AN INVESTIGATION INTO SOLID WASTE MANAGEMENT

PRACTICES IN RESIDENTIAL AREAS

THE CASE OF THE PHOENIX TOWNSHIP

By

Leena Rajpal

(9404780)

Submitted in part fulfillment of the requirements for the Degree of Masters of Arts in the Department of Geography and Environmental Studies in the Faculty of Humanities at the University of Durban-Westville.

SUPERVISOR : PROFESSOR O.O. ONYEJEKWE

C0-SUPERVISOR : MR. V. MOODLEY

MARCH 2002

DECLARATION

The Registrar (Academic)
University of Durban-Westville

Dear Madam

I, Leena Rajpal (Registration Number 9404780) hereby declare that the dissertation entitled:

"An Investigation into Solid Waste Management Practices in Residential Areas: The Case of the Phoenix Township"

is the results of my own investigation and research and that it has not been submitted in part or full for any other degree or to any other University.

Leena Rajpal

12/09/2002
Date

ABSTRACT

The rapid population growth accompanied by urbanisation and industrialisation has resulted in a dramatic increase in the volume of waste being generated by modern societies. This has led to a growing awareness of the serious threats that these wastes pose to the environment. Thus, it has been acknowledged that one of the many environmental challenges confronting authorities in Metropolitan Durban is The Management of Solid Wastes. A number of researchers have found that inadequate and inefficient waste management practices are heavily impacting on the human and natural environment.

Although formal townships are supposed to have adequate waste removal services, many of these townships are characterized by wastes being disposed of in streets, open spaces, streams etc. In the light of above, the aim of this study was to assess the Solid Waste Management Practices in the Phoenix Township. Questionnaires relating to the problem of Solid Waste Management Practices were administered to the residents of the Phoenix community. The study identified factors that contributed to the detrimental impacts on the physical and human environment.

The study revealed that the current waste management practices (which encompassed the generation, storage, collection, disposal and waste reduction options) are characterized by inefficiency. Furthermore, it was evident, that this inefficiency impacts negatively on the physical and human environments, of which the major impacts are the illegal dumping in the Phoenix area. Therefore, recommendations were made consulting both the residents and local authorities with regards to combating or curbing the problems relating to Solid Waste Management Practices

ACKNOWLEDGEMENTS

The compilation of this project was influenced largely by the support and assistance I received from numerous friends, relatives and colleagues. I am greatly indebted to the following persons:

1. Professor O.O. Onyejekwe who supervised this project. His knowledge, perception and many hours of his invaluable time played an immeasurable role in the completion of this project. I am truly grateful to such an individual whom I know, that, without his support and encouragement, I would have not completed my dissertation. Thank you sir and may God repay your kindness.

2. Mr. V. Moodley who has assisted me in the restructuring of my dissertation and making the necessary corrections. Thank you sir.

3. Mr. P Moodley from The Parks and Garden Department, who took time out to assist me with the collection of information regarding my topic.

4. Mr. Solly Singh of Keep Phoenix Beautiful Association, who assisted me in terms of data collection and information.

5. Mr. T. Rubelli of Durban Solid Waste, who willingly assisted me regarding information on Solid Waste Practices in the Durban and surrounding areas.

6. Mr. N. Ramphal and Rowena who assisted me greatly with regards to the maps.

7. Mr. V Rambaruth who assisted me immensely with the fieldwork, transportation and computer operations. Words cannot adequately express my deep gratitude to Vishal who constantly provided me with guidance and encouragement during the entire process of the project.

8. Mr. and Mrs. R. Rajpal who gave me the support and provided me with an income, which assisted me immensely in the process of my project.

9. Mr. and Mrs. V. Rajpal who gave me the support and encouragement with regards to the completion of my dissertation.

10. Professor N.M. Ijumba for allowing me time to concentrate and work on my dissertation. I appreciate all the support and encouragement you have given to me during this past year. Sir, I hope that one day I can repay your kindness.

11. Mrs. S. Sivasamy and Mrs. S. Pollayah giving me the strength and support to complete my dissertation.

12. Mr. M. Naidoo (Allan) and Mr. D. Govender for the binding of the dissertation.

13. National Research Fund (NRF) for allocating funds to me, which immensely assisted me throughout my dissertation.

DEDICATION

This project is dedicated to my future husband, Vishal Rambaruth and my parents; Mr. and Mrs. R. Rajpal; my brother and his wife Mr. and Mrs. V Rajpal for always keeping my path in life well illuminated. May God give me the chance to repay the kindness and compassion that you, my family, have shown me.

" A good act will react upon us with equal force and effect. It will bring us joy and happiness. What we give, we receive. If you want to be happy, then you must make others happy. If you want help, you must help others. Every action, every thought, however insignificant, affects the whole world directly or indirectly. So be noble and always do good".

ENLIGHTENED EDUCATION (1990: 28)

TABLE OF CONTENTS

CHAPTER TWO: THEORETICAL REVIEW

CHAPTER THREE: STUDY AREA AND METHODOLOGY

CHAPTER FOUR: RESULTS AND PRESENTATION

University of
Durban-Westville

PRIVATE BAG X54001 DURBAN
4000 SOUTH AFRICA
TELEGRAMS: 'UDWEST'
TELEX: 6-23228 SA
FAX: (031)204-4383
☎ (031)204-4111

SCHOOL OF LIFE AND ENVIRONMENTAL SCIENCES
DEPARTMENT OF GEOGRAPHY AND ENVIRONMENTAL STUDIES
ENVIRONMENT AND DEVELOPMENT PROGRAMME (EDP)

11 September 2002

Professor D McCracken

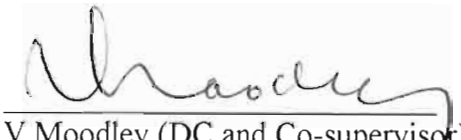
Dear Prof McCracken

MA Thesis: Ms L Rajpal (Reg. No. 9404780)

Title: An Investigation into Solid Waste Management Practices in Residential Areas: The Case of Phoenix Township

I am satisfied that Ms has made the necessary corrections/ amendments to the above dissertation and should graduate at the next graduation ceremony. More specifically, she has made the in-text technical corrections (grammar, punctuation); references missing in the text and reformatting of the tables and figures.

Yours sincerely



V Moodley (DC and Co-supervisor)

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

CHAPTER ONE
INTRODUCTION

1.1 PREAMBLE

Wastes are as old as human society. For most of man's history, people were able to dispose of their biological wastes, bones skins, fire ash, tools, shells, pottery etc that did not cause harm to their environment (Stefoff, 1991). Simple Waste Management technologies were effective because the wastes were mostly biodegradable and the populations were small and relatively isolated (Jolley and Wang, 1993). According to Steffof (1991), waste is generated during the production of materials and consumer articles and is also produced when consumer items are discarded after use. Wilson (1987: 21) takes it a step further by referring to solid waste as the 'Third Pollution'.

According to Wentz (1995), waste management can be used to describe several processes: the elimination or the reduction of waste, the recycling or reuse of waste (physically destroying, chemically detoxifying or otherwise rendering waste permanently harmless) and finally the disposal of waste (depositing material into the land, air and sea).

Over the past decade, the need for better waste management has become more obvious with the increase in population growth, waste complexity (e.g. radioactivity), knowledge of toxicological and ecological effects of anthropogenic chemicals and the analytical capability to detect low concentrations of potentially harmful pollutants. In fact, society is becoming more aware of the vital need for effective waste management to ensure a future viable world civilisation. This is evident at the local level, where landfills are becoming overcrowded and difficult to site; at the national level, with increasing consciousness for resource and waste management; and at the world level, with developing awareness of the global effects of pollution (Jolley and Wang, 1993).

1.2 CONTEXTUALISATION OF THE PROBLEM

The environment has been plagued more than ever before with the widespread effects of human activities. One such problem is the fast growing impact of solid wastes arising from

man's activities such as marketing, storing and processing and the manufacturing of all commodities. This waste is created by communities, which include households, businesses, schools, industries and other institutions in an area (Carless, 1992). Therefore it is obvious that the management of solid wastes is one of the most serious problems confronting society. At risk are public health, environmental quality and standard of living of people.

1.3 MOTIVATION FOR STUDY AREA

1.3.1 South African Situation

South Africa faces environmental challenges characteristic of both developed and underdeveloped societies. South Africa suffers from environmental problems linked to vast wealth disparities between a poor majority and an excessively consuming minority (Sunday Independent, 10/10/99). In 1999, the Minister of Environmental Affairs stated that there is a need for a comprehensive environmental policy to address problems inherited from the apartheid past (Sunday Independent, 19/10/99).

South Africa has dynamic and complex environmental problems because of its unique political, social, environmental and economic circumstances. South Africa's growth is expected to take place in urban areas and rapid urbanisation will place heavy demands on resources e.g. allocation of funds to services for waste management. It was found that the influx of people from rural areas within South Africa has resulted in phenomenal urban growth rates of up to 9% per annum (Lombard, 1999). Lombard (1999) clearly states that the challenges facing waste are so diverse that the solutions to the problems cannot be found by merely scaling up existing levels of services. In fact he concludes that the challenge for waste management in South Africa is to manage the situation with all its constraints (e.g. lack of recycling facilities) and opportunities (e.g. creation of jobs from recycling) in such a way that the environment is not threatened unnecessarily.

One step taken to uphold the above is the development of a National Waste Management Strategy (NWMS) for South Africa. The overall objective of this strategy is to reduce the generation of waste and the environmental impacts. This is to ensure that the socio-economic development, the health of the people and the quality of the environmental

resources are no longer affected by the uncontrolled and uncoordinated waste management (Joubert, 1999).

1.3.2 KwaZulu Natal (KZN)

In KZN, there has been a growing concern over the developing waste management crisis. Previous laws had prevented equitable sharing of resources. The majority of the people were denied equitable sharing of resources, access to land, water and proper sanitation, which led to impoverished, overcrowded and segregated urban and rural areas. Recently, increases in urbanisation, industrialisation and population growth coupled with insufficient collection and waste disposal services in KZN resulted in unacceptable levels of environmental degradation and health risks. Both the past and present problems contributed to the inadequate waste management in KZN. Hence, various stakeholders including the Minister of Traditional and Environmental Affairs and the KZN Portfolio Committee on Environment agreed that there is a need to develop a waste management policy in KZN (KZN Waste Management Policy and Discussion Document, 1999).

1.3.3 Durban

The Durban Metropolitan Unicity consists of 6 entities namely Outer West, North, Central, Inner West, South and Umkomaas (Ramphal, 2001). It was found that effective waste management in the rapidly growing black urban and urban fringe areas was a major challenge to waste managers e.g. in Umtata, the current solid waste services was ineffective. The rapid population growth combined with commercial and residential development was affecting the available solid waste services. There was a need for adjustments so that a balance could be maintained between the service provision and the service demands (Poswa, 1997).

1.3.4 Phoenix

Solid Waste impacts significantly on both the human and the natural environment. This seems to be an especially pressing issue in townships due to different types of inter-linking obstacles which include: inadequate waste management services and infrastructure; lack of public environmental awareness; high unemployment exacerbating a non-payment culture;

growth of informal settlements; illegal dumping, and broader issues related to increased urbanisation. It was found that in most formal townships refuse collection services already exist in the form of door-to-door service with varying degrees of street cleaning services. Despite these services, many of the areas are generally untidy, extensively littered and have numerous informal dumps within their boundaries. The general lack of cleanliness indicated that the present collection services were not effective (Reilly, 1991).

It is within this framework that this study is being executed and it is believed that it will contribute to solving the problems caused by inadequate and inefficient Solid Waste services that are currently confronting most townships in South Africa.

One such township that experience problems in terms of waste management is Phoenix which is located approximately 20km north of Durban and situated in the Central (north side) Entity of the Durban Metropolitan Unicity (refer to figure 3.4). According to Singh (2001) and Moodley (2001), although Phoenix has a refuse collection service, there are still numerous problems in the area. Moodley (2001) has found that illegal dumping and littering is a common sight in the Phoenix area. He also added that the inadequate collection services, lack of environmental awareness programmes, lack of recycling facilities, inadequate legislation have one way or the other contributed to the illegal dumping and littering of the Phoenix township.

1.4 AIMS, OBJECTIVES AND HYPOTHESIS

1.4.1 Aim of the Study

The broad aim of this investigation is to assess the Solid Waste Management Practices in the township of Phoenix.

1.4.2 Objectives of the Study

- To assess the socio-economic characteristics of residents in the townships of Residents in the townships of Phoenix;
- To determine the nature and quantity of solid waste generated by households;

- To determine the collection, storage, transportation, reduction, reuse, recycling, composting and other solid waste disposal methods used by the community;

- To investigate the impacts of solid waste on both the human and natural environments;

- To make recommendations for the future improvement of Solid Waste Management Practices at the household level and in the township area.

1.4.3 Hypothesis

The township area of Phoenix is characterised by inadequate and inefficient Solid Waste Management Practices.

1.5 CHAPTER SEQUENCE

The focus in chapter two of this investigation will be on a comprehensive theoretical exposure and evaluation of solid wastes, the impacts on the environment (natural and human). Case studies with references to the different waste management practices in various countries are also reviewed in this section of the study. A detailed description of the area under investigation will be the focus of the first part of chapter three. This will be followed by an explanation of the methodology adopted to execute the investigation. The following chapter will highlight the analysis and results of the data obtained from the applications of the methods described in the previous chapter. The emphasis in the fifth chapter of the report will be on a discussion and evaluation of the results depicted in chapter four. Recommendations and an overall conclusion of the study will occupy chapter six.

1.6 CONCLUSION

On a national scale, it is evident that Solid Waste Management was not given sufficient consideration. With the past history of apartheid, the situation became even more detrimental. South Africa has now undergone many changes over the years, which includes rapid urbanisation, increased population growth resulting in an increase in the generation of

solid wastes. This has put an enormous pressure on local authorities to provide proper services for the people of South Africa. However, not many changes have been made on the part of government, local authorities and communities themselves, to try and alleviate some of the problems associated with Solid Waste management. South Africans need to become involved in the changes to their environment rather than sitting back and hoping that the problems would be sorted out on their own. Hence it is hoped that this study can show authorities and communities how serious the Solid Waste Management Practices are and that changes need to be made.

CHAPTER TWO
THEORETICAL REVIEW

2.1. INTRODUCTION

The environment has been plagued more than ever before with the widespread effects of human activities. All around, one can see the environment changing as a result of human actions whether from wasteful exploitation of natural resources or from inefficient consumption patterns, particularly energy. Building or reshaping of landscapes, land degradation, forest damage, hazardous wastes and loss of natural resources are the inevitable consequences of human's actions (United Nations Environmental Programme, 1993).

One particular problem that poses serious threats to the environment and human health is the presence of waste. Environmentally and socially unacceptable standards currently characterise many aspects of waste management both in urban and rural areas. Waste disposal is of either poor quality or simply non-existent and in many instances, services have collapsed as a result of non-payment, poor budgeting and financial planning. Examples of environmentally and socially unacceptable standards that inevitability result in a general decline in the quality of life and environmental degradation include:

- Littering of the roads and pavements;
- Substandard, ineffective / non-existent waste collection and street cleaning systems;
- Illegal waste disposal;
- Waste disposal sites, which are poorly sited, designed and operated;
- Lack of alternative disposal facilities e.g. recycling facilities (Government Gazette, 1998).

2.2 SOLID WASTE

According to Stefoff (1991), waste is generated during the production of materials and consumer articles and is also produced when consumer items are discarded after use. In fact Wilson (1987: 21) refers to solid waste as the 'Third Pollution'. One will notice that

solid waste arises from almost every activity that man undertakes including marketing, storing and processing and the manufacturing of all commodities. Solid waste is created by all communities, which include households, businesses, schools and other institutions in an area. These wastes generated by human activities are often discarded, as they are considered useless (Theron, 1994).

2.3 HISTORY OF SOLID WASTE

Solid wastes are not unique to only modern societies but have been a constant companion of all societies throughout the ages. To the earliest humans, who frequently moved from place to place, waste was not a problem because it was left behind. However, when people began to settle, they are believed to have simply littered the floors until it became awkward and unbearable. In fact, in Rome an entire section of the city was built on a hill composed of pottery broken over the years (Francis, 1994).

Until the nineteenth century, the streets of European and American cities were filthy. Health concerns eventually prompted people to do something about the haphazard dumping. Incineration began in the late 1890's and by the 1920's, this method had become the main method of waste disposal across many countries. In the 1920's, landfilling was used to reclaim wetlands with alternate layers of waste and dirt. In the 1960's, due to the air control laws, incineration was considered non-viable and landfills were heralded as the sanitary solution (Carless, 1992).

The energy crisis in the mid 1970's drove the federal government in the United States back toward incineration. It prompted the generation of electricity by burning solid waste. Incineration was seen as a resource - recovery plant. However, during the 1970's and the 1980's, landfilling became more common and popular. Over the years landfill sites were created and successfully used. However, these landfill sites are becoming over - exhausted. Local municipalities are experiencing a serious problem of finding land for disposal. There has been a scarcity of land for new disposal sites. Hence the need for better waste management became more apparent (Carless, 1992).

2.4 SOLID WASTE MANAGEMENT

Wastes produced by a community can be a problem in terms of aesthetics and community health. Thus, it is apparent that the effective and economic removal of solid waste material and the final disposal of waste are extremely vital. This process of collection of waste through to disposal can be labelled Solid Waste Management. The process does however effectively begin with the generation of waste wherefore it includes activities ranging from storage through reclamation and disposal (Kropman, 1984).

According to Wentz (1995), waste management can be used to describe several processes, which include: the elimination or reduction of waste; the recycling or reuse of waste material; the treatment or destruction of waste (physically destroying, chemically detoxifying or otherwise rendering waste permanently harmless) and finally disposal of waste into land, air and sea. Hall and Ball (1989) stated that the aim of waste management was essentially the responsible re-introduction of waste into the environment. This means that waste needs to be put back into use without causing harm to the natural and human environment. He further stated that there was a need for a balance between the lower costs of actions and their environmental and other implications.

It is indicated from the above that the Management of Solid Waste is vital not only to humans but also the diverse and fragile environment that one lives in.

2.5 STAGES OF WASTE MANAGEMENT

The Waste Management process involves a range of activities that encompass the following:

* Generation
* Storage
* Collection
* Transport
* Recycling
* Reclamation

* Reduction
* Disposal
* And Sale of Recovered Resources

All these activities deal with the flow of waste and can take place at different stages of the waste management process. For example, waste can be recycled at the source and sold from that point, with the remaining waste being collected and transported directly to disposal sites. Alternatively, waste could be stored, collected, transported to a disposal site at which point reclamation could take place (Palmer Development Group, 1995).

2.6 WASTE GENERATION

Waste generation is central to the waste management process, as it is the origin of waste that is the focus of this process. Wastes are produced in one of three ways: through the production and consumption of goods and services, through the processing of wastes from these activities and through end-of-pipe control or treatment of emissions and effluents. The essential aspects of waste generation include: types or source of waste generated, amount of waste generated, composition of waste generated and waste reduction or minimisation (Feates and Barrett, 1994).

2.6.1 Types of Waste

There are various sources of waste and hence the types of waste can be identified according to these sources. The various types of waste include controlled, household, industrial, commercial, clinical, special, uncontrolled, inert, hazardous and municipal solid waste:

- **Controlled Wastes** comprises of household, industrial and commercial waste. Sewage sludge disposed of to landfill and by incineration is controlled waste. Controlled waste is defined in the Control of Pollution Act 1974, Environmental Act 1990, Waste Management Licensing Regulations 1994 and the Controlled Waste Regulations 1992.
- **Household Waste** is waste from private domestic accommodation, caravans, residential homes, universities or schools or other educational establishments,

hospital premises and nursing homes. Other categories include private garages, moored vessels, campsites, and prisons, meeting halls and royal palaces.

- **Industrial Waste** includes waste that arises from any industrial undertaking or organisation such as industrial waste producers from the manufacture of food products, textiles, wood products, motor vehicles and chemicals.
- **Commercial Waste** is waste from premises used mainly for purposes of trade or business or the purpose of sport, recreation or entertainment. Examples include waste from offices, hotels, shops, local authorities, markets and fairs.
- **Clinical Waste** is waste which consists mainly or partly of human and animal tissue, blood or other body fluids, excretions, pharmaceutical products, swabs, dressings, syringes, needles and sharp instruments that could be hazardous to persons that may come in contact with it. These types of waste can arise from medical, nursing, dental, veterinary, pharmaceutical, treatment, and teaching and research practices.
- **Special Waste** is so dangerous that special provision is required for dealing with it. The properties of special wastes are defined by physical, chemical and toxicological properties such as corrosiveness, carcinogenicity, toxicity and flammability.
- **Uncontrolled Waste** is not controlled such as agricultural, mining and quarry wastes that are produced in large tons but are subject to legislation. Radioactive and explosive wastes are also subject to legislation.
- **Inert Waste** is uncontaminated earth and excavation waste such as bricks, concrete, stone, building sand, gravel, ceramic materials, slates etc
- **Hazardous Waste** is waste that has substances in it that render the waste hazardous e.g. a list of generic wastes may contain substances that are corrosive, toxic, reactive, carcinogenic, infectious, irritant or harmful to human health and also may be toxic to the environment
- **Municipal Solid Waste** is collected and disposed by the local authority. Wastes consist mainly of household and commercial waste. It may also comprise of waste derived from civic amenity waste collection or disposal sites by the general public, street sweepings, gully emptying wastes and construction and demolition waste from local authority sources (Kreith, 1994).

2.6.2 Amount of Waste Generated

Historical trends of waste generated reveal an increase in the quantities of waste generated for most countries e.g. municipal solid waste revealed an increase in waste generation over the years in countries such as Europe, the United Kingdom, Italy, France, Spain, Poland and France. Table 2.1 illustrates the waste arising from different countries. It shows a direct link between the countries population size and the waste produced e.g. the United States, Germany, France, Japan and Italy has the highest rising of municipal waste. In addition, the waste arising out of each sector is also linked to the industrial development and mixture of agriculture and industry in each country (Williams, 1998).

Table 2.1: Estimated Wastes arising in selected countries (million tons)

Country	Municipal	Industrial	Agricultural	Mining	Demolition	Sewage	Hazardous
Belgium	3.5	27.0	53.0	7.1	0.7	0.7	0.9
Denmark	2.4	2.4	-	-	1.5	1.3	0.1
France	17.0	50.0	400.0	10.0	-	0.6	3.0
Germany	19.5	61.0	-	9.5	12.0	1.7	6.0
Greece	3.1	4.3	.009	3.9	-	-	0.4
Ireland	1.1	1.6	22	1.9	0.2	0.6	0.02
Italy	17.3	40.0	30.0	57.0	34.0	3.5	3.8
Japan	48.0	312.0	63.0	26.0	58.0	2	6.6
Luxembourg	0.17	1.3	-	-	4.0	0.02	0.004
Netherlands	6.9	6.7	86.0	0.1	7.7	0.3	1.5
Portugal	2.4	0.7	0.2	3.9	-	-	0.16
Spain	12.5	5.1	45.0	18.0	-	10	1.7
USA	209.0	760.0	150.0	14.0	32.0	10	275.0

Source: Williams (1998: 64)

Data concerning estimates of present and future production of wastes are essential for long - term efficient and economical waste management planning e.g. the United Kingdom National Waste Strategy gathers data on waste generation on a regional basis

which is used at a local and regional level for planning future waste management facilities and at a national level to implement the Waste Strategy. Statistical data on the quantification of waste are usually by weight (Williams, 1998). According to Pescod (1993), waste is a very variable and heterogeneous material especially household waste. In fact, the amount of waste generated by households tends to vary according to levels of economic development. Hence higher per capita income countries tend to generate higher quantities of waste, for example the United Kingdom generated 435 million tons of waste per annum in 1995. Stanners and Bourdeau (1995) stated that increasing economic development represented by the Gross Domestic Product was reflected in an increasing rate of waste production.

