben Island, disposal of solid waste is done by incinerating all the waste that is not regarded as reusable or recyclable material. However, as mentioned before, Robben Island Museum only recycles bottle or glass and cans. It is important to note that this incineration of waste is not the same as the burning of waste material. Waste incineration, according to Linde (1994), is defined as the *'thermal treatment measure preceding the disposal of the remaining waste'.* It is also viewed as a process of turning one form of pollution, solid waste into another, air pollution. Nevertheless, it is imperative to realise that on Robben Island, waste incineration forms the final disposal method of solid waste. The ashes from the incinerator are disposed haphazardly on the ground at the back of the incinerator.

This method of solid waste disposal has been in operation on Robben Island since the period of the Correctional Services. This incinerator is therefore an old piece of equipment that is diesel operated. The diesel is also supplied by the supermarket on the island. Solid waste material that is incinerated is composed of a mixture of all the paper, plastic and food waste collected on the island.

CHAPTER 3

3.1 HISTORICAL BACKGROUND TO SOLID WASTE MANAGEMENT

Even during the primitive days of human survival, humans have used the earth's resources for life support and waste disposal. However, the consumption of the earth's resources and the disposal of waste did not pose as much of an environmental threat then as it does now. The two most important reasons for this are that; firstly, the population levels were small enough to consume these resources at a rate that was low enough for the earth's resources to be naturally replenished. Secondly, the amount and the type of waste that was generated then was small and simple for the earth's surface to assimilate without any environmental degradation. For example, it is documented in Mckinney (1998), that early gathering and hunting cultures simply left their trash where it fell, and moved on.

It is also no doubt that the society at large needs to realise that waste production is an activity that cannot be eliminated, waste will always be there. Nevertheless, much more can be done to reduce waste production and manage it in a more sustainable manner in order to preserve environmental resources for the benefit of the present and the future generations (Robinson, 1996).

According to Tchobanoglous, Theisen and Vigil (1993), problems with the disposal of waste can be traced from the time when humans began congregating in tribes, villages, cities and communities. During these congregations, accumulation of waste became a consequence of life. For developed countries, this scenario occurred many years ago, very early in the century and therefore some appropriate strategies have been developed to help lessen the environmental impact of this problem and thus improve the environmental status. For example, 'Cleaner Production Technologies' and the 'Polluter Pays Principle' which both have proved to be working successfully in countries such as Germany and the United States of America (Petrie, 1994).

Nevertheless, for developing countries such as South Africa, sustainable development is still in its infant stages. Population numbers in these countries are increasing at alarming rates especially, in cities that are perceived to be more prosperous than villages and rural areas, even though they lack proper infra-structure for the proper and effective management and control of these problems. Because of this, waste disposal techniques are still insufficient and inappropriately developed and constantly changing as technology develops and changes.

Historically, littering of food and deposition of other solid wastes into vacant lands, streets and roadways of towns led to the breeding of rats, with fleas carrying bubonic plague. The plague epidemic called Black Death, which killed half of the 19th century Europeans together with other epidemics was caused by lack of proper management of these waste issues (Tchobanoglous, Theisen and Vigil, 1993). As this constituted a public health problem, health control measures also became a vital consideration to the management of waste issues. It was only in the 19th century when it was realised, by public health officials that food wastes had to be collected and disposed of in a sanitary manner. Nevertheless, due to economic differences, some countries have advanced way past this stage whereas other countries, especially poor cities in the South, are still grappling with these health problems. These health problems have often been proved to be caused by disease vectors breeding in open dumps and poorly constructed food storage facilities from poor waste management strategies.

Furthermore, in the Pre-industrial and early industrial age, communities and factories often settled near watercourses. These convenient settlements were not only easily supplied with fresh water by the nearby streams but, these streams also provided these communities with a convenient way of getting rid of their waste. Because of the movement of water downstream, water and pollutants became less concentrated. In addition, these pollutants were naturally filtered out or absorbed by the natural organisms found in the water

and the sediments (Mckinney, 1998). Nevertheless, at the beginning of the Industrial Revolution, with more development and more pollution and complexity of waste produced, depletion of the natural resources due to pollution became a serious concern.

Problems with solid waste disposal can therefore be traced back to the beginning of the Industrial Revolution which resulted in more complex and increased amounts of waste for the earth's reservoirs such as the ocean and the atmosphere to assimilate. At this stage of development of human society, not only did waste levels increase but also the composition of waste became more complicated. As a result, later in the 19th century, an urban sanitary act was passed in Europe in 1888 due to increased uncontrollable waste management problems. This act aimed at prohibiting the throwing away of solid wastes into ditches, rivers and other water courses. This was followed by the enactment of the United States' Rivers and Harbours Act of 1899 which intended to regulate the dumping of debris in navigable waters and adjacent lands.

Sanitary land-filling, which is currently the most commonly practised waste disposal technique, was first developed in the 1930's in the United Kingdom. A decade later, this method of waste disposal was developed in the United States. However, ecological problems such as air and water pollution have also resulted from poorly engineered and badly managed landfills. Nevertheless, to date, with proper technology and technical engineering, sanitary landfills are universally employed as a safer option for waste disposal.

3.2 ENVIRONMENTAL IMPACTS OF SOLID WASTE

Although waste results from human activities, when it is not properly managed, it has negative impacts both on the human and natural environments. The degree of its impact however, depends on a number of aspects, for example, the type of waste, that is, its composition and quantity,

and lastly, its management from collection to final disposal (Palmer Development Group, 1996). Poor waste management results in negative human impacts through various mediums of contamination and at various stages. For example, contamination of the ground water and rivers by illegally dumped waste and poor waste control, has far reaching negative effects.

3.2.1 Human Impacts

The first thing that happens when waste is not managed properly is the blockage of storm-water drainage systems and streams. This is a common problem experienced by most communities in South Africa, especially in the historically disadvantaged communities where waste collection and removal services have been inadequate, inefficient and sometimes even non-existent. As a result of the blockage, standing water does not drain away. As a result, there is increased risks for flooding of these areas that might cause injuries and sometimes loss of lives as well as the development of diseases from the micro-organisms that result from the contamination of decaying waste matter with dirty standing water. Often the communities that are not provided proper waste collection and disposal services are the poor communities which are already vulnerable to diseases. Air pollution is also the result of poor waste management whereby waste is burnt in the areas where people live.

3.2.2 Impacts on the Natural Environment

It has already been mentioned in the paragraph above that poor collection and disposal of waste results in waste ending up in the water courses, namely rivers, wetlands and the sea. Collection of waste in these resources result in the deterioration of the water quality. Because these water courses provide habitat to aquatic plants, birds and animals, this habitat often gets destroyed and the animals get injured or die. Also, loss of habitat results in tremendous decline in the population numbers of species as they no longer have sufficient places for nesting.

Added to the destruction of the natural habitat is loss of oxygen in these water courses due to use of oxygen by decaying organic matter and micro-bacterial activity, thus reducing the amount of oxygen available for aquatic life. Plastic waste in particular has been recognised to be causing a serious problem for river and marine life (Palmer Development Group, 1996). For example, Stander and Benade (1990) found in their investigation that large numbers of marine and freshwater birds, fish and animals die every year after ingesting or becoming entangled in plastic. This danger is usually similar for other animals and birds grazing on land as well.

Additionally, inadequately controlled waste and litter result in negative aesthetic impacts. For example in most areas, especially poor areas in South Africa, waste is usually put out in kerb sites and where there is no regular collection it is dumped in open spaces. Furthermore, improperly managed waste, because of decaying and the action of micro-organisms results in uncontrollable problems of bad smells. For example, in the Cape Times Newspaper of 5 March 1993, it was recorded that residents of Belhar, north of Cape Town complained about bad smells from the refuse dump sited only about 100 meters away from some homes which was compounded by flying ash from occasional burning.

3.3 WHAT IS SOLID WASTE MANAGEMENT (SWM)?

Tchobanoglous, Theisen and Vigil (1993) describe solid waste management as the 'discipline associated with the control of the generation, storage, collection, transfer and transport, processing and disposal of solid wastes in a manner that is in accord with the best principles of public health, economics, engineering, conservation, aesthetics and environmental considerations and that is also responsive to public attitudes'. Solid Waste Management consists of six (6) functional elements, namely:

(i) Waste generation;

(ii) Waste Handling and Separation, Storage and Processing at

the Source;
(iii) Collection;
(iv) Separation, Processing and Transformation of Solid Waste;
(v) Transfer and Transport; and
(vi) Disposal

Before disposal in a landfill site or by incineration, solid waste undergoes a lot of transformation. Some of these changes take place during the storage phase of waste at the generation site, before collection for disposal and in other cases at the transfer station. Some of these transformation processes occur as a result of human intervention in an attempt to manage solid waste while some are a result of the natural solid waste management phenomena. Following is a short synopsis of the different transformation processes that solid waste undergoes.

3.3.1 PHYSICAL TRANSFORMATION

This process is the result of the human intervention in an attempt to manage solid waste as it is generated. It is comprised of three main aspects:

(i) Component Separation;
(ii) Mechanical Volume reduction; and
(iii) Mechanical size reduction.

Component Separation is the process of manual or mechanical separation of identifiable components from commingled solid waste. According to Tchobanoglous, Theisen and Vigil (1993), component separation is used to transform heterogeneous waste into a number of more or less homogeneous components. This process is therefore necessary for the identification and recovery of re-usable and or recyclable material.

Mechanical Volume Reduction is used to describe the process whereby the

initial volume occupied by waste is reduced, usually by the application of force or pressure. For example, the compacter containers used by the Sappi company for the collection of waste paper and cardboard in order to collect more paper or cardboard at one time. The other example of mechanical volume reduction transformation process is the crushing of cans during transportation for recycling.

Mechanical Size Reduction is the transformation process used to reduce the size of the waste material transported. Examples of mechanical size reduction are shredding, grinding and milling.

3.3.2 CHEMICAL TRANSFORMATION

The chemical transformation process of solid waste usually involves a change of phase, for example, from solid to liquid or gas. This is the kind of process that takes place mainly in food waste. After some time in storage the volume of the waste material reduces significantly with a lot of liquid material coming out of the waste container. In areas where separation of waste in order to discover re-usable and recyclable materials does not take place at the source of generation, chemical transformation reduces the marketability and the value of these goods when end point separation ultimately takes place, that is, at the disposal or transfer station.

Chemical transformation is composed of three main processes, namely:

(i) Combustion or chemical oxidation;
(ii) Pyrolysis; and
(iii) Gasification

Combustion or chemical oxidation involves the chemical reaction of oxygen with organic materials in order to produce oxidised compounds. The emissions of light and rapid generation of heat accompany this kind of reaction.

The *Pyrolysis* process chemically splits organic substances that are thermally unstable through a combination of thermal cracking and condensation reactions in an oxygen free atmosphere, into gaseous, liquid or solid phases. This is the kind of process that takes place during storage of solid waste material in refuse bags or garbage bins.

Gasification is a process that involves partial combustion of a carbonaceous fuel so as to generate a combustible fuel gas rich in carbon monoxide, hydrogen together with some saturated hydrocarbons, for example methane.

3.3.3 BIOLOGICAL TRANSFORMATION

This process is one of the processes that can be used to reduce the volume and weight of solid waste material and mostly involves the organic portion of the waste. Examples of the biological transformation process include,:

(i) Aerobic composting; and

(ii) Anaerobic digestion

It is well known that yard and organic wastes undergo organic decomposition as its natural fate. Also under controlled circumstances, yard and organic wastes can be converted into compost through the action of certain bacteria on this waste material, presence of moisture and other environmental factors. This compost can be used as soil nutrient or soil conditioner that helps fertilises the soil. The biological transformation process usually takes place in a short period of about four to six weeks.

The *anaerobic digestion* process involves the biodegradable organic part of the solid waste material. Under anaerobic conditions, this waste is biologically converted to a gas containing carbon dioxide (CO_2) and methane (CH_4). Added to this CO_2 and CH_4, other end products of this process include, ammonia, hydrogen sulphide and other resistant organic matter.

3.3.4 THE RELEVANCE OF WASTE TRANSFORMATION

The natural and the human ways in which waste is transformed are important ways of managing waste. For example, through a number of ways of solid waste transformation, reusable and recyclable materials as well as conversion products and energy are recovered. Solid waste transformation processes also improve the efficiency of solid waste management operations and systems (Tchobanoglous, Theisen and Vigil, 1993).

Implications of waste transformation are very important in the design and implementation of integrated solid waste management. As mentioned, some of this transformation happens as a natural process and some of it has to be facilitated by human intervention for example, the physical transformation processes. Some of these processes form the elements of integrated solid waste management which is currently being considered as an economically and environmentally better method of managing waste. For example, the development of the National Waste Management Strategy by the South African Department of Environmental Affairs and Tourism as well as Draft White Paper on Integrated Pollution and Waste Management. All these policy papers discuss to a great degree the importance of managing waste in an integrated manner.

3.4 INTERNATIONAL TRENDS IN WASTE MANAGEMENT

The amount and composition of waste generated in the developed countries is different to that generated in developing countries. Also, it has been proven that even though developed countries generate huge quantities of more sophisticated waste than developing countries, these countries have however, developed much better technologies for managing their waste which, includes both municipal solid waste and hazardous waste. For example, the Palmer Development Group (1995), identified that developed countries' waste generation rates per capita usually exceeds 1 kg per day with waste density

not greater than 150 kg per cubic metre compared to developing countries' per capita rates generally below 0.60 kg per day and waste density greater than 400kg per cubic metre.

Also, developed countries experience different waste management problems than developing countries which to some extent can be attributed to the existence of better management technologies compared to developing countries which are still setting up these systems. Often, developed countries have problems with the disposal of waste rather than collection. According to the report by the Palmer Development Group (1995), these problems are related *inter alia* to the existence of efficient collection services and increased amount generated due to the provision of large containers such as wheeled bins for household storage. Developing countries on the other hand are grappling with a lot of issues including institutional management, controlling legislation, technology for the management of waste which is often imported from developed countries and thus inappropriate for developing countries' infrastructure and service delivery.

Additionally, legislation on waste management is much more developed and better enforced in developed countries than it is in developing countries. The Palmer Development Group (1995), also identified that waste management in developed countries is further characterised by establishments in other aspects of waste management other than developed technologies. Those aspects include:

- Greater emphasis on waste minimisation, re-use and recycling;
- Greater responsibility and participation in waste management issues by the public;
- More stringent legislation that covers all aspects of waste management.

There are significant differences in the process of waste management between developed and developing countries from storage and collection at

the generation site to disposal either by landfill or incineration. For example, in developed countries there are standardised waste storage containers such as plastic bags or bins with a regular collection service which makes the management of waste more effective. However, in developing countries, storage containers range from non-reliable containers such as cardboard cartons, plastic bags or crates to permanent containers such as plastic or metal bins which are coupled with non-regular, non-reliable collection services. The difference in collection services is mainly due to either poor infrastructure, that is, roads to financial inadequacies.

Additionally, in developed countries, waste recovery services such as re-use or recycling are more developed than in developing countries. Such that, although developed countries generate more waste than developing countries, very little of that waste ends up in landfill sites due to effective recycling both at the source of generation and end-point recycling. Even though developing countries are marred with scavenging activities, because these are officially discouraged, more waste end up in landfill sites which are often not properly managed. Furthermore, there are fewer or no markets at all for recyclable materials in developing countries compared to developed countries. Added to the problem of markets in developing countries is also the public's perception of recycling as well as of products made out of recycled material, which has a big influence on the existence of these markets.

Furthermore, there is extreme lack of knowledge on how to manage these recyclable materials as they are generated at home with lack of information regarding the location of recycling companies. This is further coupled with inaccessibility of these companies to low income communities which to a certain extent discourages the efforts of recycling. Nevertheless, most of the recycling that takes place in developing countries is mainly encouraged by economic opportunities that arise from this waste industry. For example, use of some waste material for construction of shelter and as raw materials by small scale industries and workshops during the production process (Palmer

Development Group, 1995).

Disposal of solid waste in developed countries is either by landfill or incineration. This is not that different to developing countries only that, developed countries exercise better control of their landfill sites through stringent legislation compared to developing countries. For example, in February 1993, the German parliament passed a law requiring that, prior to landfilling, domestic waste must be treated to ensure that groundwater contamination and air pollution are avoided (Palmer Development Group 1995). Nevertheless, in some countries, due to lack of space, waste disposal has become more expensive as the areas that are available for new landfill sites tend to be far away from the residential areas.

Incinerators are also used to a large extent in other countries. This method is sometimes driven by immense lack of space for the construction of new sanitary landfill sites. In Japan, about 1 915 waste incinerators, in sizes of up to 1 980 tons per day had been constructed by 1988. These incinerators processed about 68 % of post recycling waste (Hershkowitz, 1988 in Palmer Development Group, 1995).

South Africa has been proven to be a mixture of both developed and developing world. This mixture is obvious in both infrastructure and service delivery. Thus, waste management provisions have been different for these different sectors and so are the problems experienced by these communities. The next section of this document thus documents the theory and arguments around waste management as they are presented in South Africa. It is assumed that most of this information will hopefully contribute to a clearer understanding of the manner in which events occur in the way that they do on Robben Island.

3.5 THE NATIONAL SITUATION ON WASTE MANAGEMENT

Management of waste in South Africa at large is a very complex issue. The reasons for this complexity include *inter alia,* the diversity of the South African society, voluminous waste streams from different communities that require and are afforded different management strategies, fragmented, inadequate legislation and controlling authorities, and is further compounded by the lack of enforcement.

It is well know in South Africa that waste management is different for different residential areas. For example, there are different and better waste management services afforded for the traditionally white residential areas compared to those of the traditionally black areas. Again, the difference exist in service between the formal housing areas compared to the informal housing areas. Often this difference is in the collection services provided for these areas in terms of the number of days when waste is collected and the manner in which it is collected as well as the regularity in the provision of these services. It has become quite noticeable that in those areas that are afforded less than adequate and ineffective services, a lot of illegal dumping and poor waste management services constitute some of the detrimental environmental impacts which result from inadequately and improperly managed waste.

According to the paper presented by Bredenhann at the International Congress on Waste Management in 1996, the volume of waste produced in South Africa since 1991 has increased at an annual rate in excess of the average annual GDP of 0.63 %. This increase is believed to be the result of the growth rates in the mining, petroleum, power generation and steel industries which were compounded by among other things, lack of waste avoidance, reduction and reuse or recycling programmes. The high levels of waste produced in South Africa have also been associated with the special circumstances relating to the country's mining and power generation activities

(CSIR, 1991). According to this CSIR data, solid waste stream amounts to about 300 million tons each year and this tonnage excludes agricultural waste and sewage sludge.

Following is the table that illustrates the distribution of the above mentioned tonnages. This table has been adopted from the report on the Situation of Waste Management and Pollution Control in South Africa prepared by the CSIR for the Department of Environment Affairs and Tourism (1991).

Table.3.1 Distribution of waste and tones produced in South Africa per year.

Solid waste stream (1990) tones per year ca. 300 million tons
238 500 000 mining tailings 22 200 000 pulverised waste ash 15 000 000 urban waste 12 200 000 chemical waste 5 400 000 metallurgical slags 4 800 000 other waste
20 million tons agricultural waste (1989) 12 million tons sewage sludge (1983)

Waste resulting from packaging or container waste generated in South Africa amounted to approximately 1.3 million tons with litter resulting in about 200 000 tones of waste produced annually (CSIR, 1991). Packaging litter does not only costs municipalities and indirectly tax payers a lot of money, but to a large extent it causes detrimental effects on animals and plants. As a result, many animals and especially birds and fish become suffocated or entangled in this kind of rubbish. According to the figures released by the Department of Environmental Affairs in 1992, it costs South African municipalities about R80 million to collect and remove the 22 000 tons of litter discarded per year (Cape Times, January 1992).

It has been documented that, in South Africa, one person produces about 1 kg of waste per day. This constitutes about 365 kg of waste per person per annum. Therefore, according to the data by The Fairest Cape Association, South Africa's towns and cities produce about 65 000 tons of waste per day which constitute about 24 million tons of waste generated per annum.

Ninety percent (90 %) of this waste is disposed in landfill sites. However, it has already been a concern in the Western Cape that not only is the province lacking sufficient technical skills and capacity for the proper management of these landfill sites in order to prevent subsequent pollution, but there is also not enough space for the development of new safer landfill sites.

In the Durban Metropolitan Area, not all the waste from the informal areas is collected. From these areas, only 25 percent of their waste reaches the formal waste stream (Lombard, 1998). Of the 1.4 million tons of waste landfilled in the Durban Metropolitan Area, 90.5 comprises general solid waste.

Narrowing this problem even further to the Western Cape province, bringing it closer to the research site, a number of individuals from both the public and private sector have met on a number of occasions in an attempt to address the growing problems associated with waste management and the ever increasing quantities of waste generated in the Western Cape Province. These organisations proposed the need for the development of a policy, one which will deal with all the aspects of waste management that include public education, waste reduction, recycling, collection, transportation and ultimate treatment and disposal.

According to a provincial survey that was also done by the representatives of the above-mentioned group, a wide range of concerns regarding the handling and disposal of waste in the Western Cape were expressed. These concerns included those about the quality of life, problem of illegal dumping and waste disposal sites with more waste problems anticipated in the future (Coleman,

et. al, 1996). Among the issues that were considered by the respondents of this survey that need to be addressed included the lack of public awareness and education about waste and environmental issues, the need for more waste minimisation programmes and the need for the development of an integrated regional waste management strategy.

Another study by the Palmer Development Group, (1995), reported an estimate of 650 000 tonnes per annum of domestic and commercial waste generated in the Cape Metropolitan area. These tonnes were translated to fill about 130 000 compactor trucks, which tipped in a pile of about one meter (1m) high, would bury Khayelitsha within 10 years. However, these estimates are much less than the real situation as they do not include, *inter alia* illegally dumped waste that occupies a lot of space and creates an additional problem in future, uncollected waste from traditionally black townships where the services are seldom effective living a lot of it dumped along streams or lying around on the streets, garden waste, builder's rubble and a certain portion from the industrial sector (Coleman et al, 1996).

Robben Island is therefore no different to these other areas of the country regarding waste streams and problems in their management. Also, as a growing tourist destination site, Robben Island is increasingly susceptible to vast quantities of waste generated by tourists visiting the island. Although this waste is mostly seasonal and often not separated from the rest of the waste that is generated from the offices and other areas of the island, it is more likely to contain large proportions of non-biodegradable materials due to the demand for luxury items brought by these tourists (Grange and Odendaal, 1999).

Littering is mostly the biggest problem during these peak seasons and is caused by a number of reasons ranging from inadequate facilities for the collection and storage of garbage properly such as side walk bins to the maintenance of these facilities which has been one of the problems

experienced with waste management in South Africa. Hence the initiative by government bodies and other relevant stakeholders (already mentioned above) from many provinces in the country to develop an integrated waste management strategy.

3.6 WHAT IS INTEGRATED SOLID WASTE MANAGEMENT (ISWM)?

Williams (1988) defines integrated waste management as the '*integration of waste streams, collection and treatment methods, environmental benefit, economic optimisation and societal acceptability into a practical system for any region'.* It implies the use of a range of different treatment and disposal options, including waste reduction, re-use and recycling, landfill, incineration and other options such as pyrolysis, gasification, composting and anaerobic digestion. According to Williams (1988), the integration of these streams also implies that no one option is better than the other, but that the overall waste management system chosen is the best environmentally and economically sustainable for that particular region.

What do we mean by a management system that is environmentally and economically sustainable?

> *Environmental sustainability* means that the options, and the integration of those options should produce a waste management system that reduces the overall environmental impacts of waste management, including energy consumption, pollution of land, air and water and loss of amenity (Williams, 1988).
>
> *Economic sustainability* means that the overall costs of the waste management system should operate at a cost level acceptable to all areas of the community, including householders, businesses, institutions and government (Williams, 1988).

Furthermore, Williams, (1988) states that, in order to assess the most environmentally and economically sustainable systems, local existing waste management infrastructure such as availability of landfill sites, existing incinerators, the types of waste to be managed, waste tonnages generated are all issues that should be considered.

In simple terms therefore, IWM is a holistic strategy for the management of waste generated largely by human activities, so as to reduce the impacts of such waste on the human and the natural environment. The aim of this strategy is that of providing a management system that minimises the volume of waste entering and leaving the waste stream. Therefore, in a truly integrated waste management system, waste such as demolition products, sewage sludge and hazardous, agricultural, industrial and household would all be included in the waste management system and not treated separately. This should result in more effective waste management, especially for the environment like that of Robben Island where the collection and disposal of all kinds of waste generated is the responsibility of one department. This is unlike other normal cases where these different waste streams are covered by different authorities, subject to different legislation and thus making the integration in management almost impossible due to either administrative overlap or difficulty in pinpointing departmental responsibility.

Integrated Solid Waste Management is composed of six functional elements, namely:

(i) *Waste generation* that involves an assessment of waste generated and the evaluation of waste reduction at source;

(ii) *Waste handling and separation, storage and processing at source*. This part involves the activities associated with the management of wastes until they are placed in storage containers for collection. At this stage, certain activities might be undertaken, such as, separation of household waste into recyclable and non-recyclable material and provision of

suitable storage for waste.

(iii) *Collection* covers the collection and transport of the waste to the location where the collection vehicle is emptied. The location may be a materials recycling facility, a waste transfer station or a landfill disposal site.

(iv) *Separation, processing and transformation of solid waste* occur primarily in locations away from the source of waste generation. At this stage, activities such as waste treatment at materials recycling facilities, activities at waste transfer stations, anaerobic digestion, composting and incineration with energy recovery take place.

(v) *Transfer and transport* involves the transfer of waste from the smaller collection vehicles to the larger transport equipment and the subsequent transport of the waste, usually over long distances, to a processing or disposal site. This transfer usually takes place at a transfer station.

(vi) *Disposal* refers to the final disposal which usually takes place at a landfill site (Tchobanoglous, Theisen and Vigil 1993).

Integrated Solid Waste Management should be implemented as an ongoing activity that requires continual monitoring and evaluation in order to make sure that program objectives and goals are being met.

Following is a diagram that represents, in a hierarchical form, the principles of integrated solid waste management. The diagram is taken from the paper presented at the Wastecon International Congress on Waste Management (1996) and is similar to the diagram used in the National Waste Management Strategy, volumes 1 and 2 of 1998.

- Waste avoidance incorporates prevention and reduction or minimisation at source;

- Waste recycling which involves re-use; recovery and composting of material;

- Waste treatment done through physical, chemical and destruction of waste that is generated; and

- Waste disposal

It is important to realise that integrated solid waste management is not exclusively technical. It also involves the social, the economic and the legislative aspects of waste management. Effective and efficient legislation is therefore an important ingredient of this process. In the following section is the description of the legislation that has already been promulgated in South Africa regarding waste management.

3.7 REVIEW OF THE SOUTH AFRICAN POLICIES AND LEGISLATIONS ON WASTE MANAGEMENT

Ninham Shand Environmental Consultants undertook a study on the Guidelines on Waste Management in South Africa in 1993. In their report, they documented *inter alia* lack of a comprehensive national statute solely covering waste management. These guidelines documented that, according to the report by the CSIR in 1991, provisions for dealing with waste were at that time scattered among 37 national statutes, 16 provincial ordinances and numerous by-laws.

Alas, reviewing the legislation to date resulted in no new or better findings regarding the legislation on waste management. There is still lack of a comprehensive national statute that completely covers waste management. Fragmented aspects dealing with waste management have been found in at least five (5) national statutes that have been reviewed. However, the Statutes reviewed were only those dealing with solid waste management as the project only looks at this aspect of waste. Among these various statutes, none of them discusses waste according to its different forms, such as solid, liquid and gaseous. All of these statutes discuss waste collectively and vaguely leaving a lot to be desired regarding proper, focussed and effective management. Except in the Environment Conservation Act and the new Policy, 'Draft White Paper on integrated Pollution and Waste Management,' none of these statutes have afforded waste management the priority it warrants, as an essential function required to prevent pollution and protect the environment.

The main purpose of the National Environmental Management Act (Act No. 107 of 1998), which is the co-ordination of environmental functions and procedures among all organs of state is the most relevant especially for waste management because of the different forms and the nature in which waste presents itself, namely the liquid, solid and gaseous forms and thus its

fragmentation. With the exception of Part IV of the Environment Conservation Act, the National Environmental Management Act No. 107 of 1998 has to some degree incorporated waste and pollution issues under its principles. However, having these issues is not sufficient, especially considering the extent of the problem of waste and pollution in this country. As mentioned in the Draft White Paper on Integrated Pollution and Waste Management, a great degree of these problems could be traced back to the country's history of unsustainable development and inequitable use of resources that implemented poor management practices for waste in certain areas of the country than others as well as massive levels of pollution. At this stage, what the country needs is a separate comprehensive legislation that specifically deals with waste issues from generation to disposal and the resultant pollution levels. Furthermore, legislation should take into consideration the different environments and areas in which waste is generated in order to have strategies that are appropriate and can be implemented effectively.

Because of the kind of environment in which Robben Island is located, it was not necessary to review the by-laws that exist in the city of Cape Town's local authorities. The reason being that Robben Island Museum is classified as state's land that is managed by the National Department of Public Works in which the by-laws do not apply.

The following section documents the relevant sections from the Statutes that were reviewed as they relate to this particular project.

3.7.1 The Constitution of the Republic of South Africa, Act No. 108 of 1996

The Constitution forms the basic foundation for the legal implementation of any strategy and the development of any legislation that is geared to protect or improve the environment. There are two very important parts of this Statute that will be discussed at this stage.

Section 24 of the Constitution of the Republic of South Africa, Act No. 108 of 1996 stipulates that "*Everyone has the right:*

- *to an environment that is not harmful to his/her health or well-being and*
- *to have the environment protected, for the benefit of the present and future generation, through reasonable legislative and other measures that:*
    - *(i) prevent pollution and ecological degradation;*
    - *(ii) promote conservation; and*
    - *(iii) secure ecological sustainable development and use of natural resources while promoting justifiable economic and social development.*

This section forms the basic foundation for the management of the entire island as it is a Natural and Cultural Heritage and National Monument Sites and also recently been declared a World Heritage Site. According to the above section, it is paramount that activities taking place on Robben Island are not detrimental to the island's entire environment.

The Constitution further enhances the effectiveness of the above section through its Section 38; *'Enforcement of rights'.*
According to this section, *"Everyone listed in this particular section has the right to approach a competent court, alleging that a right in the Bill of Rights has been infringed or threatened, and the court may grant appropriate relief, including declaration of rights,....."*

Promulgation of the proper legislation is therefore dependant on the provisions that are stipulated in the above sections of the Constitution, as it forms the supreme law of the Republic of South Africa (Preamble, Act No. 108 of 1996).

3.7.2 ENVIRONMENT CONSERVATION ACT NO. 73 OF 1989

This national legislation is the basis on which other provincial by-laws are formulated. Part IV of this legislation deals with the Control of Environmental Pollution. Under this section, various aspects of waste, litter and its management are clearly stipulated.

Section 19 deals with the prohibition of littering. According to this section, "*No person shall discard, dump or leave any litter on any land or water surface, street, road or site in or on any place to which the public has access, except in a container or at a place which has been specifically indicated, provided or set apart for such purpose.*" However, there are shortcomings in the way in which this section has been promulgated in that it excludes the possibility of waste or litter from private properties that is carried to public areas by the actions of either the wind or water *(utero tuo ut alienum non-laedas*[3]*).* Robben Island shore line, no exception to this problem is constantly polluted by waste that is brought by the tide on to the shore line.