2.6.3 Composition of Waste

Composition of waste refers to the different components of waste i.e. the different types of materials such as paper plastic, metal, glass, chemicals, food, textiles etc. The composition of wastes is also vital for future planning initiatives such as waste minimisation, reuse and recycling (Kreith, 1994). The generation rates vary from generator to generator e.g. refer to table 2.2. One will notice that the eating and drinking places e.g. restaurants are the highest generator of wastes. This is followed by single family residents and then the apartments.

Table 2.2: United States Waste Generation rates by the type of generator

Waste Generation Sector	Average	Units
Single family residents	1.22	kg/person/day
Apartments	1.14	kg/person/day
Offices	1.09	kg/employee/day
Eating and drinking places	6.77	kg/employee/day
Wholesale and retail trade	0.009	kg/$ sales
Food stores	0.015	kg/$ sales
Educational	0.23	kg/student/day

Source: Williams (1998: 112)

2.6.4 Waste Reduction

The hierarchy of waste management, places waste reduction at the top, followed by re-use, recovery and finally disposal. Waste reduction is both environmentally and economically beneficial both to society as a whole and to business and the community. Waste reduction is synonymous with waste minimisation. According to Crittenden and Kolaczkowski (1995), waste minimisation have been found to be used as any technique, process or activity, which either avoids, eliminates or reduces a waste at its source, usually within the confines of the production unit.

According to Joubert (1999), waste minimisation refers to activities taken by the generator of waste to prevent or reduce the volume and or environmental impact of waste by source reduction and or internal recycling. This simply means that any individual can incorporate waste minimisation by avoiding unnecessary wastage e.g. households could minimise waste generation by using less packaged goods or even reusing certain waste materials such as glass or plastic containers.

2.7 WASTE STORAGE

The type of container used to store the waste generated from households, commercial and industrial premises depends on a number of factors which includes, the frequency and efficiency of collection, amount of waste, type of housing, the density of the collected wastes, collection vehicle type, vehicle usage and manpower (Scharff and Vogel, 1994). Pescod (1993) found that the correct size of the container was important since it has been found that the use of non-standard containers is the greatest cause of litter. Household waste is either stored or immediately disposed off. Immediate disposal could take the form of burial or burning. There are two basic forms of storage of waste before collection or disposal: separate unit storage and communal storage.

2.7.1 Separate Unit Storage

Separate unit storage may be standardised or non-standardised by the service agency. Non-standardised containers can include temporary containers such as cardboard cartons, plastic bags, and crates as well as permanent containers such as plastic or metal bins. Standardised

containers tend to be plastic or metal bins as well as plastic bags. Household waste containers used in the United Kingdom include traditional metal or plastic dustbins, wheeled bins and plastic sacks. With a general increase in the amount of waste generated, there has been a response to use bigger or more containers (Scharff and Vogel, 1994). According to Pescod (1993), the climate influences the size of the storage containers. The containers found in colder climate are larger compared to containers in the warmer climates e.g. in Northern Europe the containers are large due to the cold climate which allows for waste to be stored over longer periods. Hence collection occurs at least once a week. In Southern Europe, waste cannot be stored for too long due to the warm climate. Collection occurs more frequently (Curzio *et al.*, 1994).

The size of the container and the frequency of collection have been shown to influence the quantity of household waste placed in the container e.g. in the United Kingdom, the twice-weekly collection produces more waste than a weekly one. The wheeled bins are used compared with the traditional smaller metal or plastic dustbins. The use of these larger wheeled bins has also resulted in larger bulkier items being placed in the large containers (Williams, 1998).

A recent survey relating to the comparison of collection systems used for municipal solid wastes in European countries revealed that the waste collection system efficiencies for waste collected per day were found to be greater by up to four times for the larger containers compared with smaller ones. The size of containers used in the above cities ranged from 30 litres in volume to over 1100 litres (Scharff and Vogel, 1994). In the United States, a range of collection containers for municipal solid waste were used e.g. residential containers range from plastic or paper bags to 90 litre volume metal cans, to 350 - 500 litre volume plastic wheeled carts (Bonomo and Higginson, 1988).

It was found that recycling initiatives allowed for more than one container to be used e.g. in Leeds, two wheeled bins were used. The green bins were used to collect recyclable materials, newspaper, metal cans and plastic bottles whilst the black bins were used to collect the remaining waste. The green bin was collected once a month and the black bin

weekly. The system has shown a proven economic and environmental return (Kreith, 1994).

2.7.2 Communal Storage

Communal storage units can be either stationery or portable. Stationery units could include enclosures such as four - sided masonry structures whilst portable units could include large steel drums or liftable metal containers such as `skips'. Commercial buildings (offices and shops), larger households (block of flats) and institutions such as schools require much larger container capacities than single households. A typical waste container for such buildings would be about $0.85m^3$ capacity. In the United States, larger containers are used for multifamily or apartment blocks. There is naturally a degree of overlap between the storage options as a household may initially use a separate storage unit on site which is then emptied into a communal storage unit e.g. in the United States, residents collect their own waste in containers which are then transferred to the collection point (Williams, 1998).

2.8 COLLECTION

According to Habitat (1993) the objective of a waste collection system is to transport wastes collected from specific locations at regular intervals to a disposal site at a minimal cost. It is certain that Habitat (1993) was referring to the minimal cost on the environment and economic status. It is noticed that the storage and collection of waste are interlinked. It is revealed above that in some cases the size of the container depends on the collection frequency and the collection frequency depends on the size. Therefore, the researcher will discuss the collection systems in terms of their levels of service offered.

2.8.1 Non-collection Systems

A non-collection system is a system, which does not involve planned and managed removal from the residential site. Such a system usually involves the disposal of waste on site. This on-site disposal involves activities such as the separation of the waste into its different constituents such as ash, putrescible and inorganic material. Each waste type can be put into different uses e.g. ash can be worked into the soil for gardening purposes. The

useful materials can be put to various uses such as containers (cans, boxes) or used as fuel (paper, wood, cardboard). Recyclable materials can be sorted and sent for recycling (Palmer Development Group, 1995).

Although the authority provides no removal services, it is imperative that the correct disposal methods on site are promoted. This involves educating and informing people of the proper disposal options e.g. recycling, composting etc. Residents need to be made aware of the physical conditions e.g. there needs to be space on the site not only to house a compost bin or disposal site but for the compost to be of use. In the United Kingdom, small-size composting has been practised for many years at the individual household level. The government is seeking to expand the practise to try and reach a target of 40% of domestic properties with a garden to carry out home composting by the year 2000 (Making Waste Work, 1995: 14).

2.8.2 Collection Systems

2.8.2.1 Communal Collection

Waste is collected from communal collection points or transfer stations. Waste can be brought to these points by individual householders or by local "entrepreneurs" who conduct house collection on a contractual basis and then transport the waste to the collection point. At the site there may be a communal storage facility. Refuse vehicles then remove the waste from these sites. Since collection points are reduced and widely spaced, the threat of household disposal of waste on streets is very likely. Residents need to be informed of collection sites and the system is dependent on their co-operation. Since there is a lack of "ownership" of the collection point, there is a high risk of a disregard for the aesthetics and hygiene of the area. Finally in many developing countries, the communal collection system is usually inadequate due to factors such as infrequent collection, poorly located communal collection points, inadequate on-site storage or ineffective service provision (Bhide and Sundaresan, 1983).

2.8.2.2 Block Collection

A collection vehicle follows a scheduled route and stops at selected locations. A bell may be rung to alert households. Households take waste containers to the vehicle and these are emptied into the vehicle and returned to households. The success of this particular system is highly dependent on the maintenance of the schedule and the involvement of the households (Cointreau, 1982).

2.8.2.3 Waste Exchange

This system involves the exchange of waste for "goods" which can include money, food coupons, and transport coupons and even food. Households bring their waste to a central collection point where the exchange is made. The waste agency then transports the waste to the disposal site. The system is highly dependent on households and the households need to be informed of location sites. However, one must be aware that there is the danger of waste generation being encouraged (Warmer Bulletin, 1995).

2.8.3.4 On-Site Bin Collection

Each household stores its waste in a plastic or metal bin. The collection crew enters the site, takes the bin to the collection vehicle, empties the waste and then returns the bin to the site. Due to the lack of household involvement, there is a repeated site entry, which impacts on labour costs. The system is only productive when collection is frequent i.e. maximum once weekly (Scharff and Vogel, 1994).

2.8.3.5 On-Site Plastic Bag Collection

Household storage may be in a bin or bag but collection involves only removal of the bag. Hence the collection crew only enter the premises once. This is the highest level of service in terms of collection from a user perspective (Bonomo and Higginson, 1988).

2.8.3.6 Kerbside Collection

The collection crew collects waste in bins, bags, mobile containers or other containers of refuse, which are deposited by the household at the kerbside at fixed intervals, usually once or twice a week. This service is also high from the point of view of the user. This

system requires a regular and well-organised collection service. Uncoordinated and infrequent collections can cause health and odour problems e.g. if the waste is scattered by scavenging neighbourhood pets (Franklin Associates, 1992).

Table 2.3: Comparison of the service options

Service Level	Service Option	Advantages	Disadvantages
FIRST	Non-collection (On-site Disposal)	• Cheap, no service required • Waste recycled	• Cost for necessary comprehensive education programme. • Awareness and co-operation of community crucial. • Hazardous wastes e.g. batteries still need disposal elsewhere.
SECOND	Inadequate Collection	• Collection does occur	• Collection is irregular.
THIRD	Communal Collection	• Reduces number of collection points • Service provided close to household	• Widely spaced sites lead to disposal on streets. • High dependence on household co-operation. • Household need to be informed of site location. • Problem of lack of ownership of site.
	Block Collection	• Service provided close to household	• Success of system depends on maintenance of schedule. • High household involvement in system.
	Waste Exchange	• Waste Collection encouraged by reward	• High household involvement. • Need for informed households. • Danger of waste generation encouraged.
FOURTH	Kerbside Collection	• No site entry	• Households must know when to leave out waste. • Non-collection can lead to scattering of wastes.
	On Site Bin Collection	• Lack of household involvement	• High labour involvement. • Potentially intrusive to households. • Productive for infrequent collection.
	On Site Bag Collection	• Lack of household involvement • Less labour as only site entry	• High labour involvement. • Potentially intrusive to households. • Productive to infrequent collection.

Source: Palmer Development Group (1995: 67)

The table 2.3 gives an idea of the advantages and disadvantages of the different collection methods. This is useful as one will notice that both in developed and developing countries, their collection method will differ e.g. in the United States, the most common collection method used is the kerbside collection. In India, on the other hand, block collection is common (Cointreau, 1982).

2.9 TRANSPORT

According to Flintoff (1984), the collection of waste in terms of transportation is influenced by a number of factors that include the size and layout of an area, the population density, the road quality and traffic congestion, the quantity and nature of waste to be removed and finally the haul distance to a disposal site.

According to Scharff and Vogel (1994), a survey of the comparison of collection systems used for municipal solid waste in European cities has shown that they are highly efficient with a combination of containers, vehicles, personnel and logistics individually suited to the local conditions such as population density, residential structure or traffic conditions. In Paris, there are 500 collection vehicles for a population density four times higher than that of other cities and achieves a daily travelling distance of between 20 and 52 km. Budapest, however, with a similar waste quantity to Paris but a different collection organisation and traffic situation, uses 175 collection vehicles and achieves a daily travelling distance of between 53 and 175km (Williams, 1998).

According to Habitat (1989), transportation can be classified into Non - Motorised Transportation and Motorised Transportation.

2.9.1 Non-motorised Transportation

Non-motorised transportation tends to occur in conjunction with labour based collection systems. A house-to-house collection service can take place with the vehicles taking the form of handcarts, animal carts and even tricycles. In Cairo, animal drawn carts were used to collect refuse because streets were too narrow for motorised transports to enter (Habitat, 1989).

2.9.2 Motorised Transportation

It was found that the type of motorised vehicle for collection could vary according to the type of collection service. Vehicles used for a communal collection service can differ from those used in kerbside collection (Habitat, 1989)

2.9.2.1 Communal Collection Vehicles

In some areas of the United Kingdom, the increasing distance between the city centre, generation of the waste and suitable landfill sites has led to the development of transfer stations. In communal collection each collection point can be regarded as a 'transfer station" with the waste agency transporting the waste from this point to a disposal site in vehicles which can carry large collection containers. Alternatively waste from collection points can be transferred by smaller vehicles to more formal transfer stations and then on to a disposal site e.g. in Tokyo, there are some 3000 small collection vehicles (1.2 tons - 2.4 tons capacity) that travel into very narrow streets within the city (Matsuto and Tanaka, 1993).

Collection containers and transfer stations can take on various forms making collection vehicle requirements varied. Collection containers at communal collection points can vary between fixed masonry structures to portable containers such as skips. Transfer stations can take the form of collection vehicles, which remain located at a certain point until full, to permanent compaction-transfer stations where fixed hydraulic compacting is used to compress the waste into large containers. Communal collection vehicles include container-hoist vehicles, tractor and trailer-containers, truck-mounted front-loading container-handling vehicles and truck-mounted rear-loading container-handling vehicles (Wilson, 1987).

2.9.2.2 Kerbside and On-site Collection Vehicles

Kerbside collection often takes place without the need for a transfer station. The collection vehicle usually takes the waste direct to the disposal site. Motorised vehicles can largely be categorised as non-compactor, semi-compactor or compactor vehicles (Habitat, 1993).

i) Non-compactor vehicles

Non-compactor vehicle bodies require a larger load space than a compactor body to enable the vehicle to achieve its payload. The bodies are however light and therefore can permit greater payloads than compactors, especially when waste densities are high. Non-compactor vehicles include high-sided open-top vehicles, side-loading "roll-top" vehicles, tractor and open trailer system, front-loading high-sided enclosed vehicles (Habitat, 1993).

ii) Semi-compactor Vehicles

Semi-compactor vehicles achieve some reduction in waste volume but not as much as hydraulic compaction vehicles. Nevertheless there are arguments that these vehicles are more appropriate for developing country wastes, which vary from medium to high density (Curzio *et al.*, 1994).

iii) Compactor Vehicles

Compactor vehicles are designed specifically for purposes of compacting low-density compressible wastes, usually common in higher income areas. The vehicle is also appropriate in areas where labour costs are high and a small crew is required. The major types of compactor vehicles include the Rear-Loading Hydraulic Compactors, Screw Compactor trucks, Side-Loading Hydraulic Compactors, Rotating Drum Compactors and Paddle Compactors (Habitat, 1993).

Table 2.4 is useful in that it gives an idea of the different vehicles used to transport the wastes from homes to the disposal sites. This information is useful to gauge whether the type of vehicle is suitable for different environments. Later on, one will realise that in many cities and towns, there are many inadequacies in waste collection systems. The transportation vehicles are not equipped to deal with prevailing waste materials or infra-structure resulting in littering of street corners or illegal dumping e.g. the collection vehicles are unable to gain access to certain parts of Kanpur in India as the roads are too narrow. Hence, sweepers use wheelbarrows into these narrows pathways to collect the refuse, which is then taken to a central point for the trucks to collect (Cointreau 1982).

Table 2.4 Comparison between the Different Transportation Systems

Vehicle Type	Advantages	Disadvantages
Non-Motorised		
Handcarts	• Accessible to all areas	• Limited operation radius
Pedal tricycles	• Reduced travel time • Operate on any surface	• Limited operation radius • Limited capacity
Animal-drawn carts	• Useful in low traffic density areas	• Limited speed and operating radius • Can cause traffic obstruction
Motorised Compactor		
Rear-Loading Hydraulic Compactor	• Handles large bulky items • Low loading height	• Excess wear from abrasive waste • Weight distribution problems can attain rear axle
Side-Loading Hydraulic Compactor	• Better weight distribution than rear loaders	• High loading height • Small loading apertures • Excess wear from waste
Rotating Drum Compactor	• Suitable for small items and dense wastes • Continuous loading system	• Excessive wear from abrasive wastes
Paddle Compactor	• Side or rear loading • Suitable for narrow streets or heavy traffic	
Motorised Non-Compactor		
High-sided open top		• Loading operations unhygienic due to fallback • Slow loading speed
Side Loading 'roll-top	• Suitable for heavy materials	• Unsuitable for light materials such as refuse
Tractor and open trailer	• Low cost • Easily maintained • Usable on poor surfaces	• Poor vehicle productivity
Front-Loading high-sided enclosed vehicle	• Body has large capacity • Body producible locally • Body enclosed	• Slow to load • Only accommodates 1 or 2 workers
Fore-and-aft tipping vehicles	• Body can be tipped two ways • Suitable for developing countries	
Motorised Semi-Compactor		
Side-Loading, moving-barrier		• High loading height • Small loading doors • Reduced load speed • Abrasive wastes wear

Source: Palmer Development Group (1995: 80)

2.10 RECYCLING

According to Kreith (1994: 112), there is no official definition of recycling but a widely accepted view is that recycling constitutes 'the beneficial reuse' of products that would otherwise be disposed of. The main concept of recycling occurs when material from the waste stream is recovered and serves as raw material input for the manufacturer of a new product. Hence recycling is not merely the separation of materials from the solid waste stream but occurs when such materials are incorporated into products that enter the market place. In fact Carless (1992: 67) summarises it perfectly when she stated that recycling simply means 'putting something one were going to throw away to good use'.

2.10.1 History of Recycling

Recycling is not a new idea. The scrap recycling industry estimates that people were reusing metal scrap as far back as 3000 B.C and the reuse of wastepaper goes back about half that far. During World War II, rubber, metal, glass, tin cans, scrap iron, cooking grease, string, razor blades and other such materials were saved to conserve and save fuel and energy. Unfortunately, as the years passed, humans slipped back to their bad habits of wasteful energy and fuel that persists today. During the 1960's, although there were no strict laws on waste disposal, people realised that recycling was a viable solution to their disposal problems. Recycling soon developed when stricter environmental controls on landfills and incineration plants were passed, making waste disposal much higher. With the growing public outcry in America, the Research Recovery Act of 1970 and then the Resource Conservation and Recovery Act of 1976 were passed. The Recycling Industry had developed rapidly into a multimillion-dollar industry. Communities all over America began to separate newspaper, plastics, paper products, glass, aluminium and various other materials (Carless, 1992).

2.10.2 Methods of Recycling

The recycling process has two basic approaches. One is that recyclable materials are separated at the point of generation by the waste generator and these materials are collected separately and transported to recycling markets. This is called source recycling. This system is good in that other wastes do not contaminate materials. However, great

dependence and co-operation is placed on the household, as they are required to separate the wastes and store them correctly. Usually, this system requires residents to have a multibin. This ensures higher participation on the part of residents (Association of Municipal Engineers, 1991). The second approach is to collect mixed wastes and separate them at a central processing facility. This is called mixed recycling. Some plants process segregated recyclable; others separate mixtures of glass bottles, aluminium cans and steel cans; whilst still others process mixed residential or commercial wastes, separating the recyclable material produced (Wilson, 1987).

2.10.3 Types of Recycling Materials

Recyclable materials are those, which people are already recycling and for which there are well-established markets. These materials include paper, glass, metals, and plastics. The uses for these materials are endless. Many materials such as glass and aluminium can be recycled on a closed-loop basis, which means that they go back to make the same product over and over again. Paper on the other hand can be recycled into a variety of different grades and products. Hence recycling only occurs when recyclable materials (paper, glass) are made into another product (Kreith, 1994).

2.10.3.1 Paper

The most commonly recycled papers are newsprint, corrugated materials, high-grade paper and glossy paper. A study conducted for the National Solid Wastes Management revealed that nearly 25 million tons of recyclable paper was recovered in 1988. Of that, nearly 12 million tons was corrugated materials, 8.5 million was printing and writing paper and 4.5 million was newsprint (Warmer Bulletin, 1994).

- **Newsprint:** It is one of the most commonly recycled materials. Newsprint refers to newspapers, telephone books and many mail inserts. Many telephone companies in America have started a recycling campaign. Another use of newsprint is the use of the shredded newspaper for a bedding material for livestock.

- **Corrugated Materials:** This is referred to by consumers as cardboard. This material has the highest recycling rate of any paper grade. The Institute of Scrap Recycling Industries (ISRI) has stated that 10 million tons of corrugated boxes were recycled in the United States. This is ensured due to the great use of these boxes by grocery stores, department stores and other businesses.

- **High Grade Paper:** These include computer printouts, tabulating cards, copy paper, white stationery and cutting from printing plants. This paper is more valuable in the market place as it can be used as a direct substitute for wood pulp in the paper making process.

- **Glossy Paper:** This includes most magazines, which are not widely recycled as many other grades. This is because the paper is heavily coated with clay, which makes it very difficult to recycle. However a recent paper-bleaching process is beginning to benefit form the presence of the clay (Warmer Bulletin, 1996).

2.10.3.2 Glass

The following are reduced when recycled glass is used:

- Energy use by up to 32 percent
- Air pollution by 20 percent
- Mining wastes by 80 percent
- Water use by 50 percent

Approximately 25 to 30 percent of manufactured glass is made from recycled glass. Glass is popular because it is impermeable, transparent and sanitary (British Glass Recycling Company, 1996).

2.10.3.3 Metals

There are different types of recyclable metals, which include aluminium, steel and other metals (copper, iron, lead, zinc, and stainless steel), which are recycled but not widely known about.

a) Aluminium

- Using the recycled aluminium instead of the virgin ore

- Uses 95 percent less energy
- Eliminates 95 percent of air pollution
- Eliminates 97 percent of water pollution
- Saves 4 tons of bauxite and 1500 pounds of petroleum coke and pitch for every ton of remelted aluminum. Aluminum can be found in cans, pie plates, foil, frozen food and also heavier aluminum is found in lawn furniture tubing, downspouts, gutters, window frames, pots and pans (Holt, 1995).

b) **Steel**

- Using recycled iron and steel instead of virgin ore results in

- 74 percent savings in energy
- 90 percent savings in virgin materials used
- 86 percent reduction in air pollution
- 40 percent reduction in water use
- 76 percent reduction in mining wastes
- 105 percent reduction in consumer waste

This material can be found in automobiles, appliances, ships, railroad cars and industrial equipment (Rogoff *et al.,* 1994).

c) Other Metals

- These metals are recycled in large quantities but are less known which include copper, iron, lead, zinc and stainless steel. There is a thriving market in scrap materials, which can be found in old automobiles, refrigerators, ovens stoves, telephone and utility wire and cable, tubing, electrical motors, generators, ammunition shell cases, plumbing fixtures and railroad equipment (Making Waste Work, 1995).

2.10.3.4 Plastics

These are synthetic materials. They consist mainly of polymers of carbon, oxygen and hydrogen. The Plastic Bottle Institute has developed the following codes to represent the seven distinct categories of plastic, which aids recyclers, and collectors of these materials:

PET (polyethylene terephthalate) is a lightweight, transparent plastic that is resistant to chemicals and moisture.

HDPE (high-density polyethylene) is used in milk jugs, soda bottle bases and plastic grocery bags.

V (vinyl) is used in flooring, records, vinyl sliding, shower curtains and garden hoses

LDPE (low-density polyethylene) is used in cellophane wrap, diaper liners and some squeeze bottles.

PP (polypropylene) is light, highly resistant, thermoplastic resin used in packaging, coating, pipes and tubes.

PS (polystyrene) also referred to as styrofoam is used in plastic coffee cups, egg cartons and most packing pellets.

OTHER includes all other resins and multilayered material.

However the most commonly recycled plastics are PET and HDPE (Bureau of National Affairs, 1994).

2.10.4 Collection Methods

2.10.4.1 Kerbside Programmes

In a kerbside programme regular household garbage is picked up from a multibin or one-bin system at the kerb.