Section 19A deals with the '*Removal of Litter: Every person or authority in control of or responsible for the maintenance of any place to which the public has access, shall within a reasonable time after any litter has been discarded, dumped or left behind at such place (with the inclusion of any pavement adjacent to, or land situated between, such a place and a street, road or site used by the public to get access to such place) remove such litter or caused it to be removed'.*

On Robben Island, the Public Works Department (PWD) is responsible for refuse removal from all the places where refuse is collected and stored. This responsibility is however, overseen by the States and Services Dept. which is part of the Robben Island Museum. The States and Services Dept. works

[3] *Utero tuo ut alienum, non-laedas* means that one should use the property in a way that does not harm another

together with the PWD in order to make sure that the activities regarding daily maintenance that are undertaken by PWD are in keeping with the Museum's operation and vision.

Section 20 of the Environment Conservation Act relates to the issue of *waste management* especially, pertaining to the issuing of a permit, the operation and management of a disposal site. This is a very crucial section to be considered for Robben Island and its entire Environment. There are many reasons for this special consideration. The two most important ones will be highlighted at this stage. Firstly, Robben Island is surrounded by sea water which needs to be carefully considered when decisions are made regarding the disposal of waste and the choice for the establishment of a disposal site so that adverse environmental impacts can be avoided or mitigated. Secondly, the Island is surrounded by salty sea water which makes it a water scarce environment in terms of the availability of drinkable water. Robben Island has therefore always depended on water obtained from the bore holes until recently when the construction of the desalination plant took place in order to provide the island with drinkable water. Drinkable water has become more scarce partly due to the gradual depletion of the underground source of fresh water.

However, the management and the issuing of these permits falls under the jurisdiction of the Minister of Water Affairs and Forestry. Nevertheless, according to section 24, the Minister of Environmental Affairs and Tourism may make regulations concerning:

> *(a) the manner in which the application for a permit in terms of section 20 shall be submitted;*
>
> *(b) the submission subject to the provisions of section 3 (3) of the Statistics Act, 1976 (Act no. 66 of 1976), of statistics on the quantity and types of waste produced'.* Section 3 (3) of the Statistics Act No. 66 of 1976 has been amended by section 4(3)(i) of the Statistics Amendment Act No. 25 of 1986.

This kind of fragmentation in the institutions managing and controlling these issues is one reason why waste management has become ineffective and not well focused in South Africa.

3.7.3 The National Environmental Management Act, No. 107 of 1998

In this legislation, the issue of waste is not considered sufficiently as one of the country's leading environmental problems. Only in two sections of the act is there any mention of waste as an issue to be considered.

Firstly, in the definition section waste is not considered as a separate entity in environmental management but as the cause of pollution. However, under pollution, it is specifically mentioned that pollution means *"Any change in the environment caused by:*

> *(i) substances;*
> *(ii) radioactive or other waves;*
> *(iii) noise, odours, dust or heat emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or organ of state, where that change has an adverse effect on human health or well-being or on the composition, resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future".*

The problem with this definition stems from the fact that waste is regarded as an environmental problem that results in pollution only during its storage and treatment, so that other aspects involved in waste are ignored. Likewise, this definition seems to consider the storage and treatment of waste as the only aspects resulting in pollution and not necessarily what constitutes waste. Furthermore, this definition is vague when one considers the impacts of littering on the environment other than the significant aesthetic impacts that might be better encompassed in this part of the legislation.

Littering is very important especially, in an environment such as Robben Island, where littering may have adverse environmental impacts beyond the island itself. For example, litter that is blown by wind or carried by rain into the sea result in pollution of the sea and death of aquatic animals from suffocation or poisoning.

Secondly, according to the principles of this legislation, for development to be sustainable, there are various relevant factors that need to be considered including the avoidance of waste and where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise dispose of in a responsible manner. Once again, there are various ways in which waste is disposed of in South Africa and therefore the question that arises is exactly what the legislation means when it says waste should be disposed of in a responsible manner.

This act is still inadequate for the control and management of waste. The two sections that have included waste are very vague and very limited. Moreover, many important aspects of waste have been omitted that could result in better understanding and management of waste as an environmental consideration.

3.7.4 HEALTH ACT 63 OF 1977

A few aspects relating to waste management appear in this Statute, as they constitute a nuisance to human health and well-being. In this statute, nuisance refers to *'any stream, pool, marsh, ditch, gutter, watercourse, cistern, watercloset, earthcloset, urinal, cesspool, cesspit, drain, sewer, dung pit, slop tank, ash heap and dung heap so foul or in such a state or so situated or constructed as to be offensive or to be injurious or dangerous to health'.*

The major objective of this legislation is mainly 'to provide for measures for

the promotion of health of the inhabitants of the Republic of South Africa'. In other words, this statute imposes an obligation on local authorities to maintain hygienic conditions within their areas of jurisdiction and to further take appropriate steps to combat any condition that may constitute a nuisance to the health of its inhabitants (Palmer Development Group, 1995).

Section 34 of this Statute, the 'Regulations relating to conditions dangerous to health' discusses many aspects relating to the management of waste and pollution. Specifically, section 34 (j) whereby the Minister of Health may make regulations relating to *'the approval, regulation, restriction and prohibition of the use of any place for public gatherings, and to the standards which shall be conformed to in respect of the provision of water and washing and sanitary conveniences, and the serving of food and disposal of waste at, such place and such other measures as may be necessary in order to prevent the development at such place of condition s dangerous or detrimental to health'.* Although this section does not particularly relate to solid waste only, it nevertheless, affects the planning, implementation and management of any solid waste strategies that may be developed by the Dept. of Environmental Affairs and Tourism together with other affected departments. Likewise for section 34 (l) which deals with the involvement of the Minister of Health in the regulations relating to *'the periodic cleansing of premises the removal from premises of rubbish,.....'*. These two subsections, other than contributing to the fragmentation of waste management legislation also affect its effectiveness and enforceability.

Another section that pertains to waste management in this Statute is section 38 which deals with the 'Regulations relating to rubbish, night soil, sewage or other waste and reclaimed products'. Particularly sections 34 1 (a), (f) and (h) are the most relevant in the way in which they affect management of waste and thus pollution.

3.7.5 National Water Act No. 36. of 1998

The National Water Act (Act 36 of 1998) defines pollution separately from waste. According to this Act, waste refers to *'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 reasonable likely to cause, the water resource to be polluted'.*

Part four (4) of this Statute deals with the prevention of pollution of water resources as a result of activities taking place on land. According to this section, the responsibility for preventing and or remedying pollution of the water resources lies on the person who owns, occupies, uses or controlling that land in question.

Section 19 deals with the prevention and remedying of pollution of water resources and take into consideration the *"polluter pays principle"* which requires that the person responsible for polluting the water course pays for remedying the situation. With proper and effective enforcement, the polluter pays principle is a good tool to manage and control pollution. However, due to the bureaucratic and fragmented nature of the management of the various aspects of waste management, waste as a cause of pollution does not have legislation that is effective enough in considering the extent of the problem.

In this Statute, there is no mention of the permits that according to the Environment Conservation Act (Act No. 73 of 1989), are issued and assessed by the Minister of Water Affairs and Forestry.

3.7.6 Draft White Paper on Integrated Pollution and Waste Management: A policy on Pollution Prevention, Waste Minimisation, Impact control and Remediation.

Integrated pollution and waste management refers to a *'holistic and integrated system and process of management aimed at pollution prevention and minimisation at source, managing the impact of pollution and waste on the receiving environment and remediating damaged environments'.* The objective of this policy document is to move away from the fragmented and uncoordinated waste management to integrated waste management. This policy paper has a different focus to the legislations discussed above in that, it focuses on pollution prevention, waste minimisation and the integration of both systems in the management of these aspects. According to the aims of this policy paper, pollution is the result of increased waste generated and thus have to be treated. Therefore its main aim is to *'promote the prevention and minimisation of waste generation and hence pollution at source'.* It is also aimed at *'promoting the management and minimisation of the impact of unavoidable waste from its generation to its final disposal'.*

This policy document recognises the fragmentation and ineffectiveness of the current legislation with its focus mainly on waste disposal and impact control. Unlike the existing legislation, the Draft White Paper on Integrated Pollution and Waste Management recognises the need to address waste as a source of pollution and the entire waste handling process from generation to final disposal. The process of the implementation of Integrated Pollution and Waste Management involves *'waste avoidance, minimisation and prevention; recycling and re-use; treatment and handling; and storage and final disposal.* Furthermore, the importance of education and training with regards to integrated pollution and waste management has been recognised as a useful and necessary tool for successful integrated management.

This document is a very useful document for South Africa's waste and

pollution problems. It addresses partly, the most critical areas of management with regards to waste and pollution management and should form an important basis for the enactment of relevant, useful and comprehensive legislation on waste and pollution management. Moreover, the most important aspect of the promulgation of any new legislation pertaining to Integrated Pollution and Waste Management is *inter alia,* the effective enforcement of the legislation which once again has been identified as one of the principles of this document. The Draft White Paper on Integrated Pollution and Waste Management addresses very important aspects of pollution and waste management which up to date have been lacking in all the legislation pertaining to effective and efficient pollution and waste management in South Africa.

Use of these policy principles and objectives in the promulgation of a new legislation on pollution and waste management goes a long way towards improving the waste and pollution problems that South Africa experiences because it addresses waste from 'cradle to grave' and points pollution out as a result. Therefore, focusing on prevention rather than on impact control and remediation, is the way forward.

3.7.7 National Waste Management Strategies (NWMS) and Action Plans South Africa, Volumes 1 and 2

The draft National Waste Management Strategy for South Africa presents a long term plan of up to the year 2010 for addressing key issues, needs and problems that are currently experienced with waste management in South Africa (NWMS, vol.1). This policy document follows the waste hierarchy approach that is widely accepted as a rigorous approach to integrated waste management (for the waste hierarchy approach, see the integrated waste management section in chapter three).

The definition of waste used in this document is almost similar to the one in

the Environment Conservation Act No. 73 of 1989, defined as an *undesirable or superfluous by-product, emission or residue of any process or activity that has been discarded, accumulated or been stored for the purpose of discarding or processing. These waste products may be gaseous, liquid or solid or any combination thereof and may originated from domestic, commercial or industrial activities, and include sewage sludge, radioactive waste, building rubble as well as mining, metallurgical and power generation waste.*

Also, included in this document, is the definition of Integrated Waste Management Strategy as a *'holistic and integrated course of action specifying institutional, infrastructural and technological support, human and financial resources, and commitment by all South Africans to prevent and minimise waste generation at source in order to protect human health and the environment and develop resources in a sustainable manner'.*

The National Waste Management Strategy also sets out priority initiatives that have been developed within the seven main elements of the waste management hierarchy. The initiatives set out include:

- Waste Information System;
- Waste minimisation;
- Recycling;
- Waste Collection and Transportation;
- Waste Treatment; and
- Waste Disposal.

The initiatives set out in this document are proposed for the period of operation starting from the year 1999 to the year 2010. This legislation forms one of the good policy documents that have been developed to address the problem of waste in South Africa which, more often lack proper implementation and effectiveness due to lack of enforcement and fragmentation in its management.

Although the Robben Island is situated in the Western Cape, management of its waste falls under the National Department of Public works. The by-laws on waste management that have been drawn by the local municipalities in the area do not apply to Robben Island but only the National legislation which is fragmented, lacks guidelines for effective implementation and are not properly enforced.

The literature above has discussed briefly the importance of developing and implementing an integrated waste management strategy. However, for this strategy to be effectively implemented, it is important that it gets sufficient legal support that will ensure that it is properly enforced.

On reviewing the South African legislation, it has become clear that government also supports the development and the implementation of this strategy through the promulgation of the two national policies on integrated waste management.

The following section gives detailed information on the solid waste trends and management techniques on Robben Island. These results will be used in the recommendations section which will inform the feasibility of the development and implementation of an effective integrated solid waste management strategy.

CHAPTER 4

4. RESEARCH METHOD

4.1 INTRODUCTION

This study utilizes a qualitative research method in the form of audio-taped in-depth interviews to assess the attitudes, understanding or knowledge of waste issues on Robben Island by the Robben Island Museum staff and residents.

Secondary data, which is of a quantitative nature, was obtained from the Heritage Department of the Robben Island Museum. This data (the Eco-log) is recorded on a weekly basis by the Public Works Department employee's who collect, transport and dispose of waste or refuse from the different departments on Robben Island.

The researcher also undertook outings with the PWD staff doing waste collection during the days when waste was collected. These were the Mondays and Thursdays of each week for four weeks, except on rainy days when collection was then scheduled for later in the week. Data collected during these outings included measuring of refuse bags, and random assessment of the contents of these refuse bags. Other arbitrary information that arose from the observations made during these outings is also included in the data presented in this report.

4.2 SAMPLING METHOD

4.2.1 THE TARGET POPULATION

Two lists, one of workers and one of residents were obtained from the Human Resource Office of the Robben Island Museum (RIM). On these lists, there

were about seventy-five (75) residents and one hundred and eight (108) workers, making up a population of 183.

A detailed list of all residential areas on Robben Island was also included in the resident's list. However, some of these were occupied while others were not. Those that were occupied had, next to the names of the residences, the names of the occupants, their telephone numbers (for those who had telephones in their dwellings) and the departments for which they work.

The second list (workers/personnel's) only had a list of all the personnel employed by the RIM. All the workers were listed under the various departments for which they worked.

4.2.2 Sample Selection

Simple Random Sampling without Repetition (SRSOR) was employed in this study (Kalton, 1983). Simple random sampling is a sampling method in which all the elements of the target population have an equal chance of being selected in the sample. However, the SRSOR used in this study involved use of the lottery method of sample selection. The target population or the universe in this study therefore includes all the people residing and working on Robben Island.

However, it is imperative to realise that, although the SRSOR was the chosen method of selecting the sample, most of the people who live on Robben Island are also employed by the RIM and thus stand a good chance of being selected twice. Nevertheless, in order to prevent this repetition of participants, any participant or responded who was chosen for the second time was not included in the sample and the next selection was made until the name of another respondent who had not yet been selected in the second list was picked. This was done in order to obtain as wide a variety of responses as possible to best describe the situation regarding the attitudes, knowledge or

understanding and behavior of this particular population on the management of waste on Robben Island.

An initial sample consisted of thirty-eight (n = 38) respondents which was twenty percent (20 %) of the total target population. Effectively, this sample was comprised of a selection of 20 % residence and 20 % staff. Of this sample, three (3) had been employed on contract which had expired by the time field work was commenced and five (5) were away from the office for unspecified length of time resulting in inevitable reduction of the sample.

Additionally, due to problems ranging from unwillingness to participate on the part of some of the Robben Island staff and absence of some as a result of leave arrangements at the time of the fieldwork, the sample size was therefore reduced to only twenty-nine (n = 29) respondents which formed 16 % of the population. Out of these 29 respondents, 26 were taped interviews and 3 were completed questionnaires (see appendix 1). Reasons for this difference were either noisy conditions in the area where the respondent was being interviewed or uneasiness with being tape-recorded.

4.3 INSTRUMENTATION

A structured questionnaire compiled by the researcher was first piloted with three employees of the Robben Island Museum of which one of them was also a resident on Robben Island. After the pilot process, it was necessary to make some changes on the questionnaire, namely:

- Use of an audio-tape to record the interviews instead of the field-worker filling in the questionnaire as it was initially proposed. It became clear during the pilot process that filling in of the questionnaires as the respondents were talking was hindering the amount and depth of information that was given by participants. This was mainly because participants were talking faster than the

field-worker was able to capture all that information in writing and ask the questions at the same time. It was therefore, observed that respondents tended to look at the field-worker and try and talk slower and this was seen to have a negative impact on the information that they were giving. Also, the audio-taping method was giving the field-worker an opportunity to probe deeper and get more clarity on the statements made by the respondents. This ensured that the field-worker concentrated more and managed to capture almost everything that was being said.

- The questionnaire method also limited the kinds of questions asked to mostly those that were in the questionnaire which sometimes needed to be manipulated to suite the various environments where people work on the island. Hence their different perception and understanding of the waste issues as that could be greatly influenced by the environment where one works and thus the type of environmental exposure.

The questionnaire was therefore used as a guiding tool for in-depth interviews which lasted about forty (40) minutes to an hour. This questionnaire consisted of 32 questions with ten (10) main open-ended and closed questions. The closed questions (Yes / No), were followed by a series of probing questions that allowed respondents to explain their statements further (see appendix 1). However, during the interviews, the sequence of the questions was adapted to suite the flow of that particular interview which depended greatly on the respondent's understanding, knowledge and perception. For example, an interview with a tour guide was vastly different from an interview with someone working at the workshop because they are exposed to different waste issues. Compilation of the questionnaire, (structuring of the interviews) was based on the understanding that a recycling initiative was implemented on the island two years ago. However, it was still unknown how much do waste generators, that is Robben Island Museum staff and residents,

understand about waste issues that arise on Robben Island. Nevertheless, it is assumed that the attitudes of these respondents is dependent on their understanding and knowledge of these issues which ultimately relates strongly to the success of the initiative.

For the waste audit, a scale calibrated in kilograms was used to measure refuse bags as they were collected from the various areas of waste generation.

4.4 PROCEDURE

4.4.1 INTERVIEWS

The researcher approached all the respondents during their office hours including the residents, as it has been noted that all the residents interviewed are also staff members of the Robben Island Museum. The study and its purpose were clearly explained before the interview process. Respondents were treated anonymously, meaning that, names of the respondents were not used during the interviews but were only used for sample selection. This anonymity was chosen in order to make the interview process easy for the participants without the fear of being quoted or identified later. Respondents were therefore, allowed to verbally concern to participate on the project.

Some of the respondents were not comfortable with being audio-taped and therefore, in order to allay their anxieties, questionnaires were completed instead. The interviews were randomly done according to who was present in his/her office at the time when the researcher was on the island. Appointments were only made with respondents who were not mainly stationed in the office such as, tour guides, drivers and skippers.

Secondary data that is used in this study has been obtained from the daily recording work that is done by the Public Works Department workers

collecting and disposing waste. This data included information on the number of refuse bags collected from the various activities or areas where waste is generated and the amount of recyclable material recovered from that waste. This kind of work was initiated in 1997 when the Heritage Department attempted to encourage recycling on the island.

4.4.2 WASTE AUDIT

Information that was included on the waste audit data included such data as where the waste on Robben Island came from, what type of waste it was as well as how much of the waste was collected during the waste collection days. This data was collected during the waste removal days, that is Mondays and Thursdays, by the researcher through observation and measurement of the refuse bins as they were collected from the various areas. These bins were hooked on to the measuring scale before they were thrown into the back on the three ton truck. Also, during the collection, bins were randomly opened and observed by the researcher. Waste audit was conducted for four (4) weeks, two days a week as specified above.

4.5 DATA ANALYSIS

All the data have been analysed qualitatively. Taped interviews were transcribed and then analysed by the researcher by means of drawing out common trends and using certain quotes to emphasise certain issues that were important in different sections.

The rest of the field work data (collected during waste collection trips) and the secondary data were analysed using Micro-soft Excel program. Graphs were then constructed to present the data in the results section. The data were then discussed in detail in the discussion section.

CHAPTER 5

5 RESULTS AND DISCUSSION

5.1 SURVEY RESULTS

5.1.1 ROLES PERFORMED BY THE RESPONDENTS ON THE ISLAND

During the fieldwork period, participants were interviewed randomly independent of their levels of employment in the company or whether or not they worked and lived on Robben Island. Nevertheless, during the interviews, questions to these answers were asked in order to make the distinction, especially concerning the roles they played in the organisation. The relevance of this question was assumed to have major influence on the attitudes and most importantly the understanding of waste issues as some of the staff members could, to some degree be involved in waste management.

Categories of employment were divided into top management, middle management, general employee and other. The division between top management and middle management was essentially made based on the management functions performed by that particular respondent, for example, directors and other senior managers were classified as *top managers*, *middle management* level involved co-ordinators, foremen and supervisors. *General employees*, which comprised forty-nine percent (49 %) of the sample included all the people classified as labourers. The following diagram (fig.5.1) illustrates the above mentioned participant role distribution.

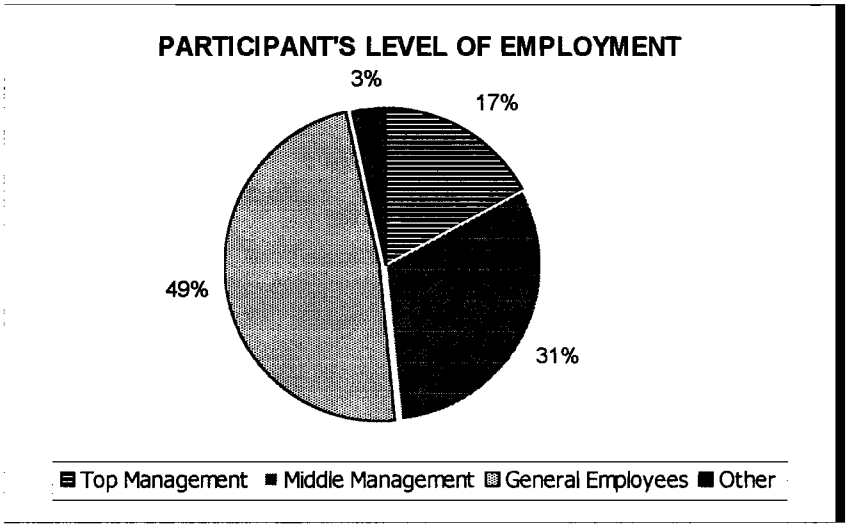

Figure 5.1. Participant's levels of employment

Although the sample was composed of 20 % residence and 20 % staff, that is, people working for the Robben Island Museum, almost 59 % of the people interviewed were either presently residing on Robben Island or people who had houses on the island but were not currently occupying those houses.

5.1.2 PARTICIPANTS' PERCEPTION OF THE WASTE PROBLEM AND ITS CAUSES

Fifty nine percent (59 %) of the respondents agreed that there existed a problem of waste or litter lying around the island. According to these respondents, this waste consisted mainly of tins (cool-drink and beer cans), paper, bottles and plastics. Nevertheless, the problem that was identified more often by these respondents was mainly waste or litter that occupied the shore line which seemed to have been arising from the sea. This waste is understood to have been brought on to Robben Island shore line by the tide arising from litter that is generated in the nearby beaches or ships moving pass Robben Island.

Furthermore, of the respondents who answered 'yes' to the question of waste/litter lying around the island, almost 50 % of them considered the cause of this problem to be the result of lack of proper litter bins on Robben Island. For example, one of the respondents answered, *'I don't know whether*

....people are going down the road drinking or what, but you will see empty tins, coke cans, beer tins, empty bottles, ...You can walk a distance on the road and you don't see a dirt bin, if there is, it's an old dirt bin that has been here since the time of the correctional services. You put something in, only to find out ....., its open at the bottom'.

Some participants were convinced that the department responsible for waste collection and removal was doing its job well. Hence, these participants did not think or notice that there was any problem with the manner in which waste is managed on Robben Island. Nevertheless, these participants did not think that they had any responsibility with waste issues taking place on the island, they thought they had their own functions to perform and waste had nothing to do with them.

Staff, residents and to some extent visitors were considered the cause of this problem. Most respondents indicated clearly that workers (staff of the Robben Island Museum) were the main cause of the litter lying around the island. For example, another respondent said that, '*Workers on the island are the main culprits, whether they Metro workers .....,.....they are all, its not only junior workers, senior workers as well, all have this mind set that somebody else is going to do it, is paid to do it, so we can dump.*' Those who mentioned tourists or visitors were not certain whether visitors contributed much to this problem. The reason for uncertainty is caused by the fact that visitors are only allowed to have refreshment in certain areas, for example, at the end of the tour around the prison area and the harbour. However, the behaviour of some staff members was identified by many respondents as the cause for the tourists behaviour because according to some of the participants, even though tourists are not allowed to do certain things such as eating and smoking on certain parts of the island, staff members continued to do such things in-front of the visitors.

Lack of education, from top management to the lowest level of employment

was also identified as one of the aspects contributing to the problem of waste and litter on the whole of the island. It was identified more often during the interviews that, the mind-set that exists on the island is the result of lack of education and knowledge in general of what the impacts are and *'keeping the environment clean, it does not happen at school nor at home'* (extracted from one of the responses).

Furthermore, some participants considered lack of awareness, negligence and the I don't care attitude as one of the reasons for litter and waste lying around on the island. During these interviews, most respondents were concerned about the kind of thinking that exists on Robben Island regarding waste issues from junior employees to top management which revolves around the idea that everybody has his or her own job and therefore the same applies with waste and litter. There is someone employed to do that job. According to one of the respondents, *'whether they Metro workers, ...security workers, ...work for the Heritage department or for the tours department, they are all, and its not only your junior workers, ...your senior workers as well. All have this mentality that somebody else is going to do it, ...is paid to clean up so we can dump'*.

Some participants, especially those working in the tours department, were concerned about lack of responsibility on the part of both residents and staff members which coupled the education factor. The concern raised was that no one wants to take responsibility for something that one is not paid to do, that is, falling outside one's job description. There are a number of respondents however, who claimed to have tried to take responsibility for cleaning the island. These respondents have gone to the extent of organising various campaigns geared towards the collection and removal of litter from the whole island. Often the participants who organised these campaigns were those who are residents on the island.

The other reason that was given by respondents for the littering taking place

on the island was lack of bins for disposing of waste on the whole island. Some participants even expressed that if the number of bins can be increased, coupled with the education of both residents and the staff, the problem of littering on Robben Island can be better managed.

5.1.3 PARTICIPANT'S UNDERSTANDING OF THE PRESENT WASTE MANAGEMENT PRACTICES ON ROBBEN ISLAND

About sixty-six percent (66 %) of the respondents were aware of the department responsible for the collection and disposal of Robben Island's waste. However, most of the participants were not exactly sure of the process of waste management that is taking place on Robben Island. For example, most of them did not know the days of the week when waste is collected and most importantly what happens after it has been collected. Almost 90 % of the participants were aware of the existence of the dump site. Nevertheless, there are two dump sites on Robben Island. One is where the big scrap material is dumped, such as building rubble and the second one is where solid domestic and commercial waste is taken for separation into recyclables and incineration of the rest (see appendix 2). Few of the participants knew of the existence of both of these sites. They often referred to one of them.

Very few of the respondents had been to the dump site to ascertain what happens, although they mostly were aware of the separation of waste into tins and bottles that takes place at the incinerator site. Often, those who had been to the site were those whose activities on the island had, to some degree, something to do with what was happening at the incinerator site. For example, the harbour master who is in charge of the boats coming to and leaving the island, including the cargo boat that transports the recyclable materials to the mainland had a good idea of what takes place at the incinerator site.

Seventy two percent (72 %) of the participants were aware of the cleaning

campaigns that have taken place on Robben Island. However, only 34 % of these respondents thought that these campaigns were successful and managed to get the island clean. Often, these campaigns were regarded as fun days and not organised on the basis that the Island was dirty. Some of these campaigns were called 'chicken parades' and involved children from the Robben Island primary school competing for a prize based on the number of bags collected by each child. Almost all of the people who were involved in these campaigns were people who lived on Robben Island. Those who were not involved, mainly staff members who did not live on Robben Island, gave the reason that these campaigns took place during the week-ends when they were not working.

Additionally, most of these respondents apportioned most of the litter on Robben Island to the residents as they mentioned that most of it happens during the week-end and is more obvious on Mondays when a lot of litter is noticeable along the sidewalks. None of the respondents, both residents and staff, thought that the campaigns were organised because the island was dirty with a lot of litter lying around. Also, very few of them could tell when and how regularly these campaigns took place.

5.1.4 WASTE SEPARATION AND RECYCLING

According to the participants, all the offices on Robben Island are supplied with two garbage bins. These include, a Sappi cardboard bin for waste paper disposal and a metal bin for the disposal of other waste material. Most participants mentioned that they supported the idea of separating waste at the source of generation, that is, in their offices and or at home, however, none of them separated waste in their offices. Those who separated waste at home, only separated the tin or cans and bottles from the rest of the garbage generated. Some participants claimed that they still separated waste in their offices and supported the idea based on financial benefits that result from that. For example, one of the participants' idea was that, *'yes I support,*

because now you have to employ more people who are going to separate may be rotten,....., bread from papers. You know, that can cost a lot of money'.

Eighty two percent (82 %) of the respondents admitted that they were not separating waste in their offices. These participants gave a number of reasons for not separating waste in their offices. The following table illustrates the various responses that were given by participants for not separating waste at source.

Table. 5.1. Participant's reasons for not separating waste at source.

Participant's reasons	**Percentage (%)**
1. Metro cleaners take the paper out of the box and mix it with rest of the rubbish in one bag	10 %
2. There is a place, the waste management area at the side of the prison where waste gets sorted	59 %
3. Robben Island Museum should employ more people to do the separation of waste	10 %
4. People in the village have to buy their own bags.	3 %

Almost all the respondents supported the recycling efforts taking place on Robben Island. Nevertheless, few of them knew the reasons behind recycling. For example, most of the respondents thought that separation of waste at source is done in order to spare the people responsible for refuse removal from any danger that can arise from broken glasses, bottles, rusted cans or tins. For example, one of the participant's response to the question was, *'It makes it easier for the man collecting the dirt, so he sees exactly where everything is, ...you see, they can't work with dirt if everything is mixed up because sometimes, especially glass, they must scratch in there and may be there's sharp object like a piece of glass that can hurt that man's fingers'.*

5.1.5 COST IMPLICATIONS FOR WASTE MANAGEMENT

Almost 90 % of the respondents were not aware of the various costs involved in managing waste. However, most respondents were concerned about the kind of service that is provided by the responsible department. In their view, waste management should not necessarily be a costly exercise, all that is important is for the Robben Island Museum to get an effective company or organisation to do the job properly. Nevertheless, those who expressed this concern were aware of the fact that whoever will be doing the job of keeping the island clean, will no doubt need to be paid.

5.2 WASTE COLLECTION RESULTS

Observations were also made by the researcher during the days when waste is collected by the Public Works staff members. The observations made included, the weighing of refuse bags as they were collected from the different areas, the number of bags from each area as well as the random observation of the contents of various bags. Random observation means that, not all bags were opened during these outings but only a few of them. The reason for opening these bags was to establish the type of waste that was generated from the various departments. For example, waste from the administration buildings and the heritage department was composed of mainly waste paper compared to the waste collected from the kitchen which was mostly organic in nature.

These outings were undertaken twice a week over a four weeks period. However, data has been documented on a weekly basis. This means that the two days' results have been added up to form one week's results. Hence the presentation of data in weeks as opposed to days (see figure 5.2 and 5.3 below).

Figure 5.2 below illustrates the average amount (in kilograms) of waste

generated on Robben Island during the four weeks period of fieldwork, from the 22nd of June to the 08th of July. According to this graph, more waste came from the private houses followed by waste generated in the kitchen. The harbour produced the same amount of waste with the administration building. The reason for this might be due to the fact that the harbour, similar to the administration buildings, is not one office but has many different areas or activities from which waste is generated (see chapter 2 for explanation). The guest house generated minimal amount of waste. However, considering the time when this data was collected, this might be due to a decreased number of visitors and fewer activities or functions organised to take place on the island during this time of the year.