- **One-bin system**, residents do not separate the recyclables themselves instead they dispose of it in one container at the kerb. There is less work for the household however it creates more work for the municipality as more equipment and staff is needed to separate the waste. This system is beneficial in that new recyclable materials can be introduced without having to issue each household with a new container (Turner, 1994)

- **Multibin system** allows residents to separate their waste into aluminium, glass, plastic and paper, which is disposed into separate containers at the kerb. These containers are provided by the municipality, which further encourages residents to participate. These containers are usually made of recycled plastic or reusable plastic. This method also reduces costs in terms of employing extra labour to separate the waste. The vehicles use to collect the waste has separate compartments (Parkin, 1995).

For the kerbside programme to be successful, the following needs to be adhered to:

- Collection needs to be scheduled for the same day as the regular garbage pickup which establishes a routine for recycling
- Education programmes need to be in place so that people become aware of recycling activities
- There needs to be a legislation in place to carry out this programme e.g. in some cities (New Jersey) it is mandatory to use the curtsied programme. New Jersey's mandatory programme enforces the separation of leaves and at least three other recyclable materials. Random checks are carried out and fines are given to residents if recycables are found in regular garbage. In New York, residents pay up to $500 for failure to separate their recyclables (Association of Municipal Engineers, 1991).

At first, the Kerbside programmes can be very expensive to initiate in residential areas e.g. Porter and Grogan (1998) indicated that it cost $2 per household per month for new programmes. However, there are many benefits from this programme:

- Regular collection of high quality recycables earn a community an income and saves considerable money in disposal costs
- Provides an alternative for areas that lack landfill sites.

It was also found that 37 million people are served by kerbside recycling programmes (Bureau of National Affairs, 1994).

2.10.4.2 Drop-Off Sites

Recycling drop-off sites have specific locations within a community such as the corner of a parking lot, an abandoned lot or the city landfill e.g. in California, shopping centres have drop-off sites. It was found that the most common recyclable materials were aluminium, glass and newspaper. The containers are generally large such as 'igloos', trailers or large waste bins. These sites can be run by a public body, privately or a combination of the two. Some charity organisations have drop-off sites from which they sell the recyclables to support their work. This is a common recycling method used mainly in rural areas. It is also a good method to use for a pilot project. There are no collection costs. However the drop-off recycling system relies solely on the voluntary participation of the community. The drop-off sites have to be secured to avoid theft. The drop-off collection needs to inform the public of its location, its hours of operation and the materials it will accept (Henstock, 1983).

2.10.4.3 Buy-Back Centres

It is a place where people can take the recyclables and be paid for them. These centres can be found in rural and urban areas. It is governed by the markets for recyclable materials e.g. aluminium maintains a stable price but glass and newspaper have fluctuated in price over the past few years. The location of buy-back centres is usually not so convenient as people will generally go further in order to earn money. The buy-back centres will not take recyclables that are contaminated and their hours of operation are fixed (Rogoff and Williams, 1994).

2.10.4.4 Charity Drives

Community groups such as Girl Scouts, church groups or schools will have a drive to collect certain recyclables that it will sell to a buy-back centre or broker to earn money for a specific project. These groups may pick up your recyclables from your home or have a specific location for the collection of materials. Either way these groups benefit from such gestures (Association of Municipal Engineers, 1991).

2.10.4.5 Landfills

Many communities include a recycling centre at the landfill site. This location allows residents to separate recyclable materials (as the landfills charge by the load) before proceeding to the disposal area. The location also saves money in terms of transport and in the cost of renting or leasing other locations (Turner, 1994).

2.10.5 Transporting and Processing Materials

Once recyclable materials are collected, they need to be transported and processed before it can be made into new products. The following will illustrate how the various methods are used to ship and process recyclable materials:

2.10.5.1 Materials Recovery Facilities (MRFs)

Once the recyclables are collected from the kerbside or any other system, they are taken to a sorting and processing facility. These are commonly referred to as Materials Recovery Facilities (MRFs). A community needs to have a continuous supply of recyclables to justify the construction of a MRF e.g. it takes a population of 250000 to 400000 to supply recycables to a MRF with a processing capacity of 100 to 200 tons per day. The MRF has varied machinery to deal with recycables that are gathered in one container without separation e.g. ***Large magnet systems*** can separate ferrous materials from other waste, ***Air separators*** can be used for lighter materials like paper and plastics and ***Optical systems*** can be used to separate glass colours, which is still under construction.

There are several benefits to using the MRF, which include:

- Mixed collection increases participation from communities
- Mixed collection also takes up less time during collection, and
- The sorting process is centralised (Chas, 1990).

There are also a number of problems associated with a MRF for example:

- It can be time consuming and costly when trying to gain a permit to open up a MRF
- The quality of recycled material (aluminium can and glass) tend to be lowered due to the contamination from other materials (glass can be contaminated with ceramics etc)

- The high percentage of broken glass goes through the MRF, but the colour-separated glass is valued more highly than mixed glass.

The MRFs that were developed in the early 1980s ranged from a simple site where materials were dumped and sorted by hand to the most recent one that employ sorters, magnets, balers and conveyor belts to deal with the recyclables. Experts believe that MRFs are here to stay (Turner, 1994).

2.10.5.2 Brokers and Other Intermediary Players

There are generally three channels by which collected recyclables may be sent:

End-users are the facilities that process or remanufacture recyclable materials for example a paper mill or aluminium plant that takes receipt of recyclable materials directly is an end-user. End-users may take material from the public whilst others take it only from brokers. A community might earn more money by selling the recyclable directly to the end-user. However the catch is that end-users have more stringent standards when it comes to the way in which recyclables may be prepared (Chas, 1990).

Brokers are the middlemen. They purchase recyclables from the public, charities and businesses and then sell them to the end-users. Brokers are popular with end-users as they guarantee the quality of recyclable materials (Chas, 1990).

Internal Markets are sources within the community that can use its recyclable materials e.g. the collection of newspapers and shredding them to use as bedding for local farmers' livestock. Most communities work with some combination of the above players when collecting and selling their recyclables (Chas, 1990).

2.10.6 End Products

2.10.6.1 Recycled Paper

According to the ISRI Recycling Paper cited in Warmer Bulletin (1996: 21) the following are the end products of recycled paper:

Corrugated goods: the new appliances such as microwaves, radios etc come packed in the cardboard boxes made from waste recycled cardboard.

Newspapers: can be recycled into newsprint, used as insulation and paper products.

Printing and writing papers: fine stationery, copying, ledger and other office paper, magazines, books, brochures, wrapping paper can all contain recycled fibres in varying amounts.

Tissues and towels: paper mills rely heavily on high and low grade scrap paper to make toilet and facial tissue, paper napkins, towels, diapers and various sanitary products.

Combination boxboard: cereal and soap boxes, shoe boxes, tissue boxes and beer and soft drink carriers are made with a high recycled-fibre content.

Construction products: insulation, gypsum wallboard, roofing paper, flooring, padding and sound absorbing materials all use recycled scrap paper.

Kraft paper: These are the brown paper bags that are used to carry groceries. It is significantly used for bulk products such as agricultural seeds, animal feeds, fertilisers and cement as well as in mail wrappings.

Moulded products: paper scraps are repulsed and moulded into special-use packaging such as paper egg cartons, fruit trays, flowerpots and certain industrial and construction products.

Developmental applications: research is being conducted to transform old newspapers into pellets to be burned as a new energy source (Warmer Bulletin, 1996).

2.10.6.2 Recycled Glass

Bottles and jars: these are widely used for beverage and food packaging. Bottles and jars can be melted down and turned into new containers in a true example of closed-loop recycling.

Other uses: broken glass of mixed colours can be used in the production of fibreglass and reflective beading and as a substitute for stone in glasphalt. Mixed colour glass can also be used to make green glass (Cook, 1994).

2.10.6.3 Recycled Metals

Steel: steel is America's most recycled material. The average consumer runs across the recycled steel in the form of cans in which food and beverages are bought. Paint cans are also recyclable.

Aluminium: aluminium is used for the containers of more than 95 percent of all canned beverages. America earns several hundred million dollars every year by saving aluminium cans and returning them in to buy-back centres. The bimetal can is made of two metals, which are aluminium (lid) and steel (body).

Other metals: copper can be used for its thermal and electrical conductivity and its chemical stability. Zinc can be used as a protective coating on steel as well as to make castings for automobile and construction applications (Association of Municipal Engineers, 1991).

2.10.6.4 Recycled Plastics

Recycled Polyethylene terephthalate (PET) ends up in many products, which include:

- Fibres (for carpet yarns, paint brush bristles, twine, rope, scouring pads, and fibrefill for pillows, vests and sleeping bags)
- Industrial strapping
- Engineering plastics
- Film and sheet for thermoforming
- Automobile distributor caps
- Bottles for cleaning products and other non-food items
- Egg cartons (Warmer Bulletin, 1992)

Recycled High density polyethylene (HDPE) ends up in products such as:

- Lumber substitutes (used for boat piers, livestock pens, shipping pallets, outdoor furniture, litter receptacles and signs)
- Base cups for soft drink bottles
- Flowerpots
- Pipes, toys, pails and drums
- Traffic barrier cones, golf bag liners, kitchen drain boards

- Milk bottle and soft drink carriers
- Trash cans and signs (Warmer Bulletin, 1992).

2.10.7 Impact on the Environment

The recycling materials, which include metal, plastic glass and paper affects the environment during some stage in the production. However, one needs to look at the most detrimental affects to the environment caused by the production of the recycled materials. It is important to note that paper and plastic poses the most serious danger to the environment. The recycling of paper causes concern during the de-inking process and the bleaching process.

The de-inking process uses toxic chemicals to remove the ink. However, the floatation method uses fewer chemicals and uses clay.

The bleaching process uses chlorine to convert pulp into white. The chemicals released during this process such as organochlorines, dioxins and furans are extremely harmful to humans and the environment. However, the use of an environmentally benign oxygen-base during the bleaching process is another alternative. The recycling of glass and metals do not pose much harm to the environment. Plastic on the other hand is considered to be the most polluting. The plastic uses five of the most polluting chemicals during its production. Finally plastic takes too long to degrade hence elevating the problems associated with solid waste and litter (Carless, 1992).

2.10.8 Advantages of Recycling

a) Reduction in landfill

Recycling reduces the amount of waste entering the landfill site. This in turn results in the landfill site life being extended. The costs involved in running the landfill are reduced because there is less waste to manage.

b) Reduction in incineration

Recycling and incineration can work together. The efficiency of the incinerator may be improved by removing materials, which do not burn e.g. glass and metals. The operating

temperature is more easily reached and less ash is produced. Recycling may therefore help to make incineration a more viable, cost-effective waste management option.

c) Job opportunities

Recycling creates job opportunities. The recycling field caters for a wide range of skilled and unskilled employment positions, from the one person scavenger to management positions in large recycling plants or programmes.

d) Savings in raw materials, energy and pollution

Industries are given a chance to partially or wholly substitute the recycled product for the raw material. Alternatively, the recycled product could be used to supplement the raw material to help increase production. Recycling also reduces wastage of energy and pollution e.g. to produce one ton aluminium requires four tons of bauxite and 0.7 tons of petroleum coke and pitch. This process releases pollutants into the air. Up to 95 percent of the energy input could be saved by recycling one can of aluminium.

e) Financial Gain

Recycling can mean the generation of income. Private business generally regards profit as the reason for becoming involved in recycling. It is not uncommon for a partnership to be drawn between a municipality and some enterprise of the private sector where both parties benefit e.g. this business may involve a programme where the private business takes the money created from the sale of the recovered recyclable materials while the municipality enjoys the extended life of its landfill site (Turner, 1994).

2.11 COMPOSTING

Composting is a natural process in which plant and other organic wastes are broken down biologically to produce a nutrient-rich material. The resulting compost can be used for soil improvement in individual gardens or on a larger scale in communities. It was found that between 20 and 30 percent of our waste is made up of organic materials, which still end up in landfills. Over 24 million tons of leaves and grass alone are thrown out each year. Yard and kitchen waste takes up a large amount of space in landfills when it could

be used effectively to improve the quality of soil in gardens or on public land through the practice of composting (Making Waste Work, 1995).

2.11.1 Small Scale Composting

Composting at home occurs when recycling yard and kitchen wastes such as leaves, grass clippings, fruit and vegetables scraps and other materials serves as a nutrient rich soil supplement for the garden. Leaves, lawn, flower clippings, coffee grounds, apple cores, nuts, seeds, carrot ends, eggshells and fruit or vegetable scraps are excellent materials that can be used for composting. However, certain materials need to be avoided such as meat, bones, cheese and grease. Paper should be limited in backyard compost piles or torn into small pieces (Herbert, 1993).

2.11.1.1 Methods of Small Scale Composting

Windrows are applicable to someone who has a large garden. This can be a miniature version of that used in large municipal waste composting systems. Depending on the space available, rows are made of 1 to 2 metres high, several metres wide and as long as required. The larger the piles, the quicker the materials will decompose. One can simply layer yard waste (about half-green materials and half-dry waste) and add kitchen waste as often as possible and turn the pile from time to time to aerate it (Diaz *et al.*, 1993).

Cylindrical Pen is another method. It is made of woven wire. This approach is suited to gardens with less space and less waste. The holes in the sides of the cylinder are essential to let the air pass through. The walls should be arranged to allow one to add materials and turn the pile (Diaz *et al.*, (1993: 35)

Perforated Steel Drum is a useful step-up, which hinders animals bothering the pile. The holes in the side are sufficient to let enough air circulate. The drum should be half full and to mix the compost one needs to roll the drum. The ideal compost pile requires a good mixture of carbon-rich materials such as dry leaves and nitrogen-rich materials such as green grass clippings, certain kitchen wastes or manure. By adding the soil to the pile, one introduces micro-organisms to the pile. The compost pile should be moist hence one

need to sprinkle water periodically during the dry weather. The mixture is ready to use when the compost is dark and crumbly and has an earthy smell. The whole process can take a period of weeks or months depending on the care the compost receive. It can be concluded that composting reduces the wastes entering the landfill site and it is also an excellent source of nutrients for the soil (Carless, 1992).

2.11.2 Large Scale Composting

Most communities throughout the world employ large scale composting e.g. Fairfield, Connecticut had opened a $3 million composting centre in 1989 to create topsoil for parks, playgrounds and public landscaping. University city, Missouri began a leaf composting program in 1983 and collects approximately 11,200 cubic yards of leaves annually. The material is turned several times during the winter and spring using an aerator or pulverizer that grinds up the material. The city sells the compost for $4 a cubic yard to nurseries, landscaping companies and individuals. Composting can be categorised into two main levels, which include yard waste composting and municipal solid waste composting. Yard waste composting takes leaves and other yard wastes only whilst municipal solid waste composting takes a wider variety of organic wastes found in garbage (Feinstein, 1992).

2.11.2.1 Methods of Large Scale Composting

Static Pile or High-rate Windrow involves making long piles, which are 5 or 6 feet high and about 15 feet wide at the base, with a flat area next to it so that any runoff liquids are controlled. Injecting blowers and piping controls the temperature and moisture levels. The piles are turned regularly with machines equipped with paddles. This method takes approximately 4 to 6 weeks for initial composting, followed by a few more weeks for curing.

Low-rate Windrow takes up to three months. This system is similar to the above (making the same piles) however; it does not use the aeration equipment. Although it keeps the cost down, the drawback is that one has to pay more attention to potential rodent and odour problems. The piles must be turned regularly.

In-Vessel Composting is done by a mechanical process in huge enclosed barrels called digesters. The digestion portion of this method takes only three to ten days because it uses heat, moisture and mechanised aeration to speed up the composting process. Most programmes then leave the compost to cure for up to four months in windrows to kill off any remaining harmful ingredients. At the end of the process, the compost is considered to be as safe as ordinary backyard dirt. The costs involved in this method are high. However, it does offer a workable system where land is in short supply (Feinstein, 1992).

The benefits of large scale composting include avoiding disposal costs and additional landfill space. The EarthWorks Group estimated that it costs about $65 per ton to dump solid waste in a landfill whereas it only costs $35 per ton to create municipal compost. There are many markets for large quantities of compost, which include farmers, nurseries and landscaping industries. Hence composting has proved to be valuable (Herbert, 1993).

2.11.3 Environmental Concerns of Composting

A number of environmentalists are concerned with high levels of heavy metals in the finished compost, rendering it unsafe and unusable. Composting on a large scale might hinder separation of recyclables. It will be costly if one has to employ people to manually remove recyclable items from the waste. Another concern is the odour caused by massive composting especially near residential areas. If composting occurs inside, turning windrows often and keeping the sites away from towns then this will help to minimise the odour problem. Compost operation would lower the quality of water. The quality of water can be affected through contamination with runoff from the compost operation or with leachate from raw, composting or composted refuse. This can be prevented if the composting operation is sheltered and it occurs on a paved surface. Composting tends to compromise the health of the public by attracting vectors and rodents. Hence preventive measures needs to be taken to reduce this health hazard. However, it is important to note that composting plays an important role in the solid waste management policy. Not only can large portions of the solid waste stream be diverted from landfills and incinerators, but also a valuable commodity can be made from the waste (Diaz *et al.,* 1993).

2.12 RECLAMATION

Reclamation occurs when materials reclaimed from the waste stream can have use or value without undergoing a process of recycling. Reclamation can occur at the source or just prior to disposal. Pickers on landfills are traditional examples of agents who reclaim waste prior to disposal (Palmer Development Group, 1995).

2.12.1 Re-use

Re-use involves using a product or package more than once or re-using it in another application e.g. re-using plastic carrier bags and glass milk or soda bottles, retreading partly worn tyres and re-using car parts via car scrap merchants. The re-use of the beverage bottles was common until the late 1980's using a deposit refund system (a small charge on the bottle), which was refunded when the bottle was returned. These schemes are widely used and are cost effective. However with the introduction of new materials and consumer preferences (plastic bottles), the deposit refund system has declined (Williams, 1998).

2.12.1.1 Benefits of the Re-use System

- Re-using a product reduces the waste quantity requiring treatment and disposal.
- Reduces the costs associated with producing the replaced items, which would include energy, materials and transport costs e.g. the economic and environmental costs associated with producing a new bottle.
- Re-use of materials can take a new application form e.g. the use of tyres for securing covers on silage mounds and for boat or dock fenders.
- Many countries still continue practising some of the re-use schemes e.g. supermarkets encourage the re-use of plastic carrier bags.
- Other countries have extended the deposit refund scheme, for batteries (Denmark and Netherlands), disposable cameras (Japan) and even car bodies (Sweden and Norway) (Rogoff *et al.*, 1994).

2.13 REDUCTION

Waste reduction is both environmentally and economically beneficial both to society as a whole and to business and the community. Waste reduction is synonymous with waste minimisation. It has been defined as any technique, process or activity which either avoids, eliminates or reduces a waste at its source, usually within the confines of the production unit. Environmental and cost savings arise from less waste being processed with, for example, savings in energy costs, waste storage space, transport costs, administrative costs and lower emissions to air, water and on to the land. Reduction in the toxicity of waste also reduces costs due to the lower costs of treatment. In America, increase in disposal costs, stringent legislation and regulations have helped to reduce waste at the source.

A number of waste reduction projects involving groups of companies have been set up in the United Kingdom with Government aid e.g. the catalyst project based in Merseryside area, the Aire and Calder project in Yorkshire and the River Dee project in Wales. The projects highlight waste reduction measures through the identification of the 'best practice' in the manufacturing process. In most cases the savings from reduction in the waste going for treatment and disposal are small; the largest savings come from reduction in the use of raw materials by changes in the process (Kreith, 1994)

2.14 DISPOSAL

Disposal of waste can take the place in a controlled or uncontrolled manner. Uncontrolled disposal could take the form of dumping of waste or open burning of waste. Controlled disposal of waste usually takes place by means of sanitary land filling or incineration (Williams, 1998).

2.14.1 Illegal Dumping

Illegal waste disposal is disposal of solid waste in an unpermitted area. It is also referred to as `open dumping,' `fly dumping,' and `midnight dumping' because materials are often disposed of in open areas, from vehicles along roadside, and late at night
(Environmental Protection Agency, 1998).

2.14.1.1 Classification of Illegally Disposed of Waste

Illegal wastes are primarily materials that are disposed of to avoid either disposal fees or the time and effort required for proper disposal. These materials typically include:

- Construction and demolition wastes such as, roofing, lumber, bricks, concrete;
- Abandoned automobiles, autoparts and scrap tyres;
- Household trash - kitchen waste, paper, packing material, obsolete smaller items, broken crockery and ash;
- Bulky waste - disused domestic appliances and furniture;
- Garden refuse - tree cuttings, grass cuttings and plants;
- Medical waste - pharmacies, surgeries, hospitals and clinics (Eilrich *et al.*, 1997).

2.14.1.2 Illegal Disposal Sites

Wastes such as scrap tyres, bulky wastes and garden refuse may be illegally disposed of because they are banned from landfills and their proper management can be costly. Residential and commercial wastes may be illegally disposed of in areas that lack or have costly pick-up services. Sites used for illegal wastes vary but may include abandoned industrial, residential or commercial buildings, vacant lots on public or private property and infrequently used alleys or roadways. The poor lighting and inaccessibility of certain areas along rural roads and railways contribute to illegal dumping. Illegal disposal of wastes can occur at any time of the day but is more common at night or in the early morning hours during warmer months. Illegal disposal sites often attract more waste, including potentially hazardous wastes such as asbestos, household chemicals and paints, automotive fluids and commercial or industrial wastes (Nel, 1996).

2.14.1.3 Sources of Illegal Waste Disposal

It is difficult to profile a `typical' offender who illegally disposes of solid wastes. However, offenders can include:

- Construction, demolition, remodelling, roofing, or landscaping contractors;
- Waste management companies or general hauling contractors (collect waste from industries such as textiles, oil refineries, tanneries, petroleum and pharmaceuticals);

- Operators of transfer stations or junkyards;
- Automobile repair or tire shops;
- Scrap collectors;
- Local residents and `do - it – yourself persons' (Environmental Protection Agency, 1998).

An individual may claim to be operating a transfer station or recycling business and accept waste at an unpermitted facility only to abandon the facility when it reaches capacity. A resident may dispose of wastes that did not get picked up by local waste hauliers such as bulky items, carpeting or household hazardous wastes. In many cases, offenders of illegal waste disposal are breaking other laws relating to vehicle licensing, insurance drug possession or theft. The costs associated with the clearing of these wastes are extremely high (Gowans, 2000).

2.14.1.4 Factors Contributing to Illegal Waste Disposal

i) Demographics

Communities that resort to illegal waste disposal are those with limited access to convenient, affordable waste disposal facilities or services and recycling programmes. These areas may also have gang or drug related activities and high crime rates, which often result in illegal waste disposal being given a low priority by law enforcement officials and prosecutors. The problem tends to be worse in areas with a high population of renters who have less stake in the community or absentee property owners who do not respond to problems. Residents in rural areas, where illegal waste disposal is a common, long-time practice, may not be aware of applicable laws or understand its harmful impacts (Nel, 1996).

ii) Physical Characteristics

Unsecured properties including undeveloped lots, abandoned structures, unused industrial facilities and remote spaces are potential targeted areas to offenders of illegal waste disposal. Areas with vacant properties tend to have a higher incidence of illegal waste disposal

because of the reduced risk factor. Other areas, including poorly lit access roads, property along railways, highways and alleys, charity drop box locations and construction sites or public areas with waste containers are also prime targets for illegal waste disposal (Gowans, 2000).

Forest preserves, wooded sites and farms (especially those near heavily populated areas) are often targets for illegal waste disposal because they are sparsely populated and dark. The borders of cities and countries tend to have a higher incidence of this activity because of a lack of police presence. Offenders, in avoidance of disposal fees, very often resort to dispose of their waste in nearby junkyards, active or closed landfills, solid waste transfer stations and temporary disposal areas such as construction sites (Gowans, 2000).

iii) Lack of Alternative Waste Disposal and Recycling Programmes

Areas without routine or affordable pick-up service for trash and recyclables tend to experience a higher incidence of household or yard waste disposal. Landfills and transfer stations that have high disposal fees are not conveniently located, have minimum tipping fees or do not accept small loads, will encourage illegal waste disposal. Materials prohibited from entering landfills such as garden refuse, scrap tyres, appliances and car batteries may be illegally disposed of. Communities lacking a contract with a waste haulier and standardised billing may have problems with residents who refuse to pay a waste haulier for service on their own (Environmental Protection Agency, 1998).

iv) Lack of Solid Waste Codes and Ordinances

Illegal waste disposal is a problem in many areas because of the lack of effective legal codes or ordinances prohibiting open waste disposal or burning of waste. In America, both activities are prohibited by federal and most state laws but enforcement by local authorities is typically done under local codes, which may be less stringent. In some cases, the fines for a waste disposal offence are less than the costs for proper waste disposal and offenders consider the fines to be simply a cost of doing business. Furthermore, failure to appropriately regulate waste hauliers and disposal operations invite illegal waste disposal (Environmental Protection Agency, 1998).

2.14.1.5 Case Studies

New York State laws put a few new wrinkles in the illegal waste disposal problem. In an effort some years ago to assist the building industry, the state created a special category of landfill that would accept only construction and demolition debris. These facilities were to be allowed to operate for a year before they needed a permit. Disposal fees were about $10 per ton, compared to $40 - $50 per ton charged by commercial (privately owned) municipal solid waste landfills. Other kinds of solid waste found their way to the unregulated construction and demolition landfills. Violating the law, the owners or operators accepted the solid waste. The construction and demolition landfills thereby became illegal waste disposal sites posing as exempt facilities (Nel, 1996).

The Springfield County had an innovative and successful anti-disposal programme and was regularly nominated for Clean City and other awards. Citizens filled out 'report-a-dump' forms in the local newspaper and sent them to the Department of Public Works. The city followed up by going to the Housing Court, which would order the property owner to clean up. If the owner failed to comply promptly, a city cleanup team would do the job then the owner given a fee for the cleanup costs. Among other services, the city offered free collection of bulky discards such as appliances (Tyrpin, 1999: 35).

These services relied on state funding. In 1989, the state paid out $30 million aid to Springfield. As a result, the Department of Public Works budget was slashed by 40 percent. The city government, replicating the anti-tax mood of the rest of the state, voted against raising any money locally. Many residents appear unwilling to pay the $20 fee that private hauliers are asking for appliance disposal. The illegal waste disposal sites are back and they are growing (Tyrpin, 1999).

Hauling costs in New Jersey are among the highest in the country because the state has too little disposal capacity and exports over half its waste to other states for disposal. In 1988, an increase in residential hauling charges resulted in so much illegal disposal of solid wastes that the town officials of Plainfield declared a limited health emergency and ordered public works crew to clean up the debris on the private property and to erect

fences around vacant lots. Some New Jersey residents, were either reluctant to pay hauling costs or unwilling to follow the state's rules on separating recyclable materials from their other garbage - throw bagged rubbish out of their cars as they swing up onto the highway entrance ramp in Newark on their morning commute to New York city (Tyrpin, 1999).

2.14.2 Open Burning Dumps

There are some 94% of open burning dumps in the United States. These open burning dumps pollute the air, contaminate the soil and groundwater, create public nuisances in the form of stench and ugliness and provide breeding places for rodent and insect pests. The United States Public Health Department has declared these sites unsanitary (Greenwood and Edwards, 1973).

2.14.3 Landfills

At landfill sites, waste materials are disposed on the sites through various methods. The refuse is deposited in trenches or pits and then compacted with earth-moving equipment and covered at the end of each day with a layer of earth to keep out the vermin. Dry land disposal involves filling gullies and canyons with refuse that is compacted and then covered with earth to produce usable level land. Most filled sites are aesthetically inferior to naturally contoured areas and such sites do affect the surface drainage patterns. Some municipal wastes do disintegrate but waste such as glass, plastic, aluminum takes a long time to disintegrate. The toxic waste contaminates the groundwater during heavy rains and floods (O'Leary and Walsh, 1992).

2.14.4 Incineration

Incineration is the second major option for waste treatment and disposal in many countries throughout the world. Concentration is made on mass burn incineration of municipal solid waste. Incineration of waste in the United Kingdom accounts for about 5% of commercial waste and less than 2% of industrial waste (Making Waste Work, 1995). Previously incineration was seen only as a way of getting rid of waste. However, nowadays incineration of waste is used as a way in recovering energy i.e. generation of

electricity from high temperature steam turbines or through district heating schemes. In the United Kingdom, there are a number of incineration plants, ranging from large-scale mass burn municipal waste incinerators, through in-house and merchant industrial and commercial incinerators of specialised wastes, to clinical waste incinerators (Hope, 1998).

2.15 ENVIRONMENTAL IMPACTS OF SOLID WASTE

The wastes generated impact on the human and natural environments. The nature and extent of the impact depends on a number of factors, which include quantity and composition of waste, the adequacy of collection services and the methods of disposal. The extent of recycling and re-use is also significant as this affects both the quantity and the composition of the matter that needs to be absorbed into the environment. The major problems result from uncollected waste and informal or illegal dumping. It is important to take note that the human and natural environments are closely linked. This implies that inadequate solid waste management impacts on the natural environment, which inevitably affects the human environment or vice versa (Hope, 1998).

For people living in areas where waste collection services are inadequate or totally absent, uncollected household waste pose serious threats to the health of such individuals. Such wastes pose a health risk both directly and via its effects on water supplies and drainage systems (Fernandez, 1993). The following depicts how wastes impacts on the environment which inevitably affects the health of humans:

2.15.1 Local Surface Water

Uncollected waste poses serious effects on the stormwater system. Waste matter, together with loose soil, can lead to blockages in the stormwater drainage system. This means that standing water cannot drain away and this standing water becomes contaminated with pathogens from decaying waste and animal waste. Contaminated standing water exposes residents to the risk of a number of diseases such as cholera and diarrhoea. Children who play in this water are at particular risk (Shamrock, 1995).

2.15.2 Rivers and Streams

The problems associated with standing water ends up affecting the water quality in stormwater channels, rivers and streams. Also, another contamination that arises is the common practice of dumping waste into these stormwater drains, rivers and streams. According to Cointreau (1982), in many developing countries, especially those with the highest percentage of urban poverty, people dispose their waste in drains resulting in stagnant waters. This contaminated water poses a health risk to people both within the immediate area and further afield e.g. children playing in the canals of Khayelitsha are at a serious risk of contracting a disease (Wright, 1992). It has also been found that these waters are harmful to those who access the water for domestic or agricultural purposes e.g. in Kano Nigeria, cattle drink water from a dump site which was once a cattle watering hole (Cointreau, 1982).

2.15.3 Groundwater

Groundwater contamination is the most common means of environmental degradation associated with municipal waste disposal. Waste that is disposed of in landfills or open dumps is subjected to either groundwater underflow or infiltration from precipitation. This results in decomposition of by-products being released into the waters moving through the waste deposit. Another danger is the production of methane, especially if the waste deposit is wet and there is little oxygen. This methane is extremely dangerous when it is able to migrate underground and seep into the basements of buildings. In many developing countries, it has been found that urban residents have built their homes over landfills without taking the necessary precautions against the methane accumulations e.g. in Onitsha, Nigeria, new middle-income level housing was constructed on the landfills while disposal was still in progress (Foster and Herata, 1988).

2.15.4 Pests

According to Hardoy et al. (1992), the concentrations of organic waste attract pests such as flies, rats and cockroaches, which can be carriers of diseases such as hepatitis A, trachoma and diarrhoeal diseases.

2.15.5 Injury

Children who play in and around uncollected garbage are at risk of injury from the broken glass or rusty tins. The chances of contracting pest-related diseases are also much greater among children due to their greater exposure and the lack of good hygiene. Children are further exposed to the risk if they eat discarded scraps of food that might be contaminated. The pets such as dogs and cats that tear bags or roam areas that have solid wastes are also prone to diseases. If these pets eat the contaminated food from the wastes, they are likely to become sick (Booth *et al.,* 1994).

2.15.6 Air Pollution

Uncollected waste is often burned and this gives rise to air pollution. Burning can lead to the release into the air of both toxins (e.g. from certain plastics) and suspended particles (e.g. ash). These may cause respiratory problems and skin and eye irritations (Hardoy *et al.,* 1992).

2.15.7 Flooding

Litter, ash and loose soil block stormwater drains. After a heavy storm, the stormwater is unable to pass through the drain resulting in floods. Flooding causes economic hardships due to loss and damage to property. Health problems result as homes are left destroyed, cold and damp (Palmer Development Group, 1995).

2.15.8 Aesthetic Effects

Uncollected waste is aesthetically unpleasant, both visually and due to the smell from rotting waste. This affects both the resident population and the wider community. According to Hardoy *et al* (1992: 28), many "psychosocial disorders such as depression, drug and alcohol abuse, suicide etc" are associated with poor living condition and inadequate solid waste collection is a good example. According to a resident referring to the problems of informal dumping close to residential areas stated that they cannot study, eat or sleep during the day without the interference of flies and they breathe air which has a pungent odour (Hans, 1993: 7).

2.15.9 Freshwater and Marine Life

A large proportion of uncollected waste ends up in water courses and eventually the sea and this has a detrimental effect on the ecology of such an area. Decaying organic matter and bacteriological activity use oxygen, which reduce the amount of oxygen available for aquatic life e.g. the Jukskei River near Alexandra, contained very low levels of oxygen. The presence of nutrients in the water leads to the growth of aquatic weeds, algae and macrophytes. This affects the quality of the water and poses potential health hazards. Plastics can prove dangerous to marine life. It was found that large numbers of marine and freshwater birds, fish and animal die every year after ingesting or becoming entangled in plastics. Plastics can pose similar problems for animal and bird life on land (CSIR, 1991).

In the following section, the researcher will be reviewing how waste is managed in developed and developing countries. This is essential in that it will help the researcher to relate the management of waste in South Africa with situations in developed and developing countries.

2.16 WASTE MANAGEMENT IN DEVELOPING AND DEVELOPED COUNTRIES

2.16.1 Introduction

According to Cointreau (1982), the management of solid wastes in developing countries has to be seen in the context of problems posed by rapid urbanisation, lack of basic facilities and services. In developing countries the emphasis is upon improving service coverage and thereby meeting the basic needs of households more effectively. The major features of wastes are:

- Increasing the need for community participation in the waste management process;
- Extensive recovery, re-use and recycling of wastes;
- The achievement of economic empowerment through involvement with wastes (Hope, 1998).

In developed countries, the main features are:

- Increased use of sophisticated technology;
- Emphasis on waste minimisation;
- Greater responsibility and participation of householders in the waste management;
- Stringent legislation on all aspects of waste management process (Kreith, 1994).

2.16.2 Waste Characteristics

Cointreau (1982) found that the generation rates for developing countries generally were below 0.60kg per day per person whilst in developed countries, the rates exceeded 1kg per day per person. The waste density in developed countries usually do not exceed 150kg per cubic metre whilst in developing countries, the densities were usually greater than 400kg per cubic metre. In terms of the composition, waste from developed countries consisted mainly of paper, metals, glass and plastics and less putrescibles whilst developing countries' waste consisted largely of putrescibles, dust and ash and comparatively little paper, metals, glass and plastic (Flintoff, 1984).

Table 2.5: Waste Generation Rates

	Country	**kg/day/person**
Developed Countries	USA	1.80
	Germany	0.85
	Italy	0.69
Middle-Income Countries	Singapore	0.87
	Hong Kong	0.85
Developing Countries	India	0.60
	Indonesia	0.60
	Pakistan	0.51

Source: Cointreau (1982: 18)

From table 2.5, the following can be noted: in developed countries, the waste generated is greater than in middle-income countries or developing countries. As can be seen, generation

rates range from 1.80 kg per person per day in the United States of America to 0.60kg per person per day in India or 0.87kg per person per day in Singapore.

Table 2.6: Waste Densities

	Countries	**kg/m^3**
Developed Countries	USA	100
	United Kingdom	150
Middle-Income Countries	Singapore	175
	Egypt	330
Developing Countries	Pakistan	500
	India	500

Source: Cointreau (1982: 20)

In table 2.6, the following can be noted: in developing countries, the waste density ranges from 500 kg per cubic metre whilst in developed countries, the density ranges from 100 to 150 kg per cubic metre. In the Middle-income countries such as Singapore the waste density range from 175 kg per cubic metre whilst in Egypt, the density ranges from 330 kg per cubic metre. According to Cointreau (1982), where refuse production is high, density tends to be low and vice versa. He stated that the lower densities of waste in developed countries were a result of the high percentage of non-putrescibles such as paper, plastics, glass and metals that was found in the packaging of consumer goods.

In table 2.7, the compositional differences are accountable to economic, cultural, climatic and geographic differences among cities. The most prominent compositional difference is as a result of the economic characteristics e.g. the paper composition in the United States (developed country) (35%) is far greater than the composition in India (developing) (2%). By taking note of the waste composition, it might prove to be useful especially when deciding on the type of recycling method that can be utilised for particular environments. It is important to note that all steps in solid waste management are related. The efficiency and effectiveness of collection is intimately related to the method of household or communal storage selected i.e. a change in any one part of the solid waste system has an effect on the other parts of the system (Cointreau, 1982).

Table 2.7: Waste Composition (percentage)

Waste	Developed Countries		Middle Income Countries		Developing Countries	
Materials	**USA**	**UK**	**Singapore**	**Hong Kong**	**India**	**Pakistan**
Vegetable	22	28	5	9	80	49
Paper	35	37	43	32	2	4
Metals	13	8	3	2	3	4
Glass	9	8	1	10	6	3
Textiles	4	2	9	10	3	5
Plastic/ Leather/ Rubber	10	2	6	6	4	9
Wood	4	Na	Na	Na	1	2
Dust/ash/	4	15	32	31	24	42
Moisture Content	22	20-23	40	45	29	52

Source: Cointreau (1982: 22)

2.16.3 Waste Storage

As stated earlier, it is important to note that the type of container used to store waste depends on a number of factors which include frequency and efficiency of collection, the amount of waste, the type of housing, the density of collected wastes, collection vehicles, vehicle usage, manpower and economics relating to the container and collection system (Scharff and Vogel, 1994).

In developed countries, the storage of waste generally takes place in standardised containers usually in plastic bags or bins e.g. in the United Kingdom, the waste containers include traditional metal or plastic dustbins, wheeled bins and plastic sacks. However, with the new technological developments, automation has led to bins being mechanically emptied into the collection vehicles e.g. the introduction of identity chips which are implanted in bins, allows for the waste agency to gain accurate details of the household generation rates which assists in the billing process. These weight-based schemes were used in Farmington, Minnesota for three years, and in East Germany and Australia (von Schoenberg, 1993).

According to Cointreau (1982: 26), non-standardised containers can range from temporary items such as cardboard's cartons, plastic bags and crates to permanent containers such as plastic or metal bins. Standardised containers are usually plastic or metal bins with the name and address of the owner and with a lid. He also noted an important point which is 'all steps in solid waste management are related'. This implies that each process is dependant on each other e.g. the size of the container depends on the weight and density of wastes being disposed and the length of storage with respect to the frequency of collection. It was found that standardised containers such as plastic bags in developing countries tend to be inappropriate because of the hot climates, which causes the bags to burst (Booth et.al, 1994).

According to Cointreau (1982), communal storage units are also common in developing countries, which include permanent structures such as three-side masonry buildings or mobile containers such as steel drums, skips or trailers. However Habitat (1989), noted that these storage depots have their disadvantages which include: depots tends to become unhygienic due to lack of cleaning responsibility, drums are easily vandalised and stolen, unemptied containers tend to become burning sites.

2.16.4 Waste Collection

It was found that in most developed countries, the level of service is once a week through kerbside collection usually by a compactor vehicle. This type of service is in line with the better infrastructures and effective waste management arrangements, which is prevalent in developed countries. However, it is important to note that there are certain factors that can also influence the collection of waste in developed countries as stated earlier by Pescod (1993) e.g.

- In warmer climates such as Southern Europe, collection of waste has to be more frequent to minimise the problems from odours and fly breeding.
- In some cities in the United Kingdom, due to the recycling initiatives, collection depends on the type of waste materials being collected (recyclable bins are collected once per month and the non-recyclable bins are collected once a week).

In developing countries, the methods of collections are less standardised than in developed countries. This can be attributed to a number of social and economic conditions that prevail

in developing countries e.g. in most developing countries, the roads are narrow and unsuitable for vehicles to travel in. Hence the kerbside collection of waste involves the use of more traditional ways, which include pushcarts, pedal tricycles, wheelbarrows and even animal drawn vehicles. In fact, the World Bank's solid waste projects in Indonesia, Manila, India and Egypt are using pushcarts as a principal mode of house-to-house collection. In Kanpur, India, sweepers using traditional wheelbarrows collect refuse. Even in Tunis, Tunisia, donkeys are regularly used to collect refuse in hilly neighbourhoods that lack paved roads (Cointreau-Levin, 1994).

A programme initiated in Curitiba, Brazil is worth taking note of, as it might prove useful for situations in South Africa. The 'purchase of garbage' programme is run in the favelas (squatter settlements) whereby residents 'sell' their bags of waste for bus fares and agricultural and dairy produce. The programme has led to a decrease in city litter and has helped to improve the quality of life of the urban poor. The payment to the communities through bus fares and food for garbage was equivalent to the municipality paying a private company to collect the waste (Rabinovitch, 1992).

2.16.5 Waste Transportation

In developed countries, the use of compactor vehicles is highly common. These types of vehicles tend to reduce the volume of waste. However, with the development of new technologies, semi-automated bin lifters are proving to be common collection vehicles. Rail transports are also used to transfer waste from transfer stations to landfills or incinerators.
As mentioned previously, the transportation vehicle range from pushcarts to open standard trucks e.g. in Tunis, Tunisia, there is a direct transfer of wastes from a pushcart to a flatbed truck. It was also found that developing countries tend to experience problems when using new technologies that were initially designed for developed countries e.g. a World Bank project in Jakarta, Indonesia found that the use of compactor vehicles were unsuitable as there was a high water content (40-50 percent) (Bartone *et al.*, 1990).

2.16.6 Recycling

Recycling has proved to be an important initiative in many countries. But it is important to take note that recycling differs in both developed and developing countries for a number of reasons which, the researcher will touch upon. Initially recycling in many developed countries was difficult to promote. However, with the rising tipping fees, shrinking landfill space and the unpopular practice of siting new landfills or incinerators, many cities throughout the United States have launched recycling programmes. Research has now shown that recycling activities in the industrial, commercial and household sector of developed countries have increased significantly e.g. in the United States, there was a remarkable growth in recycling rates from 9 percent in 1989 to 28 percent in 1996 (David, 1999). Goldstein (1997), stated that this growth rate indicated the changing attitudes of people and their support for the environment

As indicated earlier the success of recycling depends on numerous factors. In developed countries, it was found that two central factors contributed immensely to the success of recycling, which included household co-operation education and legislation.

- **Household co-operation** is vital for any recycling programme to succeed. In many instances it was found that in order to gain household co-operation two important aspects needed to take place. One involved good incentives and the other was educating residents of these programmes. Incentives can include competitions, deposit on bottles, money for cans, plastics metals etc. In the United States, 17 states reached their goal of reducing solid waste by the year 1997. These types of goals are important in that it increase competition thereby promoting recycling and reducing solid waste (Porter and Grogan, 1998). After reviewing 27 articles, Porter and Grogan (1998) also concluded that incentives influence recycling behaviour, which in turn increases solid waste recycling.

Education is also important in the success of recycling programmes. Porter and Grogan (1998) found that the individuals with the knowledge of what and how to recycle were more likely to recycle than those with less knowledge e.g. a kerbside programme was implemented in 59 districts of New York, which used flyers explaining recycling procedures, posters and meetings to inform people. This programme was successful, in that,

more than 1000 tons of newspaper, metal cans and glass bottles, were diverted from New York's waste stream (Lofaso, 1994). They also concluded that the lack of knowledge about recycling was a barrier for individuals who held strong conservation ethics (i.e. individuals with a strong conservation ethic were more likely to recycle than individuals with a weak conservation ethic). In New Zealand, it was reported that local authorities were making progress towards a goal of zero waste to the landfill through the recovery of materials and anti-rubbish education. It was found that up to two thirds of 'waste' was recovered and sold (Tangri, 2000).

- **Legislation** is an important aspect in recycling programmes especially since producers find raw materials cheaper than recyclables in the production process. In the United States, the most dramatic legislative action on waste reduction occurred from 1983 to 1993, for example, Oregon passed its 'Right to Recycle' legislation in 1983, which had given every resident access to a recycling programme. As the years passed a number of states had refined their laws to accommodate the changing situations and environment e.g. in Oregon in 1997, several recycling bills were passed including the HB 2402, which requires the use of recycled paper in filings in the courts and encourages double-sided copying (Porter and Grogan, 1998).

  In California, there have been laws passed requiring every city to reduce its waste disposal by 50 percent. This reduction termed 'diversion rates' requires trash to be diverted from landfills and incinerators through recycling and composting. Those cities that failed to comply with the Integrated Waste Management Act were given large fines, up to $50000. This was the States commitment to cut California's trash in half by the year 2000. In the United Kingdom, a number of legislation were also taken to encourage recycling which included The Waste Management Paper 28 (1992), The Environment Act 1995, and Making Waste Work 1995). The 1995 Environment Act sought to impose the share of responsibility on the producers to increase the re-use, recovery or recycling of products which they have produced (Williams, 1998). Germany had also initiated such a programme by passing a Draft Used Paper Ordinance, which had made producers

responsible for the disposal of the packaging i.e. the industry, distributor and retailers must accept waste paper returned by the consumers (Warmer Bulletin, 1993).

However, it is important to take note that in some developed countries, the levels of resource recovery is not very significant e.g. according to a survey commissioned by the Irish Department of the Environment, in the Republic of Ireland, less than 1% of the 1.22 million tons of household waste is recycled (Warmer Bulletin, 1993).

In developing countries on the other hand, the reasons for employing recycling initiatives are much different compared to developed countries. According to Bartone et al., (1990), managing solid waste is a major challenge for cities in the developing world due to conditions such as rapid urbanisation and industrial growth. There are many factors that contribute to the concept of recycling in developing countries. According to Furedy (1992), recycling is encouraged as a result of environmental conditions created by less effective collection systems and second, the economic conditions created through the waste industry. In developing countries, one would notice that recovery of these wastes are utilised in several ways e.g. waste materials are used by low-income households for the construction of their shelters and by small-scale industries and workshops as raw materials in the production (Hardoy *et al.,* 1992).

Recycling may consist of door-to-door collectors and or 'scavengers' who separate reusable materials at dumps and collection sites. In developing countries there is an increased awareness of the usefulness of scavenging at different stages in the disposal process. It was found that the earlier the scavenger can collect the material, the more profitable and successful the work is. In Manila, the government supported recycling at the following three levels:

- Households and traders were encouraged to separating materials such as paper, bottle, tin cans, iron, plastics and clothes at the source.
- Waste collectors were allowed to scavenge during collection times and
- Dump scavenging was also allowed (Habitat, 1989).

In Thailand, refuse collectors provide door to door service using large baskets and two wheeled dollies. Before loading the refuse, collectors pick through the refuse selecting all the valuable materials. These items are then sold to the middlemen (Cointreau, 1982). In Nairobi, scavengers contribute to a high degree of paper collection. Scavengers have fixed places (street corners, parking lots) where office people bring used papers. This type of collaborative work is very effective as both parties benefit. The office gets rid of their waste and the scavengers earn an income (Habitat, 1993).

An excellent example of co-operative building was between the University of Bandung and the local community scavengers. The University had supported these scavengers by developing an integrated operation for collecting, sorting and waste dealing. The University had provided the community scavengers technical advice on how to utilise certain of the waste collected e.g. they were shown how to utilise edibles for animal husbandry and organic materials for composting in vegetable gardens (Habitat, 1989).

On the other hand, scavenging in most developing countries takes place on the dump sites. It was reported that 5000 scavengers work on the open dump sites in Mexico. In Guatemala City, there are approximately 2000 poor families who live on the city's dump so that they can earn a living (Warmer Bulletin, 1995).