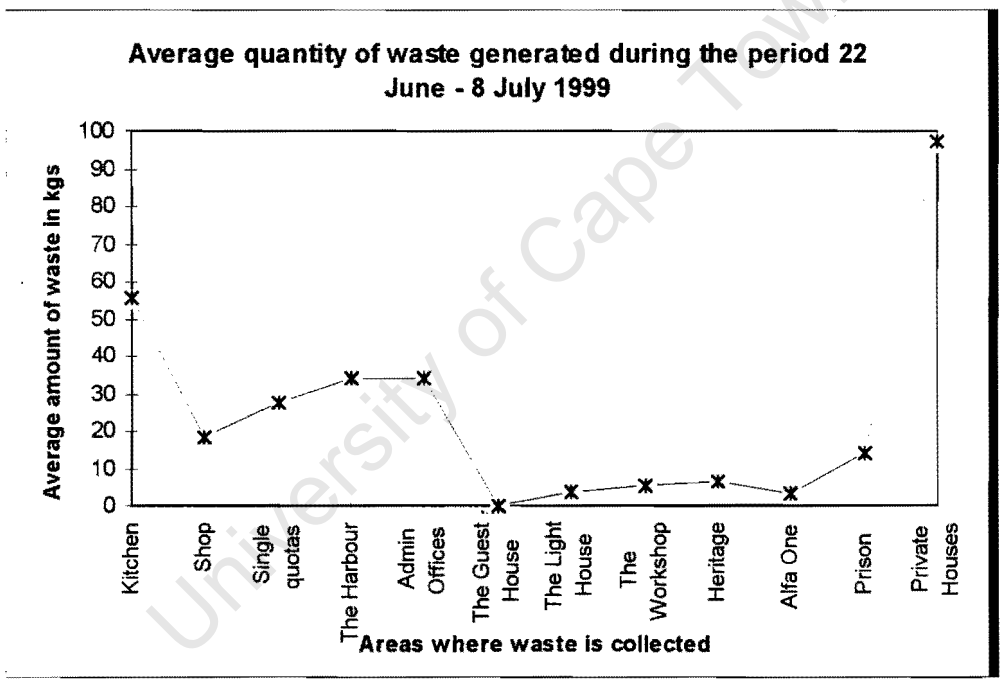

Figure 5.2. Average quantity of waste generated on Robben Island from 22 June - 8 July 1999

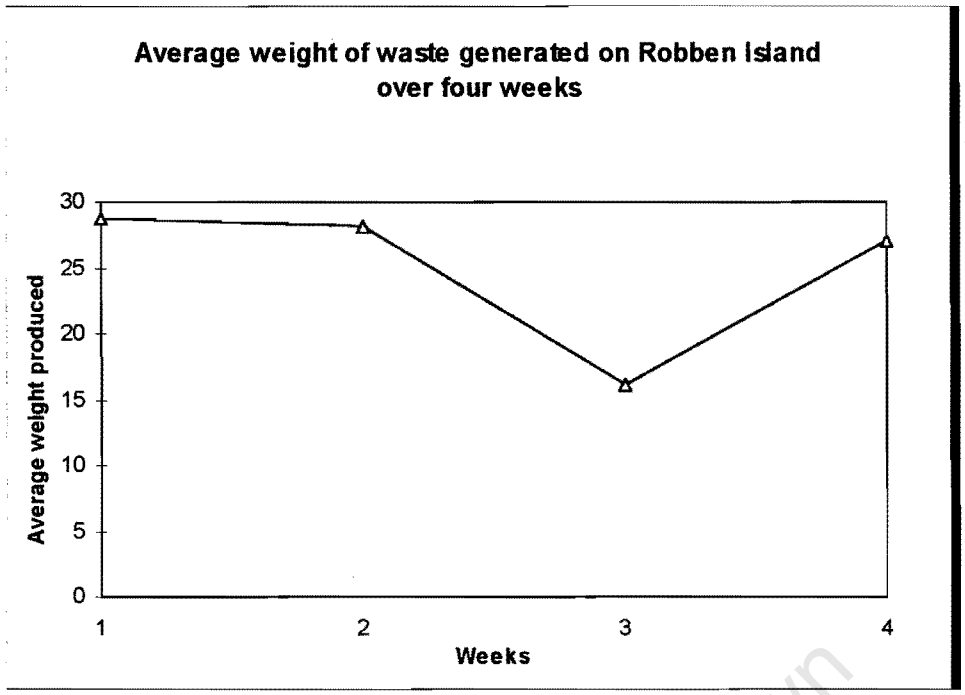

Figure 5.3 Average quantity of waste (in kilograms) collected on Robben Island between June 22 and July 8, 1999

According to figure 5.3 above, there is no significant trend in the amount of waste in the average weight of waste collected on Robben Island during the four weeks of the fieldwork. The trend seems to be constant except for one week, the third week, when there was a significant drop. Nevertheless, this drop might be the result of a number of reasons such as, weather conditions during that week resulting in fewer visitors to the island. Also, when the weather conditions are very bad, daily commuting workers are not transported across to the island and thus fewer people on the island. Also, this data only represent four weeks of one season and therefore, even if there was a difference between seasons, it would not be evident in this particular figure. The validity of this trend will therefore be confirmed by the trend that will be shown by the two winter seasons represented by the secondary data.

5.3 SECONDARY DATA RESULTS

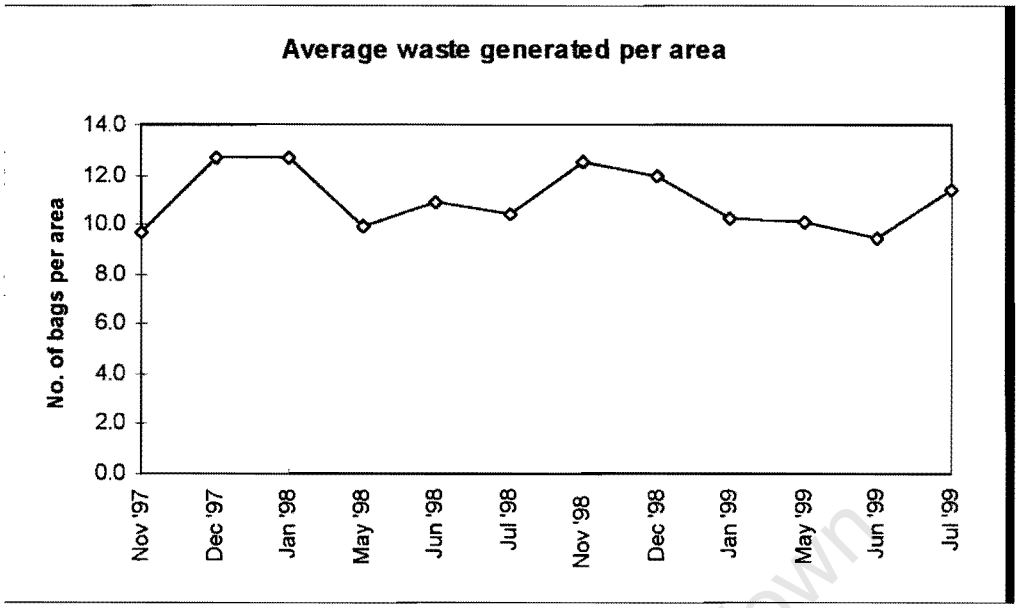

Figure 5.4 Average number of refuse bags generated per department on Robben Island over four seasons

Figure 5.4 represents the average number of refuse bags collected on Robben Island during two summer and two winter seasons. Because of the difference in the number of weeks during which waste was collected in each month, this data is therefore presented in average number of bags.

For certain months, waste was collected over five (5) weeks and in other months collection took place over four (4) weeks. It was then obvious that 5 week months will produce more waste than 4 week months. Therefore, in order to make the comparison between the seasons statistically legitimate, the graphs above represent the number in averages of bags collected from the various departments or areas of activity per month.

According to the above figure (5.4), there are many refuse bags collected during the summer months than there are during the winter months. The average number of these bags start increasing just before November month, remain constant during December and January and start decreasing afterwards. The refuse bags collected remain fairly low during the winter

months. This difference in the amount of waste produced during summer and winter can be a result of many issues such as, an increase in the number of visitors on the island during summer months and many activities arranged to take place in summer than in winter.

The above data further confirm the information by Grange and Odendaal (1999) that wastes generated by the tourism sector (Robben Island being a tourist destination site), is frequently seasonal in its nature.

Figures 5.5 and 5.7 below represents the average number of refuse bags collected from various departments on the island during three summer months, November to January. According to both figures, more waste is collected from the private houses followed by the harbour (chapter 2 describes the harbour and its activities). Furthermore, in figure 5.5 there is more waste generated during January and December in most departments compared to figure 5.7 where more waste is generated in December.

In figures 5.5 to 5.8, *Mess* represents waste collected from the kitchen and *Other* represents waste collected from the litter bins along the road and other areas that are not specified.

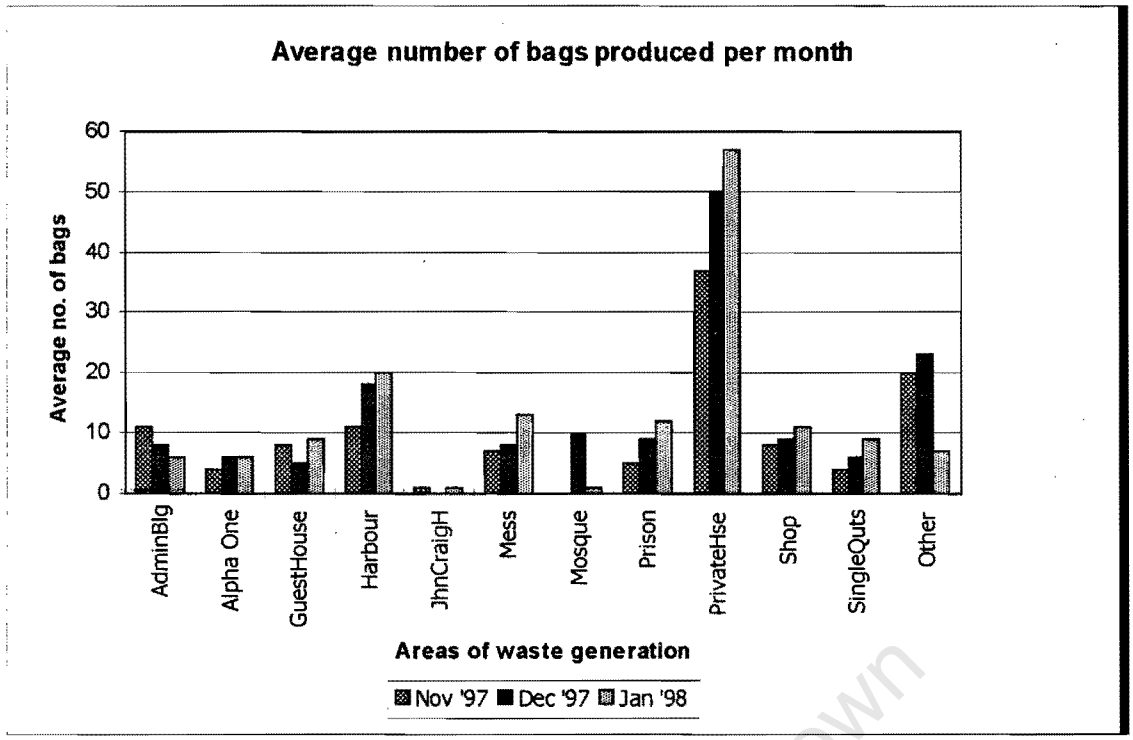

Figure 5.5. Average number of bags collected per department, Nov. '97 - Jan. '98

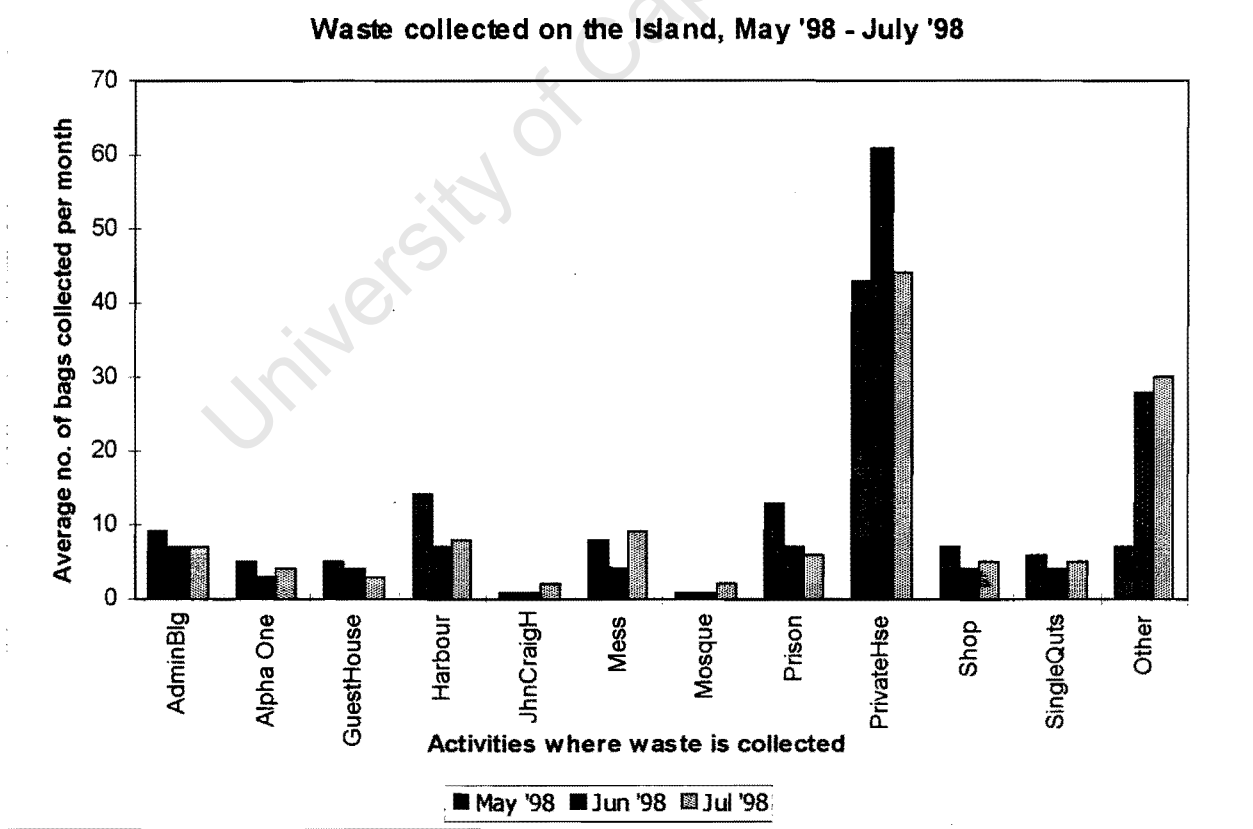

Figure 5.6. Average number of bags collected per department, May '98 - July '98

Figure 5.6 and 5.8 represents waste collected from the various departments

on Robben Island during three winter months, May to July. In both cases, more waste is collected from the private houses followed by the harbour area. In both figures, more of this waste is produced in July.

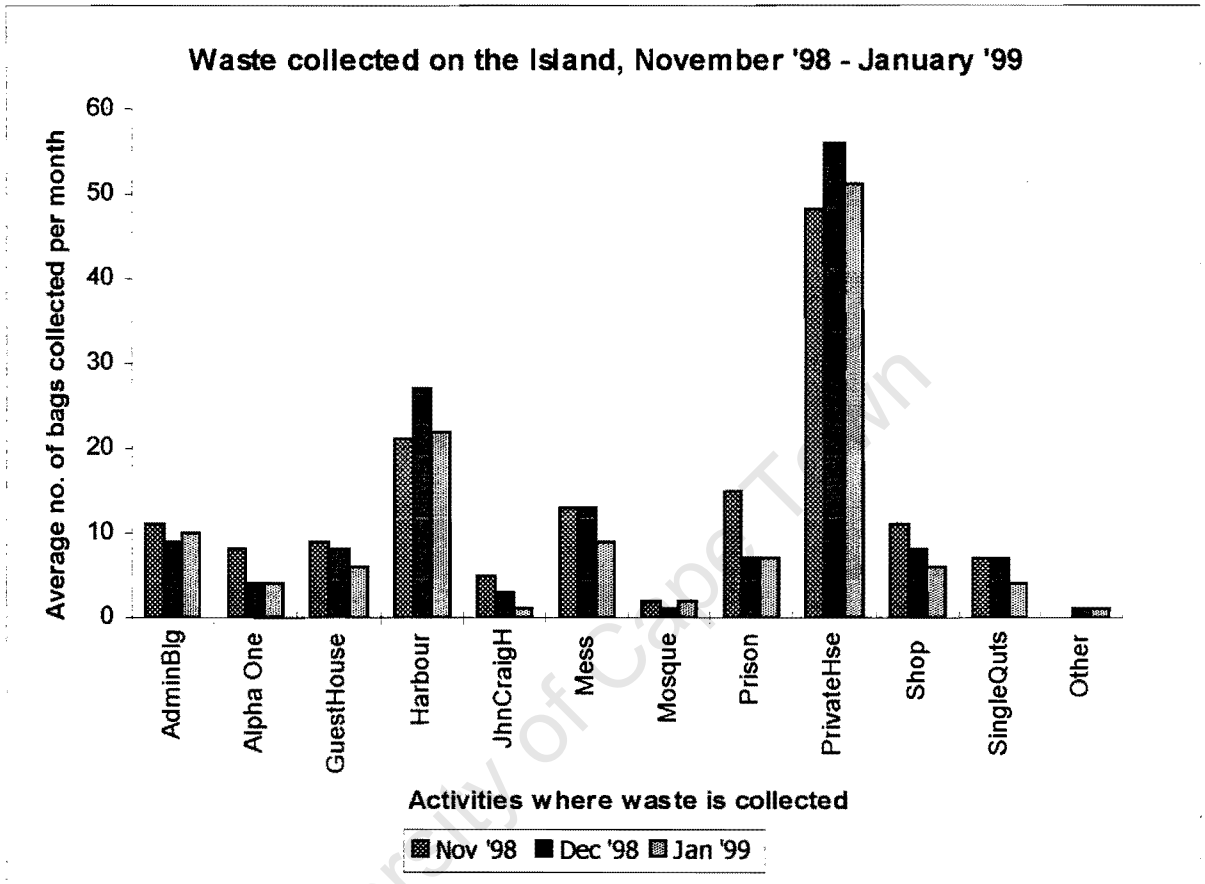

Figure 5.7 Average number of refuse bags collected per department, November '98 - January '99

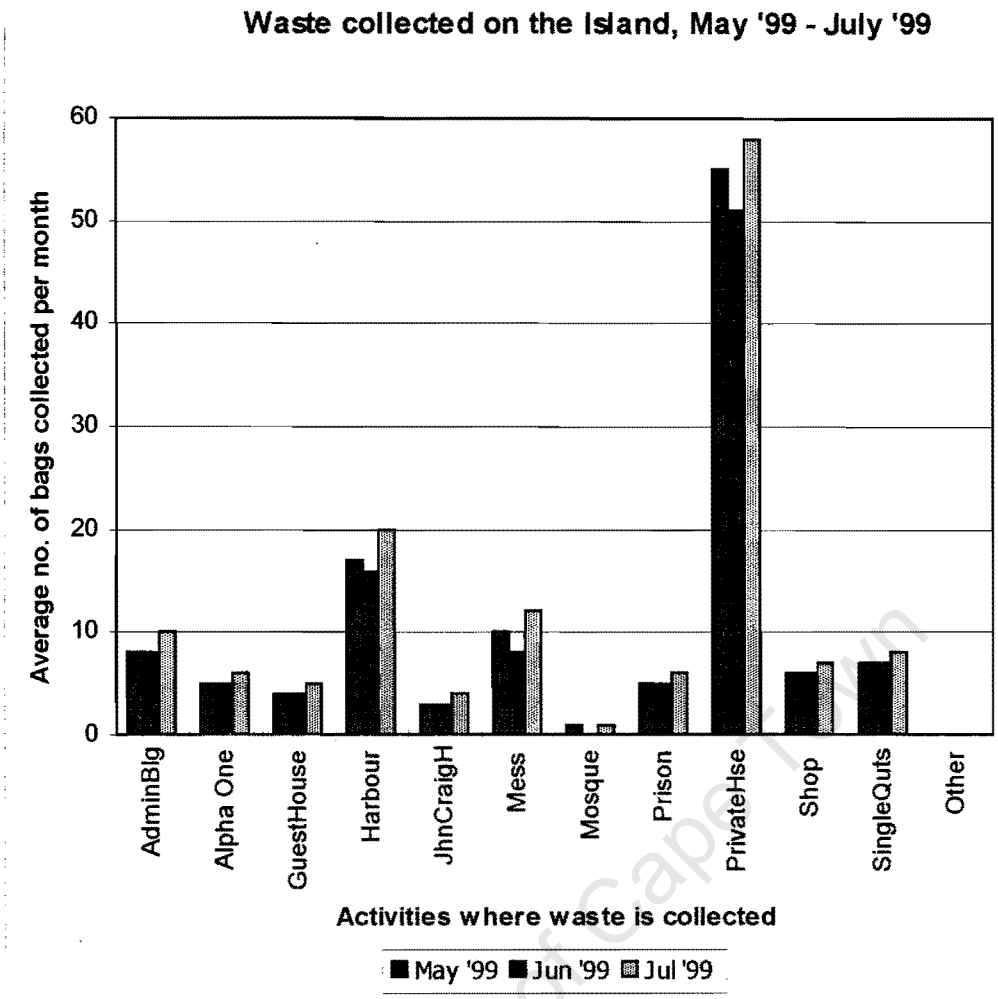

Figure 5.8 Average number of refuse bags collected per department, May '99 - July '99

Therefore, it is clear from the above figures (5.4 to 5.8), that waste generated and collected on Robben Island is different during the two seasons (winter and summer) with more waste collected during the summer seasons than the winter seasons. Nevertheless, for all four seasons the range lies between the maximum of 60 bags and the minimum of 2 bags (60 - 2). Also, private houses produce more waste than other areas on the island.

CHAPTER 6

6. CONCLUSIONS

6.1 PERCEPTIONS OF WASTE AND LITTER ON ROBBEN ISLAND

There is a problem of litter lying around Robben Island. This litter is located within the island and on the island's shoreline. Robben Island staff and residents believed that the problem is caused by a number of things, such as,

- Lack of responsibility on the staff and residents regarding proper handling and disposal of waste;
- Lack of adequate litter bins on Robben Island to discard litter instead of leaving it lying around the road side; and
- Lack of education and awareness regarding waste issues and their impacts on the environment from everybody working and residing on Robben Island.

There is a need for environmental education for everybody working and residing on Robben Island. This can help residents and staff understand the role that they play regarding waste issues and their management.

Furthermore, there is not enough knowledge about how waste is currently managed on Robben Island. Residents and staff do not fully understand their responsibilities and the responsibilities of the department managing waste and litter on Robben Island.

6.2 RECYCLING AND SEPARATION OF WASTE

The majority of workers and residents do not separate waste that is generated in their offices. Some residents only separate glass/bottles and cans while living the rest of the garbage mixed. There is no proper understanding of the reasons for recycling waste except the financial benefit

which is believed to be an extra income for the Robben Island Museum.

6.3 FIELDWORK RESULTS

Private Houses produced more waste than other departments or activities on Robben Island. Most of this waste is organic. In a four weeks period, private houses produced on average 95kg of waste. This was followed by the waste produced by the kitchen, which is also mostly organic in content. The average waste produced by the kitchen during this period was about 55kg. Waste generated by all the departments on Robben Island during this fieldwork period seemed to be almost constant.

6.4 SECONDARY DATA

Over four seasons, that is two summers and two winter seasons, Robben Island's waste generation displayed more waste generated during summer months compared to winter months. According to the data presented in this document, the amount of waste generated starts to increase in November remaining almost constant until it starts decreasing after January. However,the amount of waste generated during the winter months is constantly low. Once again, private houses generate more waste during all four seasons compared to the rest of other departments.

CHAPTER 7

7. RECOMMENDATIONS

7.1 INTRODUCTION

The purpose of this study was to assess and evaluate waste management practices that are currently employed on Robben Island. Necessary and applicable recommendations would thus be recommended based on the results of this assessment.

These recommendations are formulated based on a variety of issues that are drawn both from the field data and the literature that was used in the study. The issues include:

- The type of environment in which the research area is situated;
- The type and quantity of solid waste material that is generated on Robben Island;
- The best possible environmental and economical way in which solid waste could be managed on Robben Island.

The following section contains various recommended actions for solid waste management on Robben Island. Some recommendations are not entirely new actions for Robben Island, but additional comments on what has already been implemented in order to make it efficient and effective.

7.2 IMPLEMENTATION OF THE INTEGRATED SOLID WASTE MANAGEMENT STRATEGY

It is recommended that Robben Island Museum develops and implements an 'Integrated Solid Waste Management Strategy' (see chapter 3 for its description). The working of this strategy involves:

- Reduction or minimisation of waste from the generation site. For example,

encourage workers to use both sides of a piece of paper.

- Re-use of materials such as, encouraging people on the island to purchase products contained in returnable containers as well as re-using reusable materials.
- Recycling of waste material. Although recycling is already taking place on the island, that is, recycling of tins or cans and glass, it is nevertheless, not extensive enough to help reduce the amount of solid waste that ends up in the incinerator. For example, there is no recycling of office paper at all and most of the waste coming from the offices that gets incinerated is composed of mainly paper that has been mixed with the rest of the solid waste coming from these offices.
- Recovery of energy value from the resources through incineration of waste. However, most of the waste that is incinerated on the island can be recycled in many other forms.

It is important that before this strategy is implemented, thorough work is done to investigate the quantity and composition of all the waste that is generated especially in a sensitive environment like Robben Island where, according to the literature, because of its popularity as a tourist destination site, solid waste trends are expected to be different in different seasons of the year. This investigation is necessary in order to ensure that, once the strategy has been planned, appropriate treatment methods are developed based on the type and quantity of solid waste material generated (The Fairest Cape Association, 1999).

Furthermore, for this strategy to be effective, it is imperative that great care is taken during its planning as it is not the strategy that can just be implemented by the department managing the waste or the department in charge of the environment. A systematic process is thus recommended, starting from the people who are involved in waste generation to those managing the waste according to practical methods that can be implemented for its treatment and disposal.

7.3 EDUCATION AND RAISING OF AWARENESS FOR THE ROBBEN ISLAND PERSONNEL

It is imperative that people living and working on Robben Island are included and properly educated with regards to solid waste and its management when any initiative is planned. It is naïve of any management department to imagine that waste of any sort, could be managed effectively without the full co-operation of the population involved in its generation. For example, in 1997, a recycling campaign was started on Robben Island whereby, labels were attached on to the big black bins all around the Island. These labels demonstrated the types of materials that needed to be separated from the rest of the waste so that these could be recycled. Nevertheless, one label had all the different recyclable materials attached to the same bin that is supposed to keep all the waste until its collection day. Because people, other than those managing waste or its impacts were not fully involved, the campaign was not a successful event. Such that during the survey, some of the participants did not know of any reasons why certain waste materials were recycled other than the financial benefit for the Robben Island Museum. Also, most of them claimed to support the separation of waste where it is generated, that is, in their offices or homes, but none of them did actually separate their waste (see Table 5.1 for the reasons).

Robben Island is a small, sensitive and very unique environment that has a small human population. For any waste management strategy to be effective, education campaigns need to form the basic foundation on which everything else could be built. This was also loudly echoed during the survey by those who had been involved to some degree, in reducing the level of littering on the island. However, it is imperative that before these education campaigns are initiated, people's level of awareness and knowledge is understood. This will thus ensure that people get to learn what they do not know and understand the relevance of them educated about solid waste management even though they are not necessarily working in that department. Also, this

will not only ensure the effectiveness of the strategy but also its sustainability once it has been established. A new culture of sensitivity towards the environment and an understanding that this environment has to last for future generations to also benefit should be one of the goals of this education campaign.

7.4 RECYCLING

Some degree of recycling is already taking place on Robben Island. However, this excludes a lot of other materials that are recyclable as it only involves tins or cans and glass. A whole lot of other things that can be recycled end up in the incinerator which is not recommended for Robben Island's environment especially considering the type of solid waste that is generated.

The most important step in the recycling of waste is its separation from the point where it is generated. People from all departments must be made aware of this aspect, especially those cleaning the offices. Managers as well, from all the different departments must be encouraged to accept this aspect in their management roles, that is, ensuring that solid waste from their departments is handled properly. The reason for this added responsibility lies in the fact that managing any department on Robben Island is not the same as managing other environments such as, shopping malls because Robben Island is a World Heritage Site and its beauty and uniqueness lies in the proper management of its natural and human environments.

Furthermore, separation of solid waste from its source provides an opportunity for the reduction in the amount of waste requiring disposal as well as re-use of re-usable materials. For example, the cutting up of used paper to use as note pads, juice cartons for making pots for seedlings, re-using plastic bags etc.

7.4.1 PAPER RECYCLING

Most paper and cardboard can be recycled if proper separation at source has been done. There are other forms of paper that cannot be recycled, such as, wax or plastic coated packaging for liquids, carbon paper, self-adhesive paper, dog food bags, potato bags, and liver arch files. However, if proper separation can be done on Robben Island, most of the paper generated can be recycled with very little needing alternative disposal method.

Sappi's War on Waste recycling organisation programme used to collect paper from Robben Island until four (4) years ago when they stopped because they realised that Robben Island was then not producing enough paper (Carol Trehearn, personal communication). The procedure for Sappi is that, they supply the safmarine container to the organisation that wants to recycle the paper. For Robben Island, this means that, this container will have to be transported from the Cape Town harbour in the cargo boat and transported to the Island, to the place where waste paper is collected. However, it is important that this paper is properly packed in the Sappi bin so that enough paper is taken to the harbour every two weeks or every month.

The kind of paper that Sappi recycles include, cardboards, magazines, all kinds of paper except waxed paper, toilet paper rolls, cereal boxes and news papers. Nevertheless, Carol from Sappi made it clear that they do not supply their safmarine bins unless they are certain that enough paper is generated as the bins costs Sappi a lot of money. Also, the procedure, like in any business is profit driven. For an example, if there is a company producing ten (10) tons of waste paper per month applying to the Sappi organisation, and another producing only two (2) tons, the safmarine bin will automatically be taken to the one producing more paper over the same time period.

The other alternative will be for Robben Island to use their own refuse bags to collect the waste paper. These bags, irrespective of how many have been

collected, can be taken to the Paper King Depot in Roeland Street in Cape Town. Sappi then collects the paper from this Depot.

Alternatively, Robben Island Museum might have to do business with Nampak recycling whose procedure is totally different from that provided by Sappi. This decision however, depends on the commitment on Robben Island's side to manage their waste streams in the best environmentally and economically acceptable manner. The commitment should not only come from the department that is in charge of refuse removal but everybody on Robben Island as everybody is involved in one way or another in waste management.

As already mentioned in the previous section above, the initial step will thus require a carefully planned and detailed audit on the amount of waste that is generated in order to establish the most economically viable manner in which they can go about with recycling. According to Sylvia Beukes, (Nampak recycling, personal communication), Nampak provides ten (10) bags to the interested company for the collection of the paper. The company in return calls Nampak to collect the bags every time when they are full. However, in the case of Robben Island, the bags will have to be transported to the Cape Town Harbour for collection by Nampak.

It is important though, especially for an environment like Robben Island, that the need to recycle is not only financially driven but also driven by the concern for the environment and the need to conserve natural resources. For example, one ton of recovered paper is the equivalent of 17 pine trees in paper production (Fairest Cape Association, 1999). Plantations of paper producing trees, especially in South Africa, a semi-arid country, threaten fragile ecosystems by using up water resources. Also, recycling does not pay a lot of money and therefore if the initiative is mainly financially driven, it may not prove to be feasible.

7.4.2 PLASTIC RECYCLING

Plastic that is generated as waste on Robben Island is also incinerated with the rest of the waste. Even though there is not much plastic generated, the little amount that is generated can be collected and stored for recycling like other materials that are stored and taken to the mainland for recycling. This will therefore reduce the amount of waste that requires disposal and thus the level of pollution that is caused by the incinerator with the reduction of waste needing disposal.