At the dumping sites, most of the workers generally collect a single material in order to obtain a saleable quantity. In Asia, the plastic recycling on dumps are fairly common (Habitat, 1989). However, scavenging on open dumps can lead to a number of problems between the scavengers and the municipal workers. Some municipalities consider scavengers as a menace and also prevent them from scavenging on the dump sites. The other problem that scavengers face, is that municipal workers pick out the most valuable refuse e.g. in Mexico, the municipal workers remove the valuable refuse before they arrive at the dump site (Cointreau, 1982). However, Furdey (1992) has found that in many countries, it was better to include the existing scavengers rather than to launch new resource recovery programmes. Ohnesorgen (1993: 9-12) also stated that 'scavengers are, in a sense, a

resource because they recycle solid waste and cities have to learn to work with them and train them, not work against them'.

The following examples reveal how recycling has worked for most people in developing countries especially those who used recycling as a means of livelihood. In Nepal, waste pickers gathered low grade materials form waste bins and dump sites, which they sell to waste buyers at a slightly higher price. (Warmer Bulletin, 1995). It was found that most of these waste pickers had originated from India, as poverty seems to be a prevailing factor in their lives. These waste pickers from India collected the refuse thereby earning a living whilst the Nepalese were reluctant to deal with waste (Habitat, 1989). Furdey (1992) also found that in Calcutta, India, an estimated 40000 people made a living from recovering and using or selling resources picked from wastes.

In Cairo, waste collection was undertaken by two groups of people, the neighbourhood collection administrators (wahis) and the haulers and recycling workers (zabbaleen). The zabbaleen had found markets for practically all waste. They discard only 15 percent of the original waste volume on the dump sites (Habitat, 1989).

2.16.7 Composting

Composting is common in both developed and developing countries. Many people are composting primarily to reduce waste at their homes. The Greater Vancouver Regional District (GVRD) in British Columbia had embarked on a programme of decreasing organic waste through composting. This had come from the Federal Government who told all the provinces that they had to reduce landfill waste by 50% by the year 2000 or else face a heavy tax. In 1993, many municipalities in Britain offered compost bins to residents at a subsidised cost. This programme was received well by the public with the result that close to 45000 Lower Mainland households bought bins and embarked on backyard composting. The GVRD had offered workshops to schools, the general public and conducted group tours, which proved to be very successful. Fairfield in Connecticut opened a $3 million composting centre in 1989 to create topsoil for parks, playgrounds and public landscaping (GVRD Compost Resource Manual, 1993). Likewise, University City began a leaf-

composting programme in 1983 when the city found that leaves represented about 15% of its waste stream (Carless, 1992). In developing countries such as Kenya, Brazil and India, backyard and neighbourhood composting were practised. In Olinda, Brazil, the neighbourhoods had set up small composting units on plots of about $250m^2$ (Lardinois, 1993).

2.16.8 Waste Disposal

As indicated earlier, disposal of solid waste can take the form of dumping, composting, incineration and resource recovery. One would notice that developed and developing countries will employ one or more of these disposal methods to suit their prevailing circumstances and environment. In developed countries, the most common method of disposal is sanitary landfilling, and incineration. In most developed countries, sanitary landfills are practised due to environmental considerations and lack of suitable landfill space e.g. in the United States, the lack of landfill sites, strict disposal legislation and environmental legislation have made municipalities and states to practise sanitary landfilling (Cointreau-Levin, 1994). Resource recovery is also a common method of disposal in the United States. This can be attributed to peoples changing attitudes towards the environment and the increased markets for recycled goods (Carless, 1992). Flintoff (1984) also found that the development of new and improved resource recovery methods was always directed towards developed countries hence encouraging the practise of recovery methods.

In Japan on the other hand, incineration was considered as the most sanitary method to treat wastes. By 1988, Japan had constructed 1915 waste incinerators, in sizes up to 1980 tons per day. These facilities processed 68 percent of post-recycling wastes. This was found to be the most comprehensive recycling effort in the world (Hershkowitz and Eugene, 1988).

According to Cointreau (1982), it was found that open dumping seemed to be the most prevalent form of disposal in developing countries. Unlike developed countries where there are efficient and effective resource recovery systems, in developing countries, there is no money available for such systems to be initiated.

It was found that indiscriminate dumping in developing countries was very common e.g. in Accra, Ghana, dumping was a problem due to the limited capacity of the waste collection service. In fact, a study conducted in 1989 revealed that only 10 percent of the refuse was collected, 81 percent was dumped and 9 percent was burned. Despite the 130 official communal refuse dumps, 100 unauthorised dumping sites were created along water courses, channels and roadside verges (Songsore, 1992).

In a number of developing countries, it was found that uncontrolled dumping was rife due to lack of tenants' responsibility to provide adequate refuse removal services e.g. in Kanpur, India, landlords do not provide adequate refuse removal service for the tenants resulting in uncontrolled dumping of these wastes. In Bangkok, Thailand, uncollected solid waste accumulates around homes and in canals (Cointreau-Levin, 1994).

2.17 SOUTH AFRICA

2.17.1 Introduction

According to the South African Constitution (1994), the people of South Africa have a right to an environment that is not detrimental to human health. However, over the past 30 years, it was found that the rapid growth in population, urbanisation and industrialisation has led to a sharp increase in waste generation rates thereby placing pressure on the environment (Lombard, 1999).

Traditionally, the South African government was responsible for waste management services to communities. Services included temporary storage facilities, waste collection and transportation and the management of waste disposal facilities. The rapid population growth and urbanisation has resulted in a staggering increase in the demand for waste management services. Local authorities are found to be unable to cope with such a demand and the existing resources are breaking down. South Africa's local authorities are also facing the problem of low service payment levels (Macozama, 2000).

Over the years, the need for a cleaner and healthier environment has prompted a number of initiatives and changes in the South African Solid Waste Management scene. The researcher will review the current situation of Solid Waste Management in South Africa and the changes that researchers have recommended.

2.17.2 Legislation

By reviewing the legislation governing solid wastes in South Africa, one will be able to notice the flaws in these policies and the desperate need for amendments. The national legislation regulates certain aspects of waste management which includes: wastes on roads, wastes in protected areas, mine wastes, health related wastes, littering, waste disposal sites, waste management regulation, hazardous wastes, pesticides, radioactive wastes and tax deduction for recycling plants (Kroger, 1994).

Solid Waste at the provincial level has been controlled mainly through pollution on roads. This includes the road ordinances that prohibit the leaving of wastes on the road whilst the Road Traffic Act prohibit people on the road from wilfully throwing their wastes on or alongside the roads. There are also various nature conservation ordinances that regulate litter and wastes. The Financial Relations Act 65 of 1976 allows the provincial council to take control of environmental pollution especially littering. The Orange Free State (previously) was the first province to exercise this authority through the Dumping of Rubbish Ordinance 8 of 1976. This ordinance ensures that people could only dump their wastes in a container or a place designed for such disposal. The Natal Prevention of Environmental Pollution Ordinance of 1981 also stated that it was an offence for any individual to illegally pollute or litter the land or inland waters (Kroger, 1994).

The local authorities on the other hand had to ensure that the collection and disposal of solid wastes under Section 20 of the Health Act 63 of 1977 was sanitary. The control of solid wastes by local authorities is exercised mainly through the administration of the provincial ordinances over the littering of public places, private premises, streams, dams etc. (Palmer Development Group, 1995).

There are many researchers that criticise the above regulations for numerous reasons and call for amendments so that solid wastes can be sustainably managed. Myburgh (1991: 12) stated that the law is 'in a mess' as there are too many laws and often these laws do not address the issues, which they are supposed to regulate. He also states that there are no uniform sets of by-laws for waste management at the level of local government. Lombard (1990) also concurs with Myburgh (1991). He has found that penalties for perpetrators are not stringent enough hence support from the law officials are poor.

The CSIR (1991), made a number of recommendations which include:

- Legislation should be holistic in approach.
- A single comprehensive waste control act should be passed. This act should serve as a guide to supplement and co-ordinate all relevant legislation; it should include different sections for dealing with liquid, solid and hazardous wastes and finally it should contain a national policy for the reduction of wastes.

Lombard (1990), also made a number of recommendations which include:

- Legislation should deal with all the facets of waste such as generation, avoidance, re-use, recycle, collection and disposal.
- Regional and local authorities should have power to regulate certain aspects of wastes within their area. This is important as Kropman (1984) found in South Africa that the management of solid waste differs in many areas. Therefore, if local authorities are given these powers, they will be able to use approaches that suit their area.
- Waste terminology should be standardised.
- Effective incentives and sanctions should be incorporated so that waste streams are reduced and re-use and recycling initiatives are encouraged.
- Finally, environmental education dealing with management of waste from generation to disposal should be provided to the public.

As illustrated above, the need for better solid waste management initiatives are remarkably needed. Over the years, it was found that solid waste management, environmental management and sustainable development gained significant recognition at the government

policy level. This was followed by legislation that promotes and enforces responsible waste management practice. One of the steps taken to uphold this practice was the development of the National Waste Management Strategy for South Africa (NWMS). The NWMS in South Africa was initiated in 1997 by the Department of Water Affairs and Forestry (DWAF) and the Department of Environmental Affairs and Tourism (DEAT). It was funded by the Danish Co-operation for Environment and Development. The overall objective of the strategy was to reduce waste generation and environmental impacts and to ensure that the health of people and the quality of environmental resources were not affected by the uncontrolled and uncoordinated waste management. Table 2.9, illustrates the existing waste management approaches practised currently in South Africa compared to the proposed future situations after the implementation of the NWMS (Joubert, 1999).

Table 2.8: Present and Future key elements of Waste Management in South Africa

Existing Waste Management Approach	**Strategic objectives for Integrated Waste Management**
Limited focus on control mechanisms	Focus on environmental protection and sustainability
Inadequate waste collection services	Adequate waste collection services for all
Fragmented approach with simple media focus	Consolidated multimedia approach
Insufficient information	Integrated waste information system
Conflict of interest	Transparency and conflict resolution
Inadequate environmental planning	Holistic integrated environmental planning and capabilities
Inadequate research and development programmes	Focussed research and development programmes
Fragmented regulatory approach	Integrated regulatory approach
Regulations inadequately enforced	Enforcement facilitated
Full waste management costs not realised	Polluter pays principle and total cost accounting

Source: Joubert (1999: 5)

Hence it is clear that the National Waste Management Strategy is trying to accomplish the following:

- Prevention and minimisation of waste.
- Direct and visible reduction in the impact on the health and environment.
- Improvement in the quality of life of all South Africans with emphasis on the disadvantaged communities.
- Creation of more job opportunities.
- Ensure sustainable use and conservation of natural resources (Joubert, 1999).

2.17.3 Waste Characteristics

2.17.3.1 Waste Generation

According to the CSIR (1991), the total solid waste stream adds up to 340 to 480 million tons annually. Table 2.10 illustrates the major sources of solid waste in South Africa. In terms of domestic solid waste, it was found that the total amount of waste generated in urban areas of South Africa was 810 000 tons per week (115 000 tons per day) (CSIR, 1991). It is important to take note that South Africa is a very unique place in that it has situations that represent both developed and developing countries. Therefore, it is vital that one does not generalise solid waste management practices in South Africa.

Table 2.9: Sources of Waste Generation in South Africa

Source of Waste	Annual Production (millions of tons)
Mining	238.5
Fly Ash	22.2
Municipal Waste	15.0
Chemical Waste	12.2
Metallurgical Waste	5.4
Agriculture	20.0
Sewage Sludge	12.0
Unclassified	4.8

Source: CSIR (1991: 5)

Mayet (1994) found that there was a strong relationship between the amount of waste generated by a community and its demographics particularly the income. He found the following in connection with the above relationship:

- The highest per capita generation emerged from high income level zones with a primarily white residential population
- The lowest per capita generation emerged from low income level zones with a predominant African residential population

Mayet (1994) also stated those factors such as infrastructural development in residential areas, lifestyles, attitudes, migratory patterns, levels of education and the willingness to recycle impacts on the generation of solid wastes. Lombard (1994) concurs with some Mayet's (1994) conclusions. For example, it is noticeable that daily generation rates for high income, low density housing range from 0.8kg per capita per day to 0.2kg per capita per day for low income, high density housing.

From table 2.10, it can be concluded that waste density is closely linked to income level i.e. the lower the income, the denser the waste e.g. 330kg/cubic metres for low income, high density areas, to 144kg/cubic metres for high income, low density areas.

Table 2.10: Waste Generation Rates in South Africa

Class	Characteristics	Density (kg)	Generation Rate (kg/capita/day)
A	High Income, low density housing	144	0.8
B	Middle income, low density housing	170	0.5
C	Middle income, Medium density Housing	200	0.3
D	Low income, high density housing	330	0.2

Source: Lombard (1994: 16)

2.17.3.2 Waste Composition

As indicated earlier South Africa has conditions prevalent in developed and developing countries. This is clearly reflected in a comparison made by Gibbons et al (1992).

According to Gibbons et al., (1992), the waste content from higher income areas reflects that of developed countries and that from lower income areas is similar to developing countries.

Table 2.11: Waste Content Comparison: Developed and Developing communities in South Africa

Waste Type	* Developed	** Developing
Paper	37%	3.4%
Plastic	17%	2.4%
Glass	4%	2%
Metal	6%	1.6%
Ash/Soil	0%	82%
Organic /Food Waste	32%	4.6%
Other	6%	2.4%

Source: Gibbons *et al.*, (1992: 30)

* Figures are from Spruntville, which was considered typical of 'developed areas'

** Average from data gathered in five developing communities in the East Rand

2.17.4 Waste Storage

There are three basic standard containers used for on-site storage of domestic waste in South Africa which includes:

- Plastic Bag – 85 litre capacity
- Steel or Plastic bin – 85 litre capacity
- Plastic wheeled bin – 240 litre capacity

It was also found that residents of informal settlements make use of containers such as boxes to store waste. Hence the use of containers varies according to the residential area (Seholoholo, 1998).

In the white local authority areas, all three containers are in use, with the wheeled 240 litre bin being introduced increasingly to replace the other two traditional containers. Special

compactor vehicles are used to collect wastes from these containers. However it has been found that the use of such bins, has resulted in the increase of waste collected e.g. in Bellville, the introduction of the wheeled bins, has increased the waste loads by 25% (Fourie, 1997). In the black local authority areas, the 85 litre bins or plastic bags tend to be used. However, the prevalence of ash restricts the use of such containers. It has been found that low income areas in Gauteng have higher ash content in their waste because of the coal used as energy. Hence, it is vital that these low income areas are provided with suitable containers. However, in many black communities, there are a number of problems that arise:

- Ash is dumped if metal cans are not provided.
- There is a failure to deliver plastic bags as found in the Alexandra Township.
- Residents move continuously from one place to another with the bins issued to them, creating problems, as new bins have to be constantly issued e.g. this occurs in Alexandra and Khayelitsha (Palmer Development Group, 1995).

2.17.5 Waste Collection and Transportation

The type of vehicles used for collection and transportation of domestic waste in South Africa varies. The compactor vehicle is commonly used for collection in white local authorities. In the black local authority areas, collection vehicles vary between tractor and trailers, open topped tipper trucks, standard compactors and front-end loaders. The Majority of the black areas are characterised by the use of front-end loaders for the removal of piles of waste from pavements and streets. Roll-on-roll-off vehicles are used to transport waste from transfer stations and skip luggers transport waste from communal sites (Seholoholo, 1998). Rubelli (2001) stated that areas such as Kwa-Mashu and Mntuzuma have private contractors that use these skip luggers to collect waste. He stated that residents have complained that the skips were been vandalised. People dump all their wastes (garden refuse, rubble etc) in these skip luggers. The skippers are not timeously emptied and are attracting flies, mosquitoes, rats etc and cause the place to become unaesthetic.

2.17.6 Recycling

Lombard (1994) stated that there is a low technology recycling industry in South Africa. However, there are no incentives or subsidies to encourage the movement of recovered

materials from the sources to the converters. In 1993, the then Minister of Environmental Affairs, Japie van Wyk stated that there had been a 73% increase in the volume of material recycled. Table 2.13 below illustrates the rate at which different materials were recycled.

Table 2.12: Recycling in South Africa

PRODUCT	TONNAGE RECYCLED (per annum)
Paper and Board	570 000
Plastics	100 000
Tinplate	75 000
Aluminium	37 000
Glass	89 000

Source: Lombard (1994: 18)

It is important to take note that the results were obtained in 1992. Paper and Board (570 000) was the highest material recycled. This was followed by plastic (100 000) and glass (89 000). Aluminium was the least recycled. Van Wyk (1993) stated that the government was not planning to introduce legislation to promote recycling. He added that international and national experience had shown that the legislation in South Africa was not effective and that the incentives for recycling were inefficient.

Piet Neethling (executive president of the Packaging Association of South Africa) in 1993 stated that despite environmental, employment and economic advantages that can be achieved from recycling, local and overseas experience showed that factors such as cost constraints in the production of recycled material and limited uses for recycled products mitigated against obtaining optimum recycling rates (Race Relations, 1994).

The recycling markets are dominated by the following companies:

- Sappi, Mondi, and Nampak purchase paper and cardboard materials. It was reported in March 1993 that between 12% and 14% of South African newspapers used recycled paper. About 25% of paper used in newspapers was made up of recycled matter, which

came from the Mondi recycling plant in Durban and 75% comprised timber pulp. The Mondi plant has the capacity to process 85000 tons of used paper a year. It was estimated that this saved chopping down as much as 4 million pine trees each year. During 1993, Mondi introduced a free national newspaper collection service in order to capitalise on domestic waste paper.

- Consol purchase glass. The glass is collected and has to be sent for processing in Germinston, Gauteng.
- Collect-a-Can purchase aluminium and tin cans. Collect-a-Can was formed by a joint venture between Iscor, Metal Box of South Africa and Crown Cork. The company was launched in 1993 to recover and recycle tin cans. The aim of the company was to increase can recovery from 20% of all beverage output in 1993 to 50% in 1996 (Palmer Development Group, 1995: 67).

Over the years, environmental awareness has led to a growing interest in recycling due to the realisation that recycling is a potential solution to the waste crisis facing many South African communities. Keep South Africa Beautiful and the Keep Durban Beautiful had started large scale litter reduction and environmental activities and encouraged the recycling of waste (Myburgh, 1991). According to Lombard (1994), the market for waste paper is still fairly unstable with large surpluses for lower grade paper. Lombard (1994), found that 570000 tons of domestic waste paper was used to produce 29 different grades of paper and board during 1992. There are three known regional recycling forums operating in South Africa, namely the Western Cape and Natal Recycling forums and the East Rand Waste Processing Forum. Lombard (1996) found that the paper recycling industries control about 87% of the market.

Food and drink cans can either be made of steel or pure aluminium or a mixture of both. It has been found that aluminium cans yield more than steel cans when recycled. Although, South Africa only started recovering steel cans in 1992, in 1995, Collect-a Can revealed that more than half the cans used in South Africa were recovered and recycled (Natal Witness, June 1996). The Managing Director of Collect-a-Can stated that the recovery rate of 51%

makes South Africa the third most successful region after Japan (69%) and Germany (62%) (Natal Witness, June 1996). There are many advantages of recycling cans, which include:

- Recycling cans is valuable for conserving energy as well as materials.
- Collection, crushing, bailing and returning of cans to processors creates employment.
- The amount of waste going to the landfill is reduced.
- Steel recycling preserves non-renewable natural resources.
- Air emissions are reduced.
- Water use and water pollution is reduced (Durban Solid Waste Department, 2001).

According to Zwane (2001), Collect-a-Can is now funded by Iscor and Nampak. He added that there is a market for the recycling cans. The cost involved is as follows: 37 cents for delivered and 15 cents for collected ones.

According to Myburgh (1991), there are so many types of plastic and most commercial plastics are a combination of many types making it difficult to recycle. This has led to many companies collecting only certain plastics. Packaging contributes substantially to the waste stream. Plastic has a vital role in protecting the products. However, many products come with many layers of unnecessary packaging. Plastic is light, durable and versatile and resistant to moisture, chemicals and decay. These same qualities make them difficult to dispose i.e. most plastics are resistant to decay thus they could remain intact for centuries. The weight is also a disadvantage i.e. it takes 20000 returned PET bottles to make one tonne of new plastic and when space for collecting the bottles is restricted, this becomes problematic. There are about six resins that are commonly used in disposable packaging. The United States has devised identification systems so that plastics could be easily sorted and recycled. Plastics can be recycled as a mixture of different kinds of plastic or as a single item. Mixed plastics can be used to make park benches, refuse bins, fence posts and other items. Today the most commonly used recycled plastic is Polyethylene Terephthalate (PET). PET from recycled bottles can be reprocessed to produce: fibre fill for pillows, sleeping bags, fence posts, paint brushes, fibre in filters, carpets and clothing. The High-density polyethylene (HDPE) is recycled and used in the manufacture of non-food bottles, flower pots, pails, crates, toys and sheet plastic. Plastics with shorter lifespan like supermarket plastic bags can be recycled into plastics with a longer useful life e.g. irrigation piping.

Separation by type enables manufactures to produce high quality recycled products (Parkin, 1995).

The advantages of recycling plastics include:

- The volume of plastic waste going to the landfill is reduced.
- It helps to conserve resources.
- It reduces the amount of litter (Durban Solid Waste Department, 2001).

According to Myburgh (1991), bottles are the most commonly re-used containers in South Africa with approximately 66% of the 3.7 million glass bottles manufactured each day being either reused or recycled. Consol is one of the glass recycling organisations and Ecobot operates a bottle recovery system for particular bottles (mainly wine bottles) (Nxumalo, 1999). Glass is unique in that it can be recycled forever without any deterioration in quality. Glass at present accounts for about two to four percent of South Africa's municipal solid waste. Forty-one percent of glass sold annually is still being dumped or landfilled and 36 percent is produced and sold as returnable packaging. The majority of glass is collected via glass banks at drop-off points and 23% of the total glass bottle production is recycled. The collected glass is sent for processing in Gauteng. According to Poultney (2001), Consol pays R234 per ton for flint (clear) and amber (brown) and R200 per ton for green and R105 per ton for mixed colours. In addition, Consol pays 75% of the transport costs from Durban to Germiston and the collector pays 25%. Poultney (2001) stated that transport costs can make glass recycling unprofitable and only high volumes can make glass recycling profitable in Durban. He added that collecting glass requires careful handling, must be colour separated and totally free of any foreign matter such as stones, ceramics, metals and plastic.

There has been a number of successful ventures in South Africa which include:

- In Alexandra, the South African National Can Recycling Movement employs 28 people on a permanent basis and 20 on a casual basis. The success of this venture was attributed to the external support (Collect-a-Can donated an 8 ton truck to assist in the collection and delivery of recyclables) and low wage rates paid to workers.

- Schools have become involved in the recycling activity and are co-ordinated by the regional affiliates of Keep South Africa Beautiful. These ventures are successful because wage costs are minimal and are conducted for educational and fund raising purposes (Palmer Development Group, 1995).

Problems encountered by a few ventures in South Africa, which include:

- A recycling plant built at the Kya Sands Disposal Site as a joint venture between the Randburg Municipality and the private sector with an investment of over R9 million was forced to close down. The plant was not financially viable essentially due to the lack of a sustainable market (Turner, 1994).
- A recycling plant of the same plant scale as the Randburg was built at the Robinson Deep Disposal Site. It closed down for similar reasons (Turner, 1994).
- In Soweto, a community based recycling company known as the Green Team had been forced to change the focus of activities to conventional waste collection, as they could not find a sustainable market for its recyclables (Hans, 1993).
- A recycling venture in Durban known as Greensavers was stopped as Durban Solid Waste found that the waste stream was only reduced by between 1% and 2% and Mondi concluded that the venture economically unviable (Parkin, 1995).
- At the Sobantu Township, the recycling programmes were failing. The Environmental Desk with the help of Keep Pietermaritzburg Beautiful (KPB) had uninitiated the programme. However, KPB did not follow up the programme. The residents were not aware about the recycling programmes in their area (Gangoo et al., 2000).