Types of plastics that are recyclable include, polyethlene plastic, mixed plastic and PET plastic such as, coke bottles. Also, there are three different companies in Cape Town involved in plastic recycling, These are,

- Econo Plastic which recycles PET (poly-ethylene terephthalate) plastic;
- Kamming Plastic recycling PS (polystyrene) plastic; and
- Atlantic Plastic which recycles PE-LD (low density polyethylene) plastic

PET plastics are all the plastic cool-drink bottles such as 2 litre and 500 milli-litre bottles. The requirement for the collection of these bottles by Econo plastic is that the bottles must be fairly clean. The bottles must not have gone to the dumpsite before collection. Once again, this means that these bottles must be separated at the point where waste is generated. Econo plastic provides 100 kilogram bags to the interested party whereby, 25 bottles make 1 kilogram. Robben Island will then have to do the same like it is doing with the cans and glasses and that is, to collect the material and take it to the Cape Town Harbour where it can be collected by Econo Plastic. Lionel Jacobs is available to assist with any questions and queries on 905 2249.

Atlantic plastic deals with low density thin film plastic. This kind of plastic includes the soft supermarket bags, black refuse bags, tear off bags such as sweet wrapping, laundry or dry cleaner cover plastic, etc. The company provides 15 - 20 bags consisting of two size bags for the collection of this

material. When these bags are full, then Atlantic Plastic can collect the material from the Cape Town harbour. However, it is recommended that because of the lightness of the plastic, mini bailer machines can be used to compress the machines so that more plastic is collected at any one time. For further information on this material, Steven Cheetham is available telephonically on 933 3412.

7.4.3 Can Recycling

At this stage, about 60 % of all beverage cans are recycled in South Africa. There is currently a huge demand for all scrap metals world-wide and South Africa exports about 50 % of the scrap that it recovers (The Fairest Cape Association, 1999).

Robben Island Museum already recycles cool-drink and beer cans. Nevertheless, paint cans and other household cans are still taken to the unmonitored scrap site on the north-eastern side of the prison (see appendix 2). These cans can cause a lot of environmental damage when their contents leak into the surface and ground water system. Furthermore, this scrap site pose a lot of threat to the animals walking around the Island such as, the penguins and other animals. These cans can in turn also be collected for recycling as Collect-a-Can Company recycles all kinds of cans. Collect-a-Can can either collect the cans from the Cape Town harbour or the cans can be taken to their depot in Epping. Again this will not only provide financial benefit but also both long and short term environmental benefits. For further details, Mandy of Collect-a Can is available at 547 010.

7.4.4 Glass Recycling

Even worse than can recycling, of the glass produced in South Africa, only 23 % is recovered for recycling, 36 % is produced and sold as returnable packaging while 41 % of that produced each year is thrown away (The Fairest

Cape Association, 1999).

Robben Island is currently recycling glass. However, it is important that people on Robben Island are encouraged to re-use most of their re-usable bottles in order to reduce the costs incurred in transporting glass that can be recycled to the Cape Town harbour for recycling.

7.4.5 Composting of Organic Waste

Composting consists of the biochemical degradation of organic materials. The compost can be used as a sanitary process for treating municipal solid waste, sewage sludge, agricultural and industrial wastes. The product is usually a humus-like material, which is useful as a soil conditioner and cheap fertilizer that increases the fertility of the soil (General Electric Company, 1975).

In simpler terms, composting is nature's way of recycling which involves the controlled decomposition of organic material such as leaves, grass clippings, twigs and kitchen waste through the help of micro-organisms that are responsible for the composting process. Composting of waste is an old method that has been carried out for centuries by farmers and gardeners as it produces the cheapest natural fertilizer that is less harmful to the environment.

There are various methods in which composts can be made, namely: trenching, worm composting and layering.

Trenching is an easy method of making a compost that involves digging of a trench that is filled with compostable material. Once the trench is full, it can be used for various activities such as, growing of vegetables, trees or flowers. This method is particularly recommended to deal with the sandy soil conditions in the Western Cape.

The above method can also be very ideal for Robben Island to be used as a soil conditioner. It is also the best method for managing organic solid waste as it helps to reduce the pollution that is caused by the incinerator as a result of the emissions during the burning of the waste and ground pollution caused by the disposal of the toxic ash. There are a number of things for which the trenches can be used, such as growing of indigenous shrubs and plants that can enhance the cultural heritage of the island, development of a nursery and vegetables for sale to both visitors and the residents of Robben Island.

The other methods of composting include worm composting and layering. *Worm composting* is suitable for very small gardens such as home gardens.

Method of worm composting:

Use a 25 litre plastic bucket with drainage holes. Put sand into the bucket. This should be followed by bits of torn up cardboard. Then put mature compost and a handful of earthworms. The earthworms must be fed with chopped up organic waste such as peels and leaves. The mixture must be kept moist and in the darkness. Add shredded paper and sprinkle with soil occasionally.

(Adopted from the Fairest Cape Association's Wise Up on Waste Publication: 1999. pg 13.)

This kind of composting can also help reduce the amount of organic waste generated, especially that from the private houses that, according to the field work results are producing the most waste than the rest of the island. However, a lot of commitment in education will be required to help make sure that people understand how these methods function in order to prevent uncoordinated dumping of waste into the compost heap that could result in other environmental impacts such as negative aesthetics impacts, bad smells, etc.

Layering is the method of composting that is already undertaken haphazardly

on Robben Island. This is currently done using the yard waste such as grass clippings and trimmings that are done also by the Public Works Department's garden section, mostly on the houses. However, the compost is not properly made and also not monitored or used for any particular activity on the island.

> **Process of layering**:
> Start the compost with a layer of rough material such as sticks and branches at the bottom. Add a thin layer of manure on top of this material. Then add green organic waste and cover the top with a layer of brown leaves.
> (Adopted from the Fairest Cape Association's Wise Up on Waste publication: 1999, pg 13.)

Most of the waste generated on Robben Island can either be re-used or recycled in many different ways. Not only does recycling reduce the amount of waste that requires disposal and produces additional income, but it also protects the environment. Also, even though the current manner of waste disposal on Robben Island seems to work effectively in terms of ultimately disposing solid waste, the environmental impacts, both short term and long term such as air and ground pollution from the ashes outweigh the short term benefits of disposal. In a nutshell, incineration of waste on Robben Island does not constitute good management intervention due to the above mentioned impacts.

7.4.6 Waste Incineration

Ideally, incineration is a way of recycling waste as energy (in the form of heat), but its importance in waste management is also that it reduces the volume of waste that has to be disposed in landfills (Fairest Cape Association, 1999). However, because waste incineration is not the final disposal method of waste management but precedes disposal of the remaining waste, namely, the ash, its benefits are therefore outweighed by the significant impacts that

the ash resulting from this incineration procedure might have on the environment. Furthermore, the incineration of waste causes air pollution whose impacts vary depending on the type of material incinerated.

Waste incinerators are expensive to install and run and have little or no economic returns compared to proper separation and recycling of waste. This is especially important when the incineration is used without heat recovery which is the case on Robben Island. Also, waste incinerators require a minimum amount of waste to be delivered almost daily in order to remain functioning and this reduces the need for waste minimisation (Linde, 1994).

The incinerator on Robben Island burns mostly domestic and office waste. This kind of waste can be disposed of in many other economically and environmentally less harmful ways such as recycling, composting, etc. Also, this incinerator has been reported to have numerous mechanical breakdowns that result in the accumulation of more waste at disposal site and thus rendering the area a health hazard for the employees working at the site. Furthermore, these employees complained about the difficulty of burning hard plastic. According to them, this kind of plastic takes a very long time to burn out and thus require a lot of energy. However, because the incinerator is very old, the workers fear that this kind of heat might result in the collapse of the inside walls of the incinerator. Based on the above reasons, waste incineration is not recommended for the Robben Island environment.

CHAPTER 8

8. SUGGESTED PLAN OF ACTION FOR IMPLEMENTING AN INTEGRATED SOLID WASTE MANAGEMENT STRATEGY ON ROBBEN ISLAND

In the previous chapter, the author recommended that Robben Island develops and implements an integrated solid waste management strategy. These recommendations are based on the knowledge and understanding of the relevance and importance of this strategy that was obtained from the background information on waste management used in this research project. Furthermore, research findings on the quantity and type of waste generated on Robben Island proved the feasibility and the importance of developing this strategy on Robben Island.

However, from the research findings presented in chapter 5, it was clear that the type and quantity of solid waste generated on Robben Island does not necessarily require such an extensive and environmentally destructive disposal method such as waste incineration. Furthermore, research on other solid waste management options proved the feasibility of implementing an integrated solid waste management strategy. This strategy appears to be the most environmentally and economically effective method of solid waste management that could be implemented on Robben Island.

The author realises that the transformation processes that solid waste undergoes is different for different environments. Nevertheless, the basic principles of integrated solid waste management are the same everywhere and can be implemented anywhere with just minor adjustment to suit the site or the environment in which the strategy has to be implemented.

Therefore, the following diagram (Table. 8.1) outlines the fundamental principles of a generic integrated solid waste management strategy. This table

contains examples of the steps that could be taken for each waste material produced under the different integrated waste management principles as well the recommendations on the process of evaluating the effectiveness of the strategy.

It is important to realise that education of all the people working or living on Robben Island forms the basic foundation for the effective implementation of this strategy. This will help improve understanding and awareness of waste issues and their management. Furthermore, Robben Island personnel should be made aware of its uniqueness and its status nationally and globally.

TABLE 8.1 RECOMMENDATIONS ON THE IMPLEMENTATION OF THE INTEGRATED SOLID WASTE MANAGEMENT STRATEGY ON ROBBEN ISLAND

PRINCIPLE 1: SOLID WASTE TRANSFORMATION

The transformation process forms the basic foundation of solid waste management. This transformation process is the result of human intervention and/or naturally occurring process of solid waste management. Effective human intervention is the most important foundation of an efficient integrated solid waste management strategy. This section of the report only refers to physical transformation. Chemical and biological transformations are naturally occurring processes that take place independent of an efficient or poor waste management practice. However, physical transformation, which result from human intervention is the most necessary step to set up when attempting to manage solid waste effectively.

Physical transformation ensures the implementation of the rest of the principles of an integrated solid waste management strategy because it involves separation of waste and reduction of the amount or volume of waste that needs to be disposed of. Therefore, the most important step to be taken in this process is **'proper and adequate education'** of the people where waste is generated regarding its separation into different homogeneous components namely, cans, glasses or bottles, paper and organic or food waste. This education process or campaign must ensure that there is proper understanding of the reasons and benefits of solid waste separation from source by the affected people. Once this stage is implemented, the rest of the strategy is bound to be feasible. The only way to monitor the progress of this process is periodic assessment of solid waste that is collected from the different sections of the island.

PRINCIPLE 2: WASTE MINIMISATION				
SOLID WASTE MATERIAL	**STEPS TO BE TAKEN**	**INDICATORS**	**MONITORING OF PROGRESS**	**OVERALL RESULTS / BENEFITS**
1. Paper	♦ Educate workers regarding proper use of paper in their offices. For example, encourage staff to use both sides of the paper. ♦ Encourage and work on improving the separation of waste paper from the rest of the waste in the offices. ♦ Organise informal educational workshops on the island that will help improve staff and residents' knowledge of the importance of minimising paper use. ♦ Encourage Robben Island personnel to use proper cups and glasses instead of disposable cups.	♦ Less waste paper requiring disposal. ♦ Improved separation of waste paper from the offices. ♦ Well informed and better understanding of the need to minimise waste paper by Robben Island staff. ♦ Less littering	♦ Periodic assessment of waste paper produced by various departments on the island during waste collection. ♦ Detailed information and assessment of the solid waste produced before it is disposed to assess for effective separation of different kinds of waste from the source	♦ Better informed and cooperative staff. ♦ Improved savings on the purchases of the island stationary. ♦ Improvement in the amount of litter seen on and around the island.

SOLID WASTE MATERIAL	STEPS TO BE TAKEN	INDICATORS	MONITORING OF PROGRESS	OVERALL RESULTS / BENEFITS
2. Plastic (Most of the plastic is from packaging and refuse bags that collect waste).	♦ Education of workers and residents regarding buying of unnecessarily packaged goods. ♦ Separation of waste from its source. ♦ Investigate Robben Island Museum's current suppliers of goods for their amount of packaging and compare with other options that are available ♦ Encourage Robben Island Museum to order from suppliers who supply materials in bulk in order to reduce the amount of packaging that ends up on the island.	♦ Less plastic seen in the island's waste stream to be disposed of. ♦ Reduced amount of waste produced on Robben Island due to use of bulk packaged goods taken to the island. ♦ Less plastic or other packaging litter on the island.	♦ Assessment of waste that is produced prior to disposal. ♦ Assessment of household waste for unnecessary packaging. ♦ Strategic education campaigns regarding the environmental and economic benefits and impacts of these packaging materials on Robben Island and the surrounding environment.	♦ Same as above. ♦ Less packaging material taken to Robben Island when bulk packaging suppliers are used. ♦ Improved general state of environment on the island.

PRINCIPLE 3: RE-USE OF WASTE MATERIAL				
SOLID WASTE MATERIAL	**STEPS TO BE TAKEN**	**INDICATORS**	**MONITORING OF PROGRESS**	**OVERALL RESULTS / BENEFITS**
1. Paper and cardboard	♦ Education initiatives in which workers are informed about the various ways in which they can re-use old paper and cardboard. For example, cut the unused part of the paper and use as message or note pad. Use cardboard as box files for storing materials such as stationery and other office materials. ♦ Old re-usable paper to be taken to the Robben Island school for use by the children.	♦ Less paper and cardboard discarded as waste. ♦ Improved separation of waste at source.	♦ Periodic assessment of waste that is generated for its content and amount. ♦ Regular workshops with both residents and workers for information sharing regarding re-use of these materials and also encouragement through comparing departments for motivation.	♦ More understanding and cooperation of the residents and workers. ♦ Improved solid waste management practice as separation at source improves and the amount of waste that requires disposal decreases. ♦ Less waste requiring final disposal. ♦ Better understanding of the various ways in which waste paper can be used.

SOLID WASTE MATERIAL	STEPS TO BE TAKEN	INDICATORS	MONITORING OF PROGRESS	OVERALL RESULTS / BENEFITS
2. Bottles or glass	♦ Provide residents and workers with options for re-using glasses and bottles. For example, food bottles can be used as storage containers. ♦ Regular workshops and ad hoc meetings to provide both workers and staff with information on how to re-use these materials. ♦ Proper separation from the rest of the waste at source to provide museum management with the option of re-using these materials when recovered at the disposal site	♦ Less glass or bottle produced as waste. ♦ Less dangerous litter to be found around the island resulting from broken glasses and bottles.	♦ Same as above	♦ Improved solid waste management practice on Robben Island. ♦ Improved savings due to fewer glasses and bottles that require transportation to the mainland for recycling. ♦ Collection of glasses and bottles for recycling will also improve. ♦ The landfill site (appendix 2) will be more hygienic and better managed. ♦ Improved management of glasses and bottles that are kept at the disposal site (see appendix 2) that will be transported to the mainland for recycling.

PRINCIPLE 4: RECYCLING				
SOLID WASTE MATERIAL	**STEPS TO BE TAKEN**	**INDICATORS**	**MONITORING OF PROGRESS**	**OVERALL RESULTS / BENEFITS**
1. Establish an effective recycling program	♦ Arrange education campaigns as the starting point in developing this strategy whereby staff and residents will be informed about the importance of recycling. ♦ Provide separate and adequate bins for different recyclable materials. ♦ Ensure adequate and proper dissemination of information to Robben Island visitors about the program as they arrive on the island and encourage them to participate. ♦ Bins must be located at strategic points. For example, popular resting places.	♦ There will be less waste that requires disposal. ♦ Reduced amount of waste seen on and around the island. ♦ More accessible different bins for different waste materials.	♦ Monitor the use of extra bins provided and the level of littering on the island. ♦ Complement everybody for any improvement noticed in order to encourage more participation.	♦ Improved solid waste management on Robben Island. ♦ The island will be cleaner. ♦ Better understanding and cooperative visitors. ♦ Improved sense of responsibility on the staff, residents and visitors through the encouraged participation.