2.17.7 Composting

For more than two centuries, compost and manure were the only sources of plant nutrients in South Africa. In the early 1940s, the Department of Agriculture launched an intensive campaign to promote the composting of all sorts of wastes (Schliemann, 1980). Composting in South Africa was reduced when the fertiliser industry was established and the fertiliser could be provided cheaper. The idea of composting was then revived when the Soil Conservation Board considered urban and farm compost a potential advantage against soil erosion. (Schliemann, 1980). There are a few local authorities that have a few composting

operations as a result of the diminishing landfill space, which include Cape Town, Paarl, Bellville and Parow. However, this activity is not economically viable but is rather undertaken to prolong the life of landfills (Parkins, 1995).

The Department of Agronomy at the University of Natal, Pietermartizburg is working with the schools in Greater Edendale to initiate composting projects. These projects have proved to be successful (Nxumalo, 1999). Composting materials include: garden waste (leaves, wood chips and branches), household waste (vegetable and food scraps), animal waste and paper and cardboard in small pieces (Durban Solid Waste Department, 2001).

2.17.8 Waste Disposal Options

The main form of waste disposal in South Africa is through sanitary landfilling. Although there is much legislation relating to waste disposal, there is little legislation in South Africa that relates directly to the environmentally acceptable development, operation and closure of landfills. It is estimated that only one in ten disposal sites in South Africa are properly controlled and audited (Race Relations, 1994). In Phoenix the waste collected goes directly to Bisasar Road Landfill in Durban. The Bisasar Road landfill site is situated in Springfield. However, according to Rubelli (2001) with the formation of the Unicity and the closing down of the Verulam and La Mercy Disposal sites, there is a need for a transfer station. Incineration is also used but for mostly medical and other wastes.

Scavengers at Landfill Sites

Scavengers are viewed with varying degrees of acceptance by the authorities:

- Bisasar Road Landfill in Durban: scavengers are allowed onto the site after 4pm to collect only recyclable materials. The collection of food is prohibited due to the Health Regulations. A few of the scavengers still go out to collect food (Rubelli, 2001).
- New England Road Landfill, Pietermaritzburg: scavengers for many years had access to the site. However, the recent construction of the security fence around the site and the installation of a 24 hour security system have effectively ended scavenging on the site (Gangoo, et. al, 2000).

- Frankdale Disposal site, Cape Town – The squatter community uses this site as their primary source of income. They did have problems as the Western Cape tried to move them off the site to a serviced settlement located about 5km away from the site.

  It has been found that the rate of unemployment in the country is high and scavenging seems to be a real option for promoting recycling and creating employment. Authorities should recognise the advantages of scavenging and look at ways to make it safe (Parkins, 1995).

2.18 CONCLUSION

From the literature that has been reviewed, it appears that the Management of Solid Waste is becoming a serious problem. With the threat of inefficient and inadequate Solid Waste Management Practices posed to the environment (soil, water and air) and humans, there is certainly a need for change. The government, local authorities, businesses, non-governmental organisations and communities need to come together and discuss relevant issues pertaining to Solid Waste before it becomes too late. Today, South Africa has adequate space for siting a new landfill site but is tomorrow guaranteed. Why wait when we are forced to look at alternative methods. It should start now.

CHAPTER THREE
STUDY AREA AND METHODOLOGY

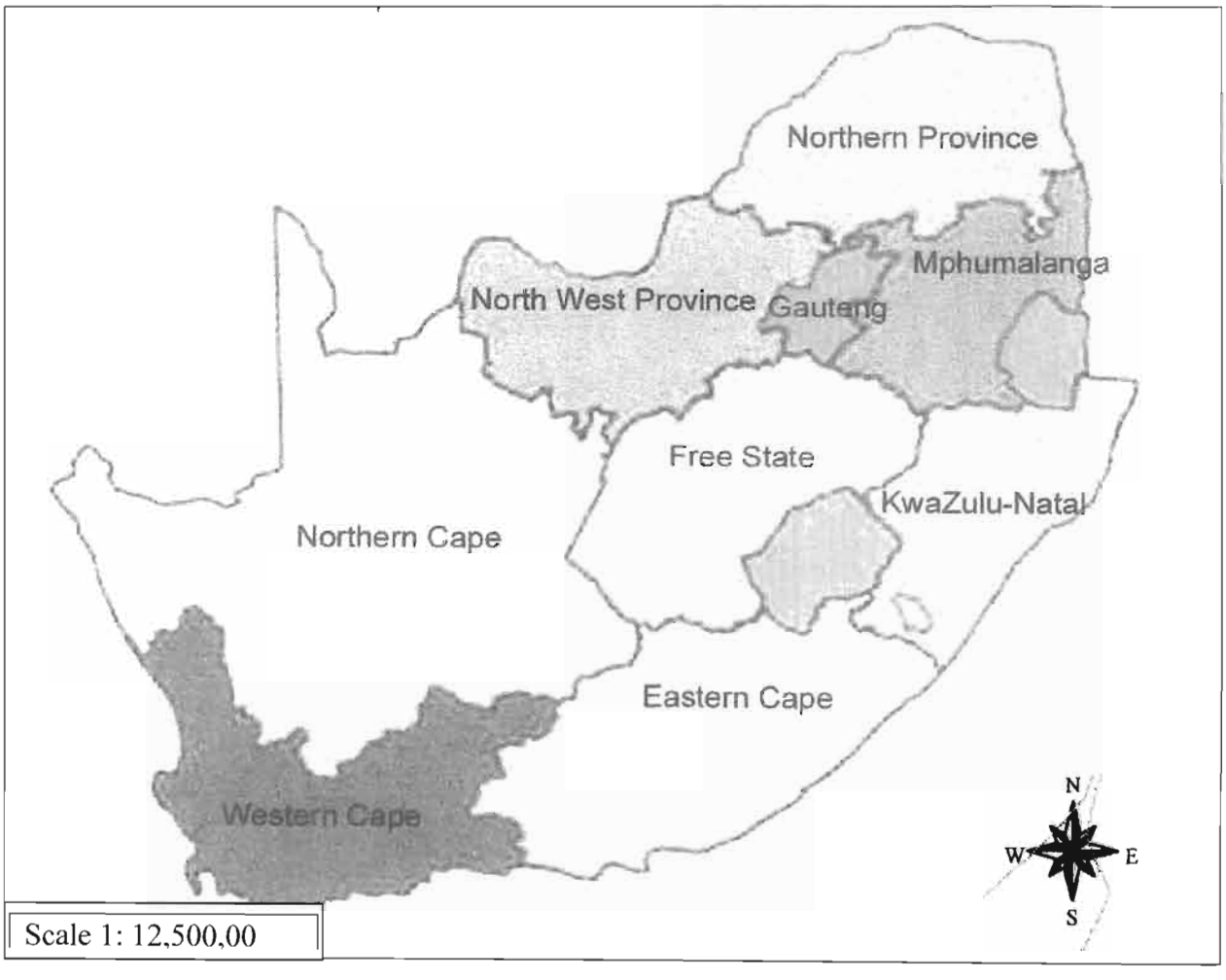
3.1 INTRODUCTION

The researcher's methodology and study area should be an integral part of any investigation. A detailed description of the study area is important to the reader and future researchers. It informs the reader of the location where the study was carried out, what type of study has taken place and the choice of that particular area for the investigation. Maps serve as important tools to geographically locate such an area. This allows the reader and future researchers to better understand the geographic location of the study area in relation to other areas. According to Leedy (1993), research methodology is a continuing process. It is a continuum that is ever changing and ever developing. A detailed description of the research methodology informs the reader exactly how the researcher intends to proceed and how the researcher handled the data. The methodology part of this chapter enabled the researcher to indicate why a particular research technique was chosen. It also helped to explain what the nature of data was and what method was used to collect them. Finally, it is vital that the reader understands `how' the study was carried out, `why' the study was carried out and what reasoning formed the basis upon which the `how' and `why' was justified. Hence, the methodology, whatever that methodology might be, should be clearly expressed and substantiated to validate the researcher's study.

3.2 STUDY AREA

KwaZulu-Natal is a one of the nine provinces in South Africa (figure 3.1). It has a total population of about 8 417 021 and is the province with the largest population. The principal languages are IsiZulu (80%), English (16%) and Afrikaans (2%). KwaZulu–Natal is located along the east coast of South Africa and is approximately 92100km^2 in area (figure 3.2) (Statistics South Africa, 1996). Kwa-Zulu Natal enjoys a subtropical climate with the coastal regions experiencing hot and humid weather during the summer months and mild weather during the winter. The rainy season falls during the summer months. Snowfall occurs over the Drakensburg during winter, which at times brings cold winds (Kwa-Zulu Natal Tourism Board, 2000).

Figure 3.1: Nine Provinces of South Africa

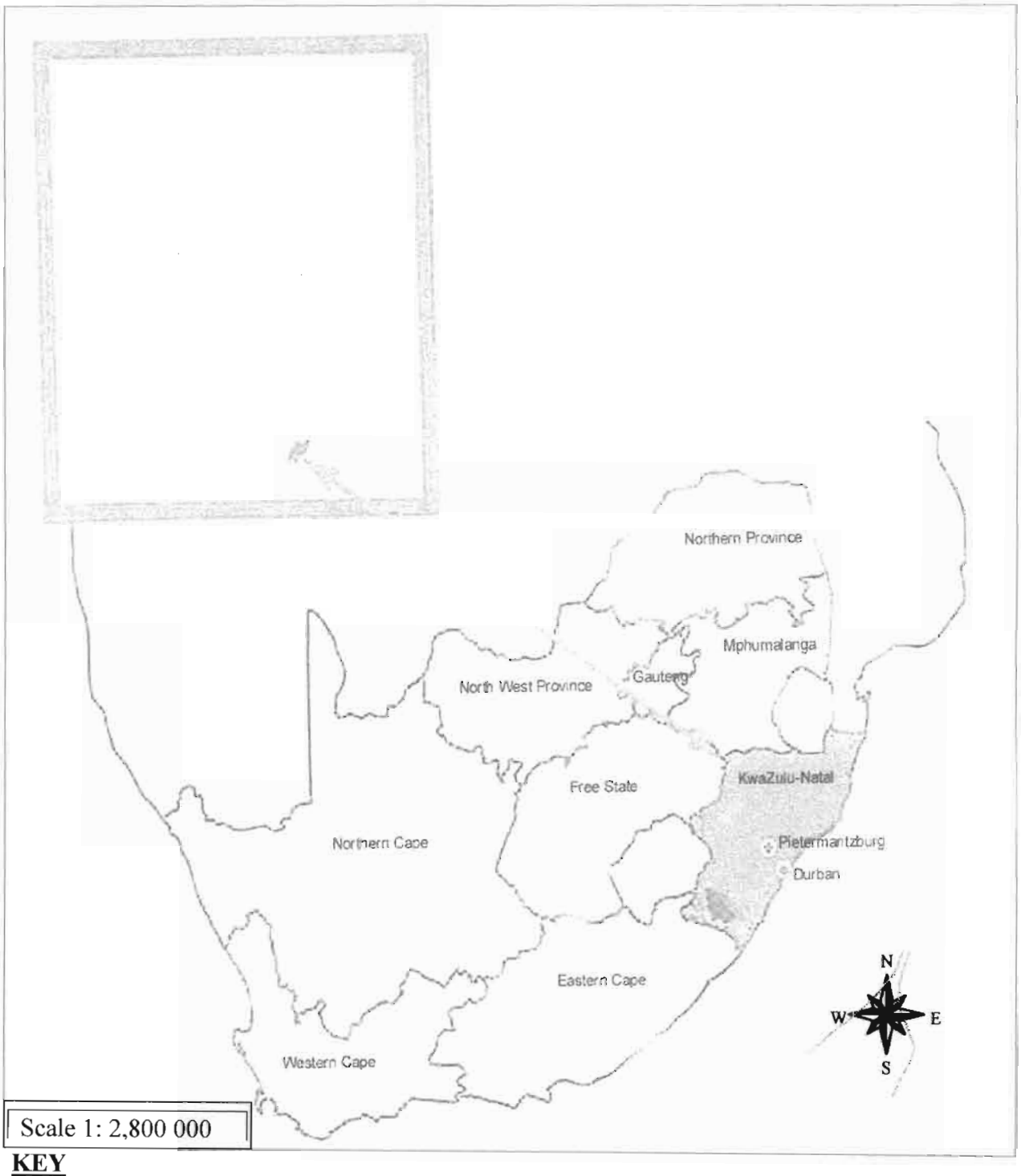


KEY

Northern Province
North West Province
Gauteng
Mphumalanga
KwaZulu-Natal
Free State
Northern Cape
Eastern Cape
Western Cape

Source: Statistics South Africa (1996: 16)

Figure 3.2: Location of Kwa-Zulu Natal



KEY

KwaZulu-Natal ■

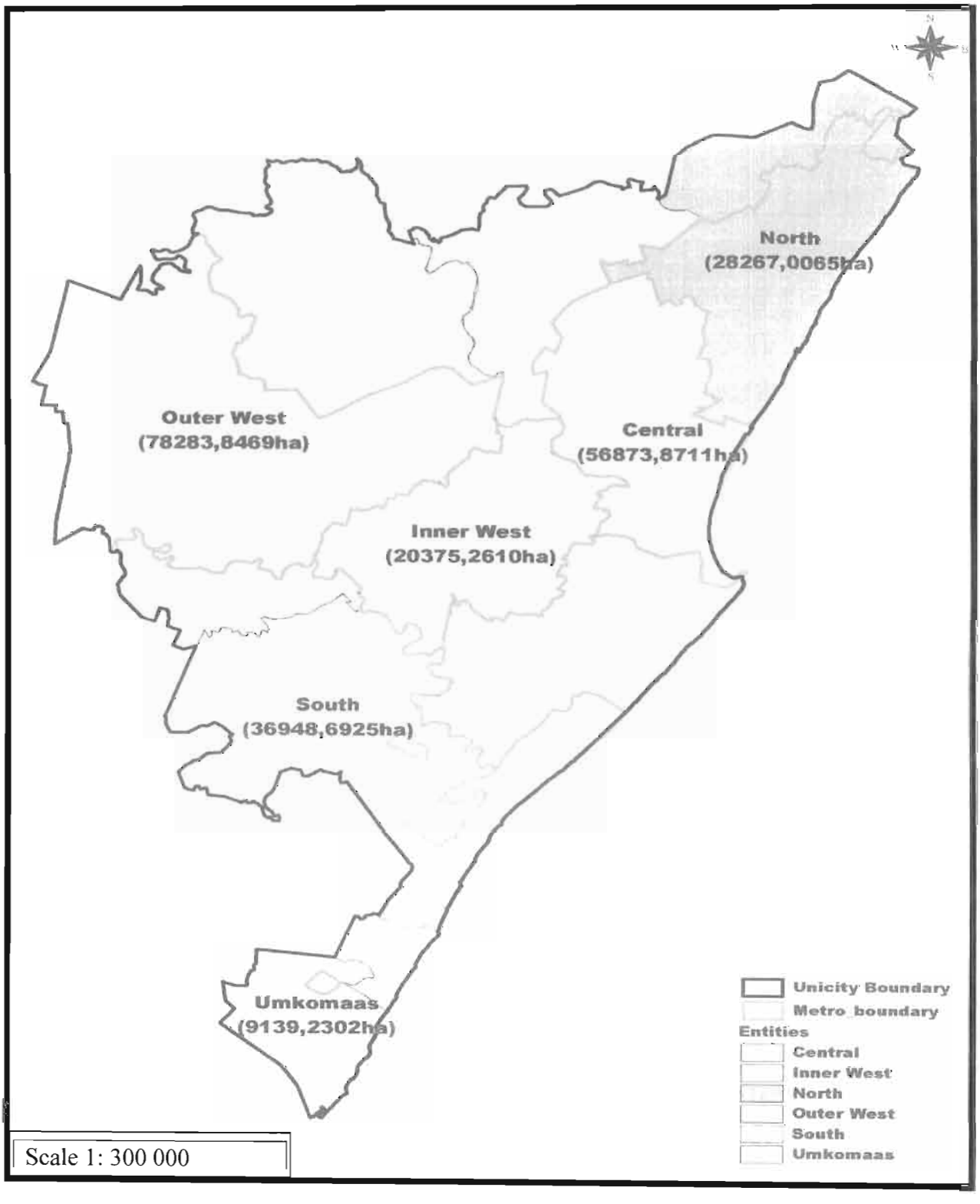
Source: Statistics South Africa (1996: 8)

Durban is the key city in KwaZulu-Natal. Recently, the merging of the previous councils has resulted in a new Durban Metropolitan Unicity. Now, the Durban Metropolitan Unicity consists of 6 entities namely the Outer West, North, Central, Inner West, South and Umkomaas (figure 3.3). The map also depicts the new boundaries of the Unicity (Ramphal, 2001). It is a bustling, subtropical city on the shores of the Warm Indian Ocean and is the second largest city in the country. The Durban / Pinetown area is the largest and fastest growing commercial centre in the province. The richness of the vegetation is evidence of the year-round warmth. The city and its surrounds are resplendent in colours of indigenous and exotic flowering, trees, shrubs and gardens. As a meeting place of East and West, Durban offers a wealth of exciting cultural differences – from African to European to Asian – in a colourful conglomeration. Durban itself is surrounded by township communities with their own rich and colourful cultural activities, which have a strong impact on the city's culture. One such township is the Phoenix Township (KwaZulu – Natal Tourism Board, 2000).

Phoenix is located approximately 20km north of the Durban CBD situated in the Central Entity of Durban Metropolitan Unicity (figure 3.4). Phoenix has a total population of approximately 159 592 (Statistics South Africa, 1996).

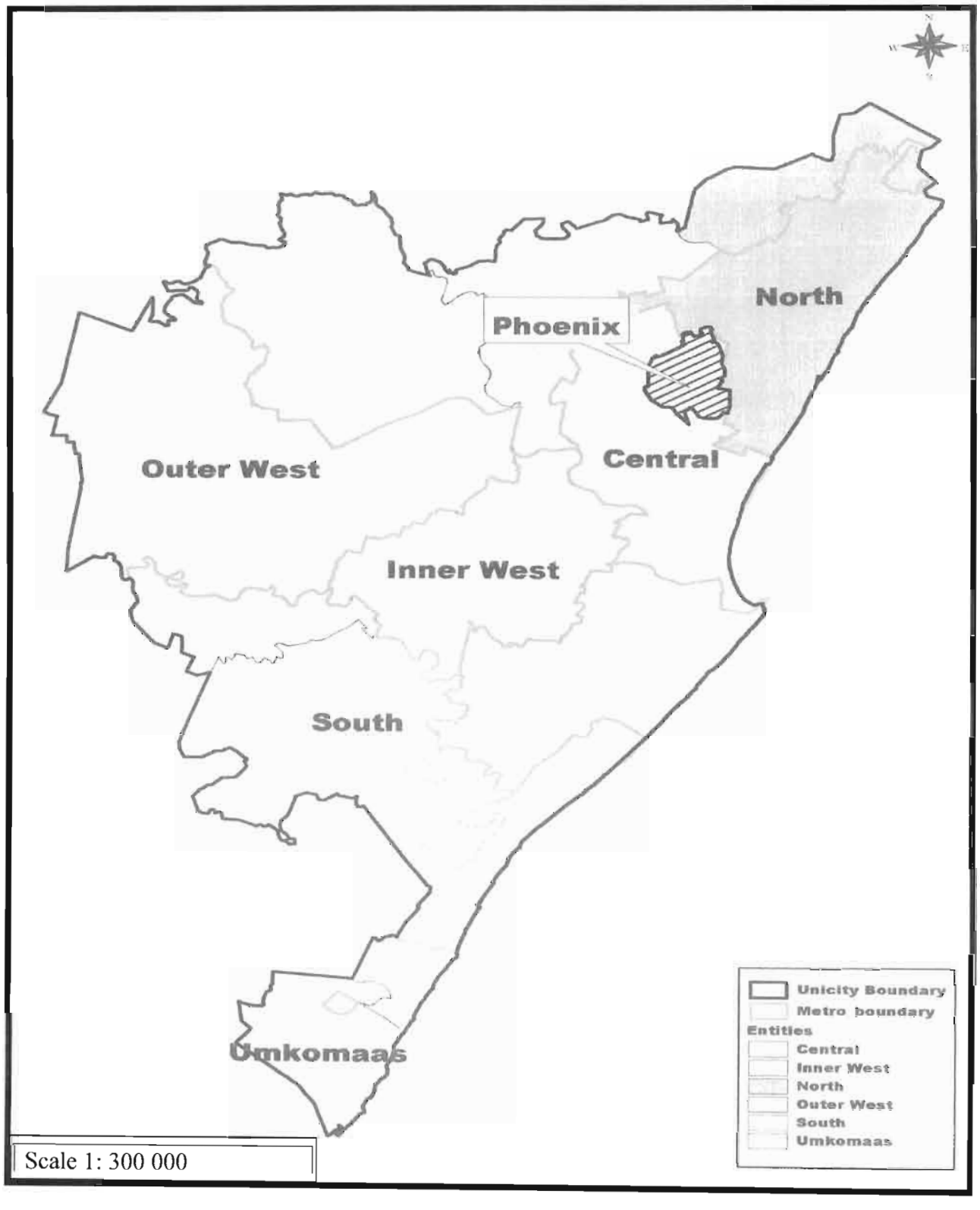
The Phoenix settlement has an illustrious historical background because Mahatma Gandhi founded it. Gandhi bought one hundred acres of land for about a thousand pounds where he believed that people could be trained to become Satyagraphis. Initially, the Phoenix settlement was situated on the north western edge of Inanda about 25km from central Durban. It comprised 100 acres of land, which Gandhi had purchased with several main buildings clustered together on a small hill known as the Apex area. Throughout its long history, the settlement played an important role from both spiritual and political aspects in promoting justice, peace and equality. In 1985, during the so-called 'Inanda Riots', the settlement was so badly damaged that it brought to an end the traditional Gandhi family life. After the riots, it was taken over by about 8000 informal settlers (KwaZulu Natal Tourism Board, 2000).

Figure 3.3: Entities of Durban Metropolitian Unicity



Source: Ramphal (Durban Metro Housing Department, 2001)

Figure 3.4: Location of Phoenix



Source: Ramphal (Housing Metro Housing Department 2001)

The former Durban Corporation chose the area around the vicinity of the Phoenix settlement to launch their Indian Housing Project. The government launched this cheap housing project to house many destitute people that were victims of forced removals and slum areas. This was to become a township for Indians only. Hence, Phoenix was one of the Indian Townships that was the product of the apartheid regime. Site development at Phoenix commenced in 1972 and the first residents moved in March 1976. The township has been developed in units and eighteen of these were planned for completion by 1984. Ultimately, 23 such units were planned with an average of 10000 people per unit. Phoenix was expected to house some 230000 people (Smout and Rajah, 1983).

Today Phoenix has a total of 25 residential units and one industrial unit with a total of 33547 dwellings (Figure 3.5). It comprises mainly of an Indian Population (Haygarth and Naidoo, 1995). Although this is taken in 1995, it does give an indication of the population group that mainly occupies the Phoenix area. It was found that seventy eight percent of respondents earn below R1500 whilst only sixteen percent earned above R1500. The unemployment rate is also extremely high (refer to Table 3.1). Moodley (2001) also stated there was high unemployment rate in the Phoenix area.

3.2.1 CHOICE OF STUDY AREA

The researcher has lived in Phoenix for several years and has found that there are several problems relating to Solid Waste. It is hoped that by carrying out the study, the results obtained can be utilised by local authorities and communities in formulating new plans and changes within the Phoenix community. Five units were chosen out of the 25 units in Phoenix using the sample strategy discussed later on. Moodley (2001) has expressed his concern regarding the management of solid waste in the Phoenix area and has agreed that much can be done to improve the current problems. Singh (2001) has also stressed that Phoenix has a problem with the management of solid waste especially with regards to illegal disposal of wastes in vacant areas. For the past two years, the Parks and Gardens Department and the City Health Department have listed a number of communities within the Phoenix area as priority cases in an attempt to combat or curb the problem of illegal waste disposal.

Figure 3.5: Compositional Units of Phoenix

Source: Ramphal (Durban Metro Housing Department, 2001)

Table 3.1: Income of the Phoenix Population

Income/ Per Month	**Total**
None	86157
R1-R200	1458
R201-R500	8881
R501-R1000	10441
R1001-R1500	17156
R1501-R2500	13880
R2501-R3500	6004
R3501-R4500	2583
R4501-R6000	2101
R6001-R8000	609
R8001-R11000	281
R11001-R16000	111
R16001-R30000	81
R30000 – or More	27
Unspecified	9822

Source: Statistics South Africa (1996: 14)

3.3 METHODOLOGY

According to Leedy (1993), in any research, it is found that the nature of the data dictates the research method that is employed in the processing of that data. For this reason, there are several so-called research methods, some of which include the survey method, historical method, case-study method, statistical analytical method and experimental and quasi-experimental method.

3.3.1 Survey method

It is a method of collecting information about a human population in which direct contact is made with the units of the study (individuals, organisations, communities) through such systematic means as questionnaires and interviews (Levy and Lemeshaw, 1991). Analysis

would include techniques such as tabulations, correlations, regression analysis, factor analysis and the use of statistical graphics (bar charts, plots, and pie charts). If the proper techniques are implemented, the researcher has the potential to generalise to large populations and the measurement reliability is high (Mouton, 2001). For this particular investigation on solid waste management practices, the researcher chose the survey method.

3.3.2 Description of Survey Method

The survey method is employed to process the data that comes to the researcher through observation. The following are characteristic of the survey method:

- This method deals with a situation that demands the technique of observation as the principal means of collecting data.
- The population for the study must be carefully chosen, clearly defined and specifically delimited in order to set precise parameters for ensuring discreteness.
- The data in the survey method are susceptible to distortions through the introduction of bias into the research design. Particular attention should be given to safeguarding the data from the influence of bias.
- The survey method relies upon observation for the acquisition of data. The data must then be organised and presented systematically so that valid and accurate conclusions can be drawn from them (Leedy, 1993).

3.3.2.1 Advantages of the Survey Method

- It allows for the classification of information, which is attained at the expense of intricacy and complexity in the data.
- It offers great possibilities of replication.
- The method is less expensive compared to a census.
- The survey method permits greater speed in collecting and analysing data.
- There is a greater flexibility in the topics covered by the survey (Levy and Lemeshaw, 1991).

3.4 DATA SOURCE

3.4.1 QUESTIONNAIRE

According to Leedy (1993), a commonplace instrument for observing data beyond the physical reach of the observer, is the questionnaire. In fact, Flowerdew and Martin (1997) stated that questionnaires are frequently used as tools for collecting data in Human Geography and related areas of research. Essentially, there are 5 categories of questions, each with a distinctive function.

According to Krueger (1998), these question categories are opening, introductory, transition, key and ending questions.

Opening Question should contain some factual information that might seem easy and fast to obtain. The intent of the opening question is to establish a sense of community e.g. the period of residence.

Introductory Questions introduce the general topic of discussion and or provides participants with an opportunity to reflect on experiences and their connection with the overall topic. The introductory questions could ask for an explanation or an overview of how people have experienced a product or service e.g. evaluate the solid waste service received – good, poor, satisfactory etc.

Transition Questions move the attention towards the key questions that drive the study. It serves as the logical link between the introductory question and the key questions. Transition questions ask the participants to go into more depth than introductory questions about their experience

Key Questions drive the study. Typically, there are two to five questions in this category. It is crucial for the moderator to know which questions are key questions. The moderator needs to allow sufficient time for a full discussion of these questions.

Ending Questions bring closure to the discussion and enable participants to reflect on previous comments.

3.4.1.1 Advantages of the Questionnaire

- Increased respondent confidence: The questioning route tends to enhance respondent's confidence since the questions address the topics precisely as intended.

- Quality Analysis: The questioning route produces more efficient analysis because it minimises subtle differences in questions that could alter the intent.
- Enhanced Consistency: The questioning route is preferred when different moderators are working on the same project (Mouton, 2001).

3.4.2 INTERVIEW

The structured interview is closely allied to the questionnaire. The questions of an interview are carefully planned and accurately worded. Interviews are considered as professional situations that demanded equally professional planning and conduct on the part of the interviewer. The following steps prescribed by Leedy (1993) guided the researcher in successfully handling the interview for gathering data for the research study:

- Interviews were set up in advance and permission was needed to tape conversations.
- Data was confirmed immediately in writing.
- A copy of the questions was available for the interviewee and a typescript of the interview was forwarded to the interviewee for confirmation of its accuracy.

3.5 USE OF SURVEY METHOD FOR PRESENT STUDY

The following steps were adhered to when trying to understand the research problem:

- Ideas were gathered to help shed light on the problem.
- When formulating the questionnaire, researchers and local authorities and academics were consulted.
- The first draft of questions was prepared, paying particular attention to the phrasing and sequencing of the questions.

The following points by Leedy (1993), were maintained during the planning of the questions:

- The questions had to be clear, brief and reasonable. Simple questions got the respondent to bring shape and form to the discussion.
- 'Why' questions were avoided as they generally remind people of interrogations.
- Giving examples were limited, as providing examples was found to hinder the thinking of respondents. The examples given were used as probes.

- Open - Ended Questions encouraged people to respond based on specific situations.
- Questions were focused on the fulfilling of the research objectives.

3.6 SAMPLE STRATEGY

The 25 residential units were combined to form 5 groups, which was representative of the Phoenix area. The following steps were used:

Step One:

The five groups were formed by grouping them according to their proximity to each other resulting in the following combination (refer to figure 3.7):

- Group A – Trenance Manor, Shastri Park, Palmview, Woodview and Foresthaven
- Group B – Brookdale, Westham, Lenham, Northcroft, Caneside
- Group C – Whetstone, Rydalevale, Redfern, Longcroft, Clayside
- Group D - Stonebridge, Rockford, Greenbury, Rainham, Southgate-Centenary Park
- Group E – Sunford, Eastbury, Starwood, Stanmore and Grove-end

Step Two:

The sum of the population of each group was calculated as follows:

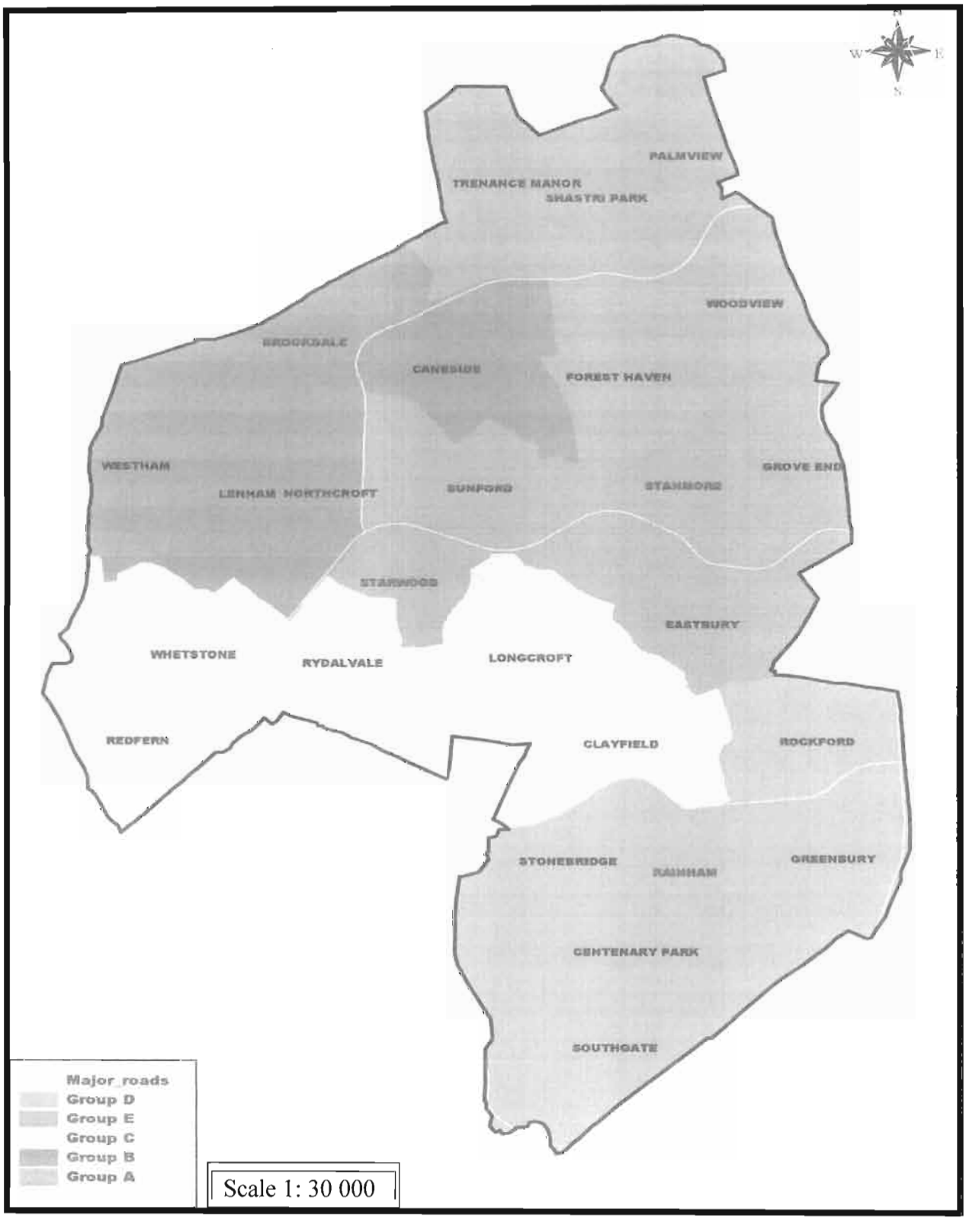
- Group A – 6291+7177+6255+6766+8177=34666
- Group B – 7477+8677+7405+4944+10721=39224
- Group C – 6708+7669+6613+7213+6646=34867
- Group D – 5147+4047+7558+2446+3720=22918
- Group E – 7953+7570+394+6074+5629=27620

Step Three:

The average of the total population of a unit within each group was calculated as follows:

- Group A – 34666/5 = 6933
- Group B – 39224/5 = 7845
- Group C – 34867/5 = 6973
- Group D – 22918/5 = 4584
- Group E – 27620/5 = 5524

Figure 3.6: Proximity Grouping Units



Source: Ramphal (Durban Metro Housing Department, 2001)

Step Four:

The population of a unit, which was closet to the average within a group, was selected. Hence the following units were selected within each of the groups (Refer to Figure 3.8)

- Group A – Woodview
- Group B – Brookdale
- Group C – Longcroft
- Group D – Rockford
- Group E – Grove-end

A sample of 20 dwellings from each of the above five selected units was systematically selected. Systematic sampling is perhaps the most widely known selection procedure. It is commonly used and simple to apply; it consists of taking every *n*th sampling after a random start e.g. taking every 4^{th} address from a list would produce a systematic sample (Kish, 1965). The researcher had taken every 347^{th} households in each of the selected areas to administer the questionnaires. The data obtained from the questionnaires was manually processed.

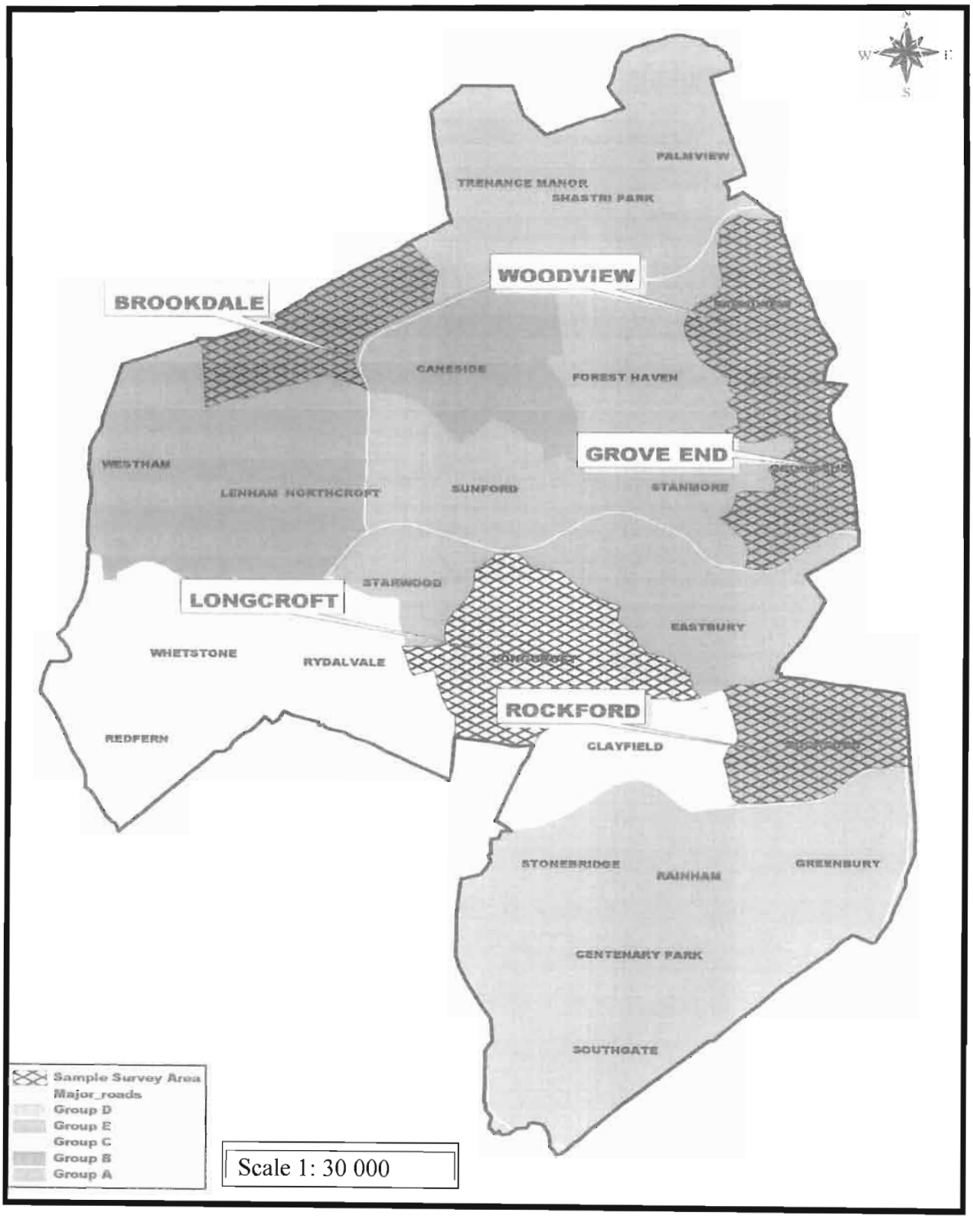
Advantages of Systematic Sampling

- The application of systematic sampling is easy, 'foolproof' and flexible e.g. the clerical tasks of selecting every nth line from listing sheets are done more easily than in a corresponding random selection. Furthermore, it is easier to check the clerical applications of intervals than of random selection.
- Systematic sampling can easily yield a proportionate sample e.g. a sample of every nth dwelling of a block will be spread around its sides which may differ considerably in characteristics (Kish, 1965).

3.7 INTERVIEW TECHNIQUES AND PROBLEMS ENCOUNTERED

The researcher administered a total of 100 questionnaires (appendix 1) in all the five selected units in Phoenix. The questionnaires were given to the respondents in their homes. The researcher selected early evening time so that the head of household could be questioned. If the head of household was not available, a substitute was made e.g. the wife.

Figure 3.7: Selected Sample Units



Source: Ramphal (Durban Metro Housing Department, 2001)

Failing the possibility of a substitute, a call back was required. During the administration of the questionnaire, the researcher tried to maintain the following:

- Courteous - A request in the beginning for co-operation enhanced the chances of having the questionnaire answered;
- Sufficient Time - Respondents were given ample time to answer the questionnaire;
- Clarity Constraints - Ensured that respondents understood the questionnaire;
- Cultural Constraints - Ensured that respondent's cultural or traditional values were not breached or disrespected.

However, there were a few problems experienced by the researcher during the administration of the questionnaire:

- Terminology Problem - A number of individuals were not familiar with certain words e.g. unaesthethic, scavengers (this was explained to them)
- Role of Authority - At a number of households, only the men answered the questionnaire. The women were consulted but were not able to answer the questions themselves. There was one household, where the women could not answer the questionnaire without consulting her husband first.
- Rude Behaviour – It was found that some individuals were not interested in answering the questionnaire. They were prepared to give only a few minutes of their time.
- Violent Area – An area in Grove-end is rife with gangs. It was dangerous to go into this area. In fact the disposal site is known to be an area of criminal activity. Even the residents admitted this.

Despite the above problems, the researcher was able to execute the administration of the questionnaire very satisfactorily.

Interviews were conducted with the local authorities and relevant community groups involved in the solid waste management process. A series of questions pertaining to solid waste management were compiled. The interviews had to be scheduled. Most of the conversations were taped. This method proved to be extremely useful as sometimes the

researcher had forgotten vital information. Then the interview was summarised highlighting the important information (appendix 11).

3.8 CONCLUSION

It is clear that this chapter - Study Area and Methodology is an integral part of both the research proposal and report. This chapter informed the reader exactly how the researcher intended to proceed with the survey and how the data was processed. It also helped to explain what the nature of the data was and what method was used to collect them. The detailed description of the study area and methodology was vital to the validation of the researcher's study. This chapter provides the basis for data analysis in the following chapter.

CHAPTER FOUR

RESULTS AND PRESENTATION

4.1 INTRODUCTION

The purpose of this chapter is to analyse the data collected during the interview and present such data by means of tabulations and graphical representations. According to Chaudhary (1991), processing of data implies editing, coding, classification and tabulation of the collected data. Analysis on the other hand refers to the computation of certain measures along with searching for a pattern relationship among data records. According to Krueger (1998), the researcher should ensure that the following critical ingredients of analysis are adhered to:

- The analysis must be systematic and verifiable.
- The analysis requires time, which will assist in entertaining alternative explanations.
- Finally, analysis is improved by feedback that seeks to enlighten.

According to Levy and Lemeshaw (1991), coding is a classification process whereby data collected is arranged in groups or classes in terms of the resemblance and similarity. The researcher classified the data based on descriptive characteristics e.g. types of wastes disposed, ratings of Durban Solid Waste Services etc. Data was also classified based on numerical characteristics e.g. number of family members, amount of waste bags generated etc. According to Leedy (1993), tabulation is a systematic organization of data in columns and rows. The researcher tabulated the data manually and presented the data in columns and rows.

Hence, the data obtained for the study was edited, coded, classified and tabulated and is presented by the following tables and graphical representations as appears hereafter. The five selected areas from Phoenix were assigned the following categories: Woodview (community A), Brookdale (community B), Longcroft (community C), Rockford (community D) and Grove-end (community E).

4.2 SOCIO-ECONOMIC CHARACTERISTICS

4.2.1 Period of Residence

Table 4.1: Period of Residence (percent)

Period of Residence	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
1-5 yrs	20	25	0	0	5	10
6-10 yrs	5	25	5	15	20	14
11-14 yrs	40	20	50	30	30	34
> 15 yrs	35	30	45	55	45	42

n = 20

The majority of respondents have been residing in Phoenix for over 15 years where from community C, D and E (over 45%). Community A and B reveals that small percent of respondents (30 & 35% respectively) have resided in these areas for greater than 15 years. This is evident, as majority of the respondents has lived in community A and B for less than 10 years compared to the other communities. Communities A and B are new areas in Phoenix compared to the other areas. Overall, the majority of the respondents (76%) have lived in the Phoenix area for more than ten years.

4.2.2 Gender of Household Head

Table 4.2: Gender of Household Head (percent)

Gender	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Male	100	85	95	75	100	91
Female	0	15	5	25	0	9

n = 20

The majority of the household heads in practically all the communities are male. In community D seventy five percent (75%) of the household heads are male whilst twenty

five percent are female (25%). This percentage of male (75%) compared to the other communities is less. However, Community D still has a higher percentage of males (75%) compared to the females (25%). Overall, it is evident that males dominate as household heads in the Phoenix area (91%) (table 4.2).

4.2.3 Level of Education

Table 4.3: Level of Education of Household Head (percent)

Level of Education	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Primary	5	35	50	60	40	38
Secondary	50	55	45	40	50	48
Tertiary	45	10	5	0	10	14

n = 20

Half the respondents from community C (50%) and more than half of community D (60%) have a primary education. The majority of the respondents from community A (50%), B (55%) and E (50%) have a secondary education. The highest number of respondents who have received a tertiary education was from community A. Overall, majority of the respondents in the Phoenix area had at least a secondary education (48%).

4.2.4 Household Size

Table 4.4: Household Size (percent)

Household Size	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
2-4	45	35	15	10	25	26
5-7	55	65	80	35	75	62
8-10	0	0	5	40	0	9
>10	0	0	0	15	0	3

n = 20

The majority of the respondents from community A (45%) and B (35%) had between two to four members in their family. The respondents from all the communities except community D (35%) had above fifty percent. Community D had a large percentage of respondents (55%) with a household size of more than 8 members. Overall, the majority of the respondents had household size of between 5-7 members (62%).

4.2.5 Income of Household

Table 4.5: Monthly Income of Households (percent)

Household Income	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
>R500	0	25	35	55	20	27
R500 - R1000	0	10	20	30	5	13
R1001 – R1500	20	20	5	10	15	14
R1501 – R2000	10	20	20	5	20	15
R2001- R2500	20	15	15	0	20	14
>R2500	50	10	5	0	20	17

n = 20

Most of the respondents from community B (55%), C (60%) and D (95%) earn less than R1500 per month. Community D has an exceptional high percentage of low-income earners. On the other hand, community A (80%) has an exceptional high rate of high-income earners. In community D, the highest level of education of the majority of respondents attained was primary level (table 4.3). In community A, the highest level of education majority of respondents attained was tertiary (table 4.3). Therefore the level of education could be one of the factors that influenced the monthly income of respondents in community D and community A (i.e. majority of the low-income earners have only a

primary education whilst majority of the high income earners have a tertiary education). Overall, the majority of the respondents in the Phoenix area earn less than R1500 a month (54%). These results correspond with table 3.1 (Statistics South Africa, 1996), which also indicates that the majority of the respondents earn less than R1500 per month.

4.3 HOUSEHOLD WASTES

4.3.1 Types of Household Waste

Table 4.6: Types of Generated Household Waste (percent) (multiple responses)

Household waste	Com. A	Com. B	Com. C	Com. D	Com. E	Average
Paper	75	60	70	65	70	68
Metal	45	15	10	10	20	20
Plastic	100	100	100	100	100	100
Kitchen	100	100	100	100	100	100
Glass	50	55	40	35	45	45
Other	10	15	5	10	10	10

n = 20

Table 4.21 represents a scenario of multiple responses i.e. the respondents indicated more than one type of waste generated. In all the communities, respondents have indicated a high degree of plastic and kitchen waste composition (100%). Paper composition seems to be generated in all the communities more or less having the same proportions ranging from sixty percent (60%) to seventy-five percent (75%). Metal composition on the other hand seems to be largely found in community A (45%) whilst least found in community C (10%) and D (10%). Glass composition ranges from thirty-five percent (35%) in community D to fifty percent (55%) in community B. Overall, the majority of the respondents in Phoenix had the same plastic (100%) and kitchen waste (100%) composition whilst sixty-eight percent and forty-five percent of respondents paper and

glass composition respectively. A small proportion of respondents (20%) generated metal whilst ten percent generated other wastes.