SOLID WASTE MATERIAL	STEPS TO BE TAKEN	INDICATORS	MONITORING OF PROGRESS	OVERALL RESULTS / BENEFITS
2. Paper and cardboard recycling	♦ Ensure that the staff cleaning the offices is adequately informed about the separation of paper and other recyclable materials from the rest of the waste. ♦ Ensure provision of separate bins and understanding of their purposes in all the offices. ♦ Separate bins for recyclable material must be accessible throughout the entire island. For example, separate bins for paper and cardboard, glass and bottle, cans and other waste.	♦ Different bins provided for different waste materials. ♦ Collection of paper for recycling instead of incineration. ♦ Less waste requiring incineration.	♦ Evaluate waste generated from the entire island and follow up incidences where waste has not been properly managed or separated. ♦ Delegate more responsibility for this activity on the staff and management of the various departments and occupied residences of Robben Island.	♦ Less litter found on the entire island. ♦ Improved waste management on Robben Island. ♦ Well informed Robben Island personnel regarding waste issues and their involvement. ♦ Reduced amount of paper burnt in the incinerator.

SOLID WASTE MATERIAL	STEPS TO BE TAKEN	INDICATORS	MONITORING OF PROGRESS	OVERALL RESULTS / BENEFITS
3. Glass and bottle recycling	♦ Educate Robben Island personnel about the importance of proper of waste at source. ♦ Provision of adequate bins for litter disposal	♦ Same as above	♦ Same as above	♦ There will be fewer glasses and bottles that will be transported to the mainland for recycling. ♦ Improved savings with fewer materials transported to the mainland and regular maintenance of the crane.

SOLID WASTE MATERIAL	STEPS TO BE TAKEN	INDICATORS	MONITORING OF PROGRESS	OVERALL RESULTS / BENEFITS
4 Recycling of food or domestic waste	♦ Education of Robben Island personnel about the different ways in which food or domestic waste can be recycled. ♦ Arrange workshops with all the people living and working on Robben Island where they will be taught the different techniques of food recycling. ♦ Establish a demonstration set up constructed from the waste that is collected weekly on the island. This should be used as a sure case to convince people of the feasibility of this activity (food or domestic waste recycling). ♦ Establish a common site where people who are either not interested in recycling food waste at home or those who are still learning the technique can take their waste to.	♦ Reduction in the amount of waste to be disposed of by the managing department. ♦ Improved smell from the waste bins and garbage bags collected for disposal.	♦ Regular assessment of the quantity and type of waste that is collected weekly for disposal.	♦ Improved solid waste management on Robben Island. ♦ Informed and cooperative staff and residents of Robben Island. ♦ Cleaner environment.

PRINCIPLE 5: WASTE DISPOSAL

Most of the waste that will require disposal on Robben Island once all the recommended principles have been implemented involves the transportation of recyclable materials from the island to the mainland. Considering the quantity and the type of waste produced on the island other than the transportation of recyclables, the rest of the waste can either be re-used or recycled within Robben Island. For example composting of yard waste or domestic waste. The incinerator that is currently used on the island for waste disposal is unnecessary and a source of environmental pollution.

It is evident throughout the report that Robben Island does not produce huge quantities of complex solid waste. Nevertheless, it is imperative that the island develops and implements adequate and proper solid waste management strategy in order to meet the requirements and expectations of a World Heritage Site as it is classified as such. Therefore integrated solid waste seems to be feasible and most appropriate for Robben Island. However, for this strategy to be effective, Robben Island management and all its personnel and residents need to be committed to properly implementing this strategy. The researcher therefore, strongly recommends the adoption of an integrated solid waste management strategy on Robben Island. Moreover, this will be in keeping with the latest legal developments in solid waste management. For example, the development of the National Waste Management Strategies (NWMS) and Action Plans, South Africa, Volumes 1 and 2.

9. REFERENCES

Baum, B., Parker, C. H., De Bell and Richardson (1974): Solid Waste Management. Michigan. Ann Arbor Science

Bredenhann, L. Wates, J. and Joubert, M. G: The Development of a National Waste Management Strategy for South Africa. Paper presented at the Wastecon International Congress. 17 - 20 September 1996. Durban. South Africa

Bredenhann, L. A critical overview of the development of waste management legislation in Southern Africa. Paper presented at the Wastecon All-Africa Congress. 27 - 29 September 1994. Somerset West. South Africa

Coleman, A., Barbour, T. and Law, S.: New Environmentalism in Progress: Drive for Integrated Waste Management in the Western Cape. Paper presented at the Wastecon International Congress. 17 - 20 September 1996. Durban. South Africa

Constitution of the Republic of South Africa, Act. No. 108 of 1996. Cape Town. Government Gazette No. 17678

CSIR Programme for the Environment (February, 1991) : The situation of Waste Management and Pollution Control in South Africa. Pretoria. Department of Environmental Affairs and Tourism

Department of Environmental Affairs and Tourism (December, 1998): Draft National Waste Management Strategy and Action Plans. Volumes 1 and 2

Dierwechter, Y. A. and Macdonald, R. The influence of community participation on the Waste management Agenda in Khayelitsha: Self-sustainability through A 'Developmental Impact Perspective'. Paper presented

at the Wastecon All-Africa Congress. 27 - 29 September 1994. Somerset West. South Africa

Draft White Paper on Integrated Pollution and Waste Management: A policy on pollution, Waste Minimisation, Impact control and Remediation. Department of Environmental Affairs and Tourism. Cape Town. Government Gazette No. 19161

Environment Conservation Act, No. 73 of 1989. Cape Town. Department of Environment Affairs and Tourism. Cape Town. Government Gazette No. 17354

Environmental Justice Networker (1998): Why the big fuss about incineration? Quarterly Newsletter of the Environmental Justice Network Forum. Winter, 1998, no. 18, p. 3

Fourie, W. D. M. and Claassen, P. (1992): The Integrated Environmental Management Procedure. Pretoria. Department of Environmental Affairs and Tourism

Grange, N. and Odendaal, F. (1999): Guidelines for the Environmental Assessment of Coastal Tourism. Mozambique. The secretariat for Eastern African Coastal Area Management

General Electric Company (1975): Solid Waste Management. Technology Assessment. New York. Van Nostrand Reinhold Company

Hershkowitz, A. and Salerni, E. (August 1988): Garbage Management in Japan: Leading the way. In Palmer, I and Macdonald R (1996): Evaluation of Solid Waste Practice in Developing Urban Areas in South Africa. Report to the Water Research Commission. Cape Town. Palmer Development Group

Hill, R. and Theron. J. N. (October, 1990): Ekskursie na Robben Island.

Report for the Geological society of South Africa. W. P. Branch

Hutton, Barbara (1994): Robben Island. Symbol of Resistance. Cape Town. The Rustica Press

http://goafrica.about.com/library/...Brief history of Robben Island - Africa for visitors. 14 February 1999

http://robben-island.org.za/abrief.html. Robben Island - a brief history

http://www.panda.org/resources/factsheets/species/16jack.htm.Jackass Penguin, 1993

Kalton, G. (1983): Introduction to survey sampling. United States of America. Sage Publications Inc

Kroese, M. (1998): Proposal on Feral Cats. Unpublished data

Levy, P. S. and Lemeshow, S. (1991): Sampling of populations: Methods and Applications. New York. John Wiley and Sons

Linde, H. Air Pollution - Incineration and the burning of waste. Paper presented at the Wastecon All-Africa Congress. 27 - 29 September 1994. Somerset West. South Africa

Lombard, J. (April 1998): Managing waste in the Durban Metropolitan area. LGD. Lombard and Associates

Malherbe, N. (September 1990): Future of Robben Island. Stellenbosch, Cape Town.

Matthews, Z.: Litter costs the SA taxpayers millions to remove. It also looks horrible and threatens the environment. Isn't it time we cleaned up our act?

Cape Times. 5 March, 1993. Stock Press

McKinney, M. and Schoch, R. (1998): Environmental Science. Barlett and Jones, pp 523 - 560

National Waste Management Strategies and Action Plans South Africa, Volumes 1 and 2. Department of Environmental Affairs and Tourism and the Department of Water Affairs and Forestry. Cape Town. Danish Co-operation for Environment and Development

Ninham Shand Engineering and Environmental Consultants (March 1993): Guidelines for waste management in South Africa: A handbook for local authorities. Cape Town. Mirage Printers

Parliament Monitoring Group (January 1999): National Waste Management Strategies and Action Plans South Africa. Condensed Version of the Draft National Waste Management Strategy, Version B. Department of Environmental Affairs and Tourism. Pretoria

Palmer, I. and Macdonald, R. (1996): Evaluation of Solid Waste Practice in Developing Urban Areas in South Africa. Report to the Water Research Commission. Cape Town. Palmer Development Group

Parsons, T. and Knight, P. G. (1995): How To Do Your Dissertation in Geography and related disciplines. London. Chapman and Hall

Robinson, H. D.: Sustainable Waste Management: Is there a future for landfills? Paper presented at the Wastecon International Congress. 17 - 20 September 1996. Durban. South Africa

Rudestam, K. E. and Newton, R. R. (1992): Surviving your dissertation. A Comprehensive guide to content and process. New-bury Park: Sage Publications

Russell Stevens (1994): Hout Bay Resident's Perceptions of Garbage Recycling. MA Thesis. University of Cape Town

Saatchi and Saatchi Cape (May, 1999): Call for proposals. Tourism Planning and Management. Communication No. 52

Tchobanoglous, G., Theisen, H. and Vigil, S. (1993): Integrated Solid Waste Management: Engineering principles and management issues. New York. McGraw-Hill Inc

The Fairest Cape Association (1999): Wise up on Waste. Second Edition. Cape Town

The Health Act, No. 63 of 1977. Department of Health and Welfare. Cape Town. Government Gazette No. 16049

The National Environmental Management Act, No. 107 of 1998. Department of Environmental Affairs and Tourism. Cape Town. Government Gazette No. 19519

The National Water Act, No. 36 of 1998. Department of Water Affairs and Forestry. Cape Town. Government Gazette No. 19182

United Nations' Educational, Scientific and Cultural Organisation (Unesco, February 1997): Operational Guidelines for the implementation of the World Heritage Convention

White, P. (1996): So what is integrated waste management? Warmer Bulletin 49. Tonbridge. Journal of the World Resource Foundation

White, P., Franke, M. and Hindle, P. (1995): Integrated Solid Waste Management: A life-cycle inventory. London. Blackie Academic and Professional

Williams, P. (1988): Waste treatment and disposal. New York. Wiley

Yeld, J. (1997): Caring for the Earth, South Africa: A guide to sustainable living. Stellenbosch. WWF - SA in partnership with the IUCN, UNEP and the Gold Fields Foundation

10. PERSONAL COMMUNICATION

Barbara Jenman	Fairest Cape Association	462 2040
Carol Trehearn	Sappi War on Waste	531 3077
Mandy	Collect - A - Can	547 010
Leshoro Mario	Robben Island Museum	4111 006
Lionel Jackobs	Econo Plastic recycling	905 2249
Sylvia Beukes	Nampak recycling	545 346
Steven Cheetham	Atlantic Plastic recycling	933 3412

APPENDICES

APPENDIX I

SURVEY TO ASSESS THE UNDERSTANDING AND PERCEPTION OF SOLID WASTE AS IT IS GENERATED AND MANAGED ON ROBBEN ISLAND

1. What are the reasons for you to be on Robben Island?

Residence	**Work**	**Other (Specify) .....**

2. What is the main role fulfilled by you on Robben Island?

Management	**Employee**	**Resident only**	**Other, (Specify).....**

3. Describe the main activities of your assigned role on Robben Island?

.....

.....

4. Looking at the whole Island, have you notice any problem with waste or litter lying around?	**Yes**	**No**

4.1 If yes, can you describe the problem?

.....

.....

4.2 What sort of waste has caused this problem?

.....

.....

4.3 If no, why do you say so?

.....

.....

5. What do you think is the cause of the problem that you have described above?

SURVEY TO ASSESS THE UNDERSTANDING AND PERCEPTION OF SOLID WASTE AS IT IS GENERATED AND MANAGED ON ROBBEN ISLAND

.....

.....

6. Is there anything that you are currently doing about this problem?	**Yes**	**No**

6.1 If yes, what are you doing?

.....

.....

6.2 If no, why are you not doing anything?

.....

.....

7. What do you think needs to be done to solve this problem?

.....

.....

8. How is waste currently managed on Robben Island?

.....

.....

9. Who is responsible for its management?

.....

.....

10. Have you ever been involved in any attempt to assist in the management or control waste and/or litter on Robben Island?	**Yes**	**No**

10.1 When did this happened?

SURVEY TO ASSESS THE UNDERSTANDING AND PERCEPTION OF SOLID WASTE AS IT IS GENERATED AND MANAGED ON ROBBEN ISLAND

.....

10.2 What was this attempt all about?

10.3 Was it a successful event? | **Yes** | **No** |

10.4 If yes, In what way did it become a success?

.....

.....

10.5 If no, What do you think went wrong?

.....

.....

11. Do you support the separation of waste from its source? | **Yes** | **No** |

11.1 If yes, describe why you support it?

.....

.....

11.2 If no, what are your reasons for not supporting it?

.....

.....

12. Do you separate waste generated in your office? | **Yes** | **No** |

12.1 If yes, how?

.....

.....

13. Do you think that waste management is a costly exercise | **Yes** | **No**

SURVEY TO ASSESS THE UNDERSTANDING AND PERCEPTION OF SOLID WASTE AS IT IS GENERATED AND MANAGED ON ROBBEN ISLAND

13.1 If no, why do you say so?

.....

.....

13.2 If yes, How and who pays for it?

.....

.....

ADDITIONAL COMMENTS

.....

.....

.....

Compiled by: Nolubabalo Sidzumo, M. Phil. 2nd year 1999.

APPENDIX 2

APPENDIX 2A. WASTE COLLECTED ON ROBBEN ISLAND BEFORE IT IS INCINERATED

APPENDIX 2B. WASTE BAGS AFTER SORTING, GREEN BAGS TO BE INCINERATED AND CANS TO BE RECYCLED

APPENDIX 2C. CONTAINERS COLLECTING GLASS AND CANS FOR RECYCLING

APPENDIX 2D. LANDFILL SITE WHERE SCRAP WASTE IS DISPOSED HAPHAZARDLY

APPENDIX 2E: LANDFILL SITE FOR THE DISPOSAL OF SCRAP MATERIAL INCLUDING DRUMS THAT CONTAIN WASTE OIL FROM THE WORKSHOP

APPENDIX 2F: WASTE OIL THAT LEAKED OUT OF THE DRUMS IN THE LANDFILL SITE

APPENDIX 2G: WASTE CARDBOARD STORED IN A ROOM AT THE BACK OF THE INCINERATOR LANDFILL SITE

APPENDIX 2H: THE ROOM WHERE WASTE CARDBOARD IS STORED

APPENDIX 3

ROBBEN ISLAND SOLID WASTE AND RECYCLING LOG

Date:	
Name:	

NUMBER BAGS/BINS COLLECTED		
	Non-Recycle bags/bins	Recycle bags/bins
Mess		
Guest House		
Admin Building		
Prison		
Harbour		
Single Quarters		
Private Houses		
Shop		
John Craig Hall		
Alpha One		
Mosque		

TOTAL BAGS/BINS RECYCLED	
Glass	
Cardboard/paper	
Cans	
Plastic	

BURNING	
What was burned?	
Amount burned	
Total hours burned	

OTHER OBSERVATIONS/PROBLEMS (e.g: dead animals in waste, rotting waste, flies)