4.3.2 Storage of Household Waste

Table 4.7: Storage of Waste (percent)

Waste Storage	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Plastic Bag in Bin	100	100	100	100	100	100
Plastic Bag	90	75	85	70	55	75
Drum / Bucket	10	10	15	5	5	9
Other	5	5	0	10	0	4

n = 20

Table 4.7 represents a scenario of multiple responses i.e. respondents used more than one method to store their waste. The most frequent method of waste storage for respondents in all the communities was the plastic bag in bins (100%). The second most frequent method of household waste storage by the respondents in all the communities was the plastic bags (this occurred as the bins were full). Not many respondents in all the communities used the drum or bucket to store waste. Overall, the respondents in the Phoenix area frequently used the plastic bag in bins and the plastic bag for storage of household wastes.

4.3.3 Number of Waste Bags

Table 4.8: Number of Waste Bags (percent) (multiple responses)

Number of Waste Bags	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
One	10	30	15	30	45	26
Two	75	60	70	55	50	62
Three	15	10	15	15	5	12
>Three	0	0	0	0	0	0

n = 20

In table 4.8, the majority of respondents in communities A (90%) and C (85%) used more than one waste bag. A minor proportion of respondents in all the communities used only one waste bag. However, the majority of the respondents from community E used only one waste bag (45%) compared to the other communities. These results correspond with table 4.8 as majority of the respondents used more than one method of storage e.g. community A respondents used the plastic bag in bin (100%), and plastic bag (90%) and therefore more than one waste bag was used. Overall, it is evident that respondents in Phoenix used more than one waste bag (74%).

4.3.4 Weight of Waste Generated

Table 4.9: Weight of Household Waste (percentage of responses) (per week)

Mass of Waste	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
0-5kg	35	40	45	50	40	42
6kg-10kg	60	50	50	45	45	50
11kg-15kg	0	0	0	0	0	0
Not sure	5	10	5	5	15	8

n = 20

The majority of the respondents (above 60%) in all the communities have generated waste with a weight of between 6kg-10kg per week. The highest weight in the range of 6kg-10kg was from community A (60%) whilst the lowest weight was from community D (45%). A good proportion of respondents (below 50%) in all the communities have generated waste with a weight of between 0kg-5kg e.g. thirty five percent of respondents in community A generated waste between 0-5kg per week. Overall, it can be concluded that most of the household wastes in the Phoenix area had weights between 6kg-10kg (50%).

4.3.5 Cost of Removal Services

Table 4.10: Cost of Removal Services (percent)

Costs	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
R1-19	90	75	70	55	95	77
R20-R29	0	0	0	0	0	0
>R29	0	0	0	0	0	0
Not Sure	10	25	30	45	5	23

n = 20

The majority of the respondents in all the communities stated that the removal costs of household wastes were between R1-19. A minor proportion of the respondents in each of the communities were not sure about the removal costs of household wastes. Overall, the respondents in the Phoenix area claimed that removal service costs between R1-R19.

4.3.6 Rating of Removal Services

Table 4.11: Rating of Removal Service (percent)

Ratings	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Poor	55	50	65	60	60	58
Satisfactory	35	45	30	35	35	36
Good	10	5	5	5	5	6
Very Good	0	0	0	0	0	0

n = 20

It is clear from table 4.11 that the majority of the respondents in all the communities were not very happy with the removal services for e.g. community C with a large percentage of response (65%) stated that the removal service was poor. Only a small percentage of respondents were happy with the removal service. Overall, it is evident that over half the respondents (58%) stated that the removal service was poor whilst thirty-six percent (36%) claimed it was satisfactory. The respondents gave numerous reasons for claiming that the service was poor. These included:

- The frequency of collection was inadequate (once a week – 100%).
- There were insufficient refuse bags especially in households that had large number of members (two refuse bags per week).
- The collectors do not pick up broken appliances, furniture or garden refuse.

4.3.7 Disposal of Broken Appliances and Furniture

Table 4.12: Disposal of Broken Appliances and Furniture (percent)

Methods of Disposal	Com. A	Com. B	Com. C	Com. D	Com. E	Aggreg.
Open Spaces	20	25	15	15	5	16
Burn	15	5	0	10	5	7
Other	60	65	85	75	80	73
Not applicable	5	5	0	0	10	4

n = 20

In all the communities, majority of respondents used alternative methods to dispose their broken appliances and furniture. This included residents giving their broken appliances and furniture to scavengers, charities, beggars or the maids. Some of the respondents in each of the communities have also admitted to disposing their waste in open spaces (illegal dumping) e.g. twenty-five of respondents (25%) in community B disposed their waste in open spaces. Overall, it is evident that majority of respondents (73%) used other methods to dispose their broken appliance sand furniture (refer to table 4.15).

4.3.8 Disposal of Rubble

Table 4.13: Rubble Disposal (percent)

Method of Disposal	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Open Space	40	35	25	25	35	32
Contractors	30	15	20	0	15	16
Other	5	15	20	10	5	11
Not Applicable	25	35	35	65	45	41

n = 20

In each of the communities (table 4.13), most of the respondents stated that they did not have rubble e.g. a large percentage of respondents from both community D (65%) and community E (45%) indicated that they did not have rubble. Between eighty five percent (community A) to sixty percent (community B) of the respondents in each area had disposed their rubble in numerous ways. A large proportion of respondents from community A (40%) had admitted to disposing their rubble in open spaces. The respondents claimed that it was the most convenient and the least expensive, as it would be costly to hire a vehicle to remove the waste from their property. The respondents also mentioned that the closest dumpsite for rubble disposal was in Springfield. Thirty percent of respondents (30%) from community A stated that they had contractors to remove the

rubble. It was found that majority of the respondents claiming to have contractors, where having their houses renovated. The builder or contractor was responsible for the removal of the rubble. However, the respondents could not verify that these builders or contractors did in fact dispose the rubble at a dumpsite. The respondents were concerned with the removal of the rubble from their property. A minor percentage of respondents in each of the communities used other methods to dispose their rubble e.g. community C used other methods to dispose their rubble. Other methods of disposal included using the rubble for levelling the land. Overall, the majority of the respondents (41%) stated that they did not have rubble on their property whilst thirty two percent of the respondents (32%) admitted that they disposed the rubble in open spaces (refer to table 4.15)

4.3.9 Disposal of Garden Waste

Table 4.14: Disposal of Garden Refuse (percent)

Method of Disposal	**Com. A**	**Com. B**	**Com. C**	**Com. D**	**Com. E**	**Aggregate**
Open Spaces	30	20	25	35	15	24
Burn	50	70	70	65	85	68
Other	15	5	5	0	0	5
Not Applicable	10	5	0	0	0	3

n = 20

The wide variety of methods that each of the respondents employ to dispose of their garden refuse in table 4.14, gives an indication that garden refuse is found practically in every home e.g. community C, D and E employ all three methods to dispose of their garden refuse. The majority of the respondents in each of the communities employ the burning method to dispose of their garden refuses e.g. community E (85%) employ the burning method. This is followed by disposing garden refuse in open spaces e.g. community D (35%) disposes their garden refuse in open spaces. The fifteen percent of respondents from community A used the garden refuse site in Canehaven. The

respondents from community A (10%), and B (5%) stated that garden refuse was not applicable to them as their yards were fully paved or cemented.

It is important to take note that numerous factors contributed to the above results:

- It was found that the majority of the respondents (93%) in all the communities were unaware of the Green bag programme. This programme was initiated with regards to garden refuse. The bags cost R28 for 12 bags, which can be bought from certain stores, garages and the Durban Solid Waste Department. The minor proportion (7%) of respondents that was aware of the programme was informed at work, by friends or relatives living outside the Phoenix area.
- It was also revealed that the majority of the respondents (82%) were not aware of the Garden refuse site in Canehaven whilst only a small proportion (18%) were of the site. From the eighteen percent (18%) of respondents that were aware of the garden refuse site, only five percent used the site. The prevalent reasons for not using the garden refuse site included the cost and transportation factor.

Overall, it is clear that majority of the respondents (68%) burn their garden refuse whilst twenty-four percent (24%) of the respondents dump their refuse in open spaces (see table.15).

Table 4.15: Method of Waste Disposal (percent)

Types of Waste	**Open Space**	**Contractors**	**Burn**	**Other**	**Not Applicable**
Rubble	32	16	-	11	48
Broken Appliances	16	-	7	73	4
Garden Refuse	24	-	68	5	3

n = 100

4.3.10 Scavengers

Table 4.16: Prevalence of Scavengers (percent)

Responses	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Yes	100	100	100	100	100	100
No	0	0	0	0	0	0

n = 20

All the respondents in table 4.16 (100%) in each of the communities stated that their area had scavengers. Moodley (2001) stated that scavengers were prevalent in the Phoenix area especially during the waste collection days. However, mixed responses were received regarding the issue of how the scavengers are viewed by society. The majority of the respondents (83%) stated that scavengers were useful, however they felt that ravaging through the bin bags for food was unhealthy and unhygienic. Some of the respondents suggested that foodstuffs such as chicken, fat, meat etc should be kept separately and given to the scavengers on the removal days. It was found that many of the residents were in fact practicing this type of service. The respondents also claimed that some of the scavengers picked up the old furniture, broken chairs, which the refuse trucks seldom collected. On the other hand, the seventeen percent of respondents (17%) found that scavengers were a nuisance because they considered the scavengers as people who were invading their privacy. The respondents also claimed that scavengers leave the refuse bags open which encourages the dogs and cats to ravage them resulting in the bags been torn and the waste scattered along the verge.

4.4 WASTE MINIMISATION

4.4.1 Recycling Programmes

Table 4.17: Prevalence of Recycling Programmes (percent)

Responses	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Yes	40	20	25	0	40	25
No	60	80	75	100	60	75

n = 20

The majority of respondents (75%) in all the communities were not aware of any recycling programmes in their area e.g. all the respondents in community D (100%) were not aware of any recycling programmes (table 4.17). The twenty-five percent (25%) of respondents in certain communities became aware of recycling programmes at their children's schools and in their religious institutions not within their area e.g. community A (40%) were aware of recycling programmes. It was found that at primary schools, children were encouraged to recycle paper, which they had brought from their homes. Even religious institutions such as churches and Sai Groups encouraged recycling programmes. It was also found that overall, the majority of the respondents (93%) were interested in recycling programmes within their area whilst a minor proportion (7%) were not interested. The interested respondents stated that facilities (refuse bags), environmental awareness programmes, incentives, kerbside facilities should be provided by the council to encourage people to practice recycling. The refuse bags will help households to separate their waste at the household level. The environmental awareness programmes will inform people of the benefits of recycling and the dangers of pollution. Incentives such as competitions, sponsorships are also very helpful. Kerbside facilities included suitable containers in appropriate locations within the community.

4.4.2 Proposed Recycling Schemes

Table 4.18: Proposed Recycling Programmes (percent)

Recycling Programmes	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Igloos	25	35	20	25	40	29
School/ Community	35	25	30	20	30	28
Buy-in Centres	30	35	35	50	30	36
None	10	5	15	5	0	7

n = 20

The above table 4.18 indicates the type of recycling programme that the interested respondents (93%) would prefer in their area. The buy-in centre seems to be the most favourable recycling option e.g. fifty percent (50%) in community D prefer this option. This option is a source of income. The igloos and recycling at schools and communities were also supported in each of the communities. Overall, the buy-in centre was the most favourable recycling scheme that the interested respondents chose (36%).

4.4.3 Household Waste Minimisation Practices

Table 4.19: Waste Minimisation Practices (percent) (multiple responses)

Types of Practice	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Compost	15	20	10	5	20	14
Re-use	100	100	100	100	100	100
Recycle	25	10	15	15	10	15
Reduce	30	20	25	25	25	25

n = 20

There were multiple responses obtained with regard to the practices used by respondents to minimise waste entering the general waste stream in each community (table 4.19). The most common method prevalent in each community was re-use. It was also found that respondents practiced recycling but did not even realise it e.g. the re-use of glass jars, packets etc. The recycling practised in each of the communities was as a result of their children who were in primary school and religious institutions. The Primary Schools encouraged children to recycle newspaper.

Certain religious institutions encouraged people to practise recycling. The respondents from each of the community that practised recycling sometimes did not realise it e.g. use of their own shopping bag rather than buying or taking another bag from the supermarket. It was found that a number of respondents going to the fruit and vegetable market took packets from their homes rather than buying new packets. Overall, it is evident that

majority of the respondents in the Phoenix area practice re-use (100%) whilst a minor proportion use composting (14%). Only fourteen percent (14%) of the respondents practised composting.

4.5 ILLEGAL DISPOSAL OF WASTES

4.5.1 Prevalence of Illegal Waste Disposal

Table 4.20: Prevalence of Illegal Waste Disposal (percent)

Responses	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Yes	100	100	100	100	100	100
No	0	0	0	0	0	0

n = 20

As indicated by table 4.20, all the respondents (100%) in each of the communities had illegal dumping occurring in their areas.

4.5.2 Types of Illegal Wastes Disposed

Table 4.21: Types of Illegal Wastes (percent) (multiple responses)

Types of Waste	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Rubble	90	80	80	75	90	83
Household Waste	60	65	65	70	80	68
Garden Refuse	95	100	100	100	90	97
Factory / Industrial	60	70	80	75	80	73
Old Appliances	40	35	25	10	15	25
Other	60	55	40	50	65	54

n = 20

As indicated by table 4.21, multiple responses were received with regards to the types of wastes. It is evident that the types of waste disposed in each of these communities are exceptionally high. Garden refuse seems to be the highest type of disposed waste in each of the communities e.g. community B, C, D had a disposal rate of one hundred percent (100%). This is followed closely by rubble with some communities having a high disposal rate of ninety percent (90%) e.g. community E and community A.

The respondents that claimed that other wastes were illegally disposed in the area included wastes such as food wastes (chicken feathers and remains, old fish, meat, crab shells, rotten vegetable), polystyrene cups and containers etc e.g. sixty percent (60%) of respondents in community A claimed that other wastes were illegally disposed in there area. A small proportion of the respondents in each of the community stated that old furniture and appliances were illegally disposed in their area e.g. forty percent of respondents in community A claimed that old appliances and furniture was illegally disposed. Overall, garden refuse (97%) followed by rubble (83%) were the highest illegal disposed waste in the Phoenix area. The least disposed waste was the old appliances and furniture (25%).

4.5.3 Distance of Illegal Dumping Site

Table 4.22: Distance of Illegal Disposal Site (percent)

Distance of Disposal site	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
<100	25	25	30	25	30	27
100m-199m	30	40	25	30	35	32
200m-299m	35	20	20	25	15	23
>300m	20	15	25	10	20	18

n = 20

The percentage of respondents in all the communities claiming that the disposal site is less than 100 m are quite close (ranging from 25% to 30%). Community B has the highest percent (40%) of respondents claiming that the illegal disposal site is located

between 100m-199m in their area. Thirty five percent (35%) of the respondents in community A stated that the dump site was located between 200m-299m in their area. Finally, minor proportion of respondents claimed that the disposal site was located over 300m. Overall the distance of most of the disposal sites (32%) in the Phoenix area was located between 100m-199m from households. This indicates that residents had easy access to the illegally disposed wastes in these areas.

4.5.4 Transportation of Illegal Wastes

Table 4.23: Transportation of Illegal Disposed Wastes (percent)

Modes of Transport	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Vehicle	20	15	25	10	20	18
Barrow	35	25	55	35	45	39
Manually	45	60	20	55	35	43

n = 20

As indicated by table 4.23, the highest percentage of respondents claimed the manual use of disposal of wastes in community B (60%). This was followed by the use of the barrow in community C (55%). The least used method to transport waste was the vehicle in community D (10%). Overall, the majority of the respondents in Phoenix used the manual method of disposal (43%) followed by the barrow method (39%) and the least used method was a vehicle (18%). These results can be attributed to the distance of the illegal disposal sites to the respondent's homes (table 4.22). As indicated by table 4.22, the illegal disposal sites are located close to the respondent's homes hence making it easier to dispose the unwanted wastes manually.

4.5.5 Offenders of Illegal Dumping

Table 4.24: Offenders of Illegal Dumping (percent) (multiple responses)

Types of Offenders	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Residents	55	70	60	65	75	65
Outsiders	85	75	80	70	80	78
Squatters	0	0	0	0	0	0
Factories	75	70	70	65	75	71
Builders/ Contractor	80	65	80	70	75	74
Other	50	45	55	45	60	51

n = 20

Table 4.24 represents a case of multiple response with regards to the offenders of illegal waste disposal i.e. respondents blamed more than one person for the disposal of wastes in their area. The highest percentage of respondents from community A (85%) claimed that outsiders were responsible for illegal dumping in their area. Forty-five percent (45%) of respondents both in community B and community E claimed that offenders included supermarket owners, garages, butcheries, vegetable stalls, vendors and community centres.

Builders were also pointed out by the respondents as being contributors of illegal waste disposal e.g. eighty percent (80%) of respondents in community A and community C stated that contractors were offenders of illegal waste disposal in their area. Respondents also stated that residents themselves were responsible for illegal dumping within their area e.g. seventy percent of respondents from community E stated that residents were offenders of the illegal dumping in the area. Overall, respondents in the Phoenix area largely blamed outsiders (78%), builders (74%), factories (71%) and residents (65%) for illegally disposing wastes in their area.

4.5.6 Impacts of Illegal Waste Disposal

Table 4.25: Impacts of Illegal Waste Disposal (percent)

Types of Impacts	Com. A	Com. B	Com. C	Com. D	Com. E	Aggregate
Odours	80	90	75	85	75	81
Unaesthetic	100	100	100	100	100	100
Rodent /Insects	85	85	80	75	70	79
Drain Damage	60	50	65	65	70	62
Stream Pollution	80	85	80	90	85	84
Air Pollution	40	35	45	50	35	41

n = 20

Table 4.25 represents a case of multiple responses in that illegal waste disposal had more than one impact in each of the communities. The table also indicates that the impacts of illegal dumping are exceptionally high. Practically every community is affected by each of the impacts. The majority of respondents in each of the communities (100%) stated that illegal dumping made their community unaesthetic. The respondents especially in community B (90%) and community D (85%) stated that the odours emitted from the illegal dump sites were unbearable. They also mentioned that foodstuffs such as rotten potatoes, fish remains etc emitted the worst odours. The respondents living close to the illegal disposal sites complained about the insects (mosquitoes, flies) and the rodents e.g. community A (85%) and community B (85%) stated that rodents and insects were a huge problem as a result of the illegal disposal site especially in summer.

The respondents in each of the communities stated that illegal disposal of wastes had caused pollution of their water sources (stream or rivers). The respondents in community E (70%), community C (65%), community A (60%), community B (50%) and community D (65%) also claimed that illegal dumping had created numerous problems such as drain blockages. The wastes found near or in drains or manholes caused blockages during rainy seasons. As a result of the blockage, the water accumulated on the

roads causing obstructions for vehicles on the roads. Some of the respondents claimed that the accumulated water ended up flooding their homes. A minor proportion of the respondents in each of the communities claimed that air pollution resulted from burning of the wastes at the disposal sites e.g. thirty-five percent (35%) of respondents claimed that air pollution was caused by illegal waste disposal.

Overall, it is evident that the impacts of illegal waste disposal in the Phoenix area are largely felt by all the communities e.g. one hundred percent (100%) of the respondents claimed that their area was unaesthetic. Between sixty-two percent (62%) to eighty-four percent (84%) of the respondents stated that their area had odour, rodent, drain and stream problems. Forty-one percent (41%) of the respondents stated that the illegal dumping had resulted in air pollution.

4.5.7 Authorities Response to Illegal Waste Disposal

Table 4.26: Authorities Response to Illegal Waste Disposal (percent)

Authorities Response	**Com. A**	**Com. B**	**Com. C**	**Com. D**	**Com. E**	**Aggregate**
Prosecution	0	0	0	0	0	0
Notices	5	15	20	20	30	18
Remove Waste	10	20	30	20	45	25
No Reaction	10	15	10	10	5	10
No Reports	15	10	8	10	4	47

n = 20

Firstly, it was found that, it was found that fifty-three percent (53%) of the respondents from all the communities reported the illegal dumping in their area to the local authorities. Community E (80%) had the most number of respondents whilst community A (35%) had the least number of respondents, who had informed the local authorities about the illegal dumping taking place in their area. Table 4.26 illustrates the response

that local authorities had taken with regards to the claims made by respondents (53%) about the illegal dumping. The most common response to the illegal waste disposal was the removal of the waste e.g. forty-five percent (45%) of the respondents in community E stated that the wastes were removed by the local authorities. Thirty percent (30%) of the respondents in community E stated that the local authorities put up notices in their area. Fifteen percent (15%) of the respondents in community B stated that they received no response from the local authorities. All the respondents in each of the communities claimed that no prosecutions (0%) took place. Overall, it is evident that the main response that local authorities had taken in the Phoenix area was the removal of waste (25%) and the erecting of notices (18%).

4.5.8 Suggested Improvements for Combating Illegal Waste Disposal

Table 4.27: Suggested Improvements for Combating Illegal Waste Disposal (percent) (multiple responses)

Improvements Needed	**Com. A**	**Com. B**	**Com. C**	**Com. D**	**Com. E**	**Aggregate**
Prosecute	75	85	70	80	85	79
Increased Refuse Bags	90	80	95	85	95	89
Increased Removal frequency	70	75	65	75	80	73
Develop Area	100	85	90	100	95	94
Awareness Programme	95	80	90	85	90	88
Increased Disposal sites	100	85	100	100	95	96

n = 20

The respondents were very eager to convey their suggestions on how to combat the problem of illegal waste disposal in their area hence multiple responses were prevalent as

indicated by table 4.27. The increased disposal sites seem to be the favourite improvement mentioned by the respondents in each of the community e.g. community A (100%), community C (100%) and community D (100%) wanted an increase in proper disposal sites in their area. Numerous respondents mentioned that the location of the disposal sites should take into consideration the transportation factor. The respondents stated that the disposal sites need to be ideally situated so that residents can gain access with limited costs imposed on them.

The respondents from community A (100%) and community D (100%) largely agreed on developing the illegal disposal sites into parks, gardens, recreational facilities etc. A number of respondents also stated that these vacant properties should be sold since a number of people do not have homes. This will enable people to build houses on these vacant properties thereby reducing the vacant properties for the purpose of illegal dumping. The respondents from community C (95%) and community E (95%) insisted on an increase of the number of refuse bags. The respondents from community E (80%), community D (75%) and community B (75%) wanted the refuse collection days to be increased from one day to two days per week. Mainly households with a large household size favoured this response. The respondents also mentioned that the increase in frequency is especially needed during the summer months, as food wastes cannot be kept too long in the refuse bins. The food wastes in summer attract flies, rodents, and cats and creates unbearable odours.

The awareness programmes was also needed in each of the communities e.g. The respondents from community A (95%), community C (90%) and community E (90%) stated that if residents became aware of the impacts of illegal waste disposal, they might change their attitudes towards the environment. Finally, respondents also supported the need for more stringent laws to prohibit illegal waste disposal in each of the communities e.g. community B (85%), community E (85%) and community D (80%) supported the issuing of spot fines to offenders of illegal waste disposal. The respondents stated that fines should be large amounts so that this deters residents and outsiders from dumping. The respondents also mentioned that cooperation between the local authorities, police

services and residents is important so that offenders can be caught and illegal dumping can be reduced. Overall, respondents in the Phoenix area have given good support to the improvements needed to combat the problem of illegal waste disposal.

4.6 CONCLUSION

It is imperative that the data (responses to the questionnaire) is represented correctly so that the researcher can now look at it from a holistic point of view. This would enable the researcher to explain and discuss the finding revealed in this chapter. Hence, the data in this chapter is organized into tables and graphs that will prove extremely profitable in the preceding chapter.

CHAPTER FIVE
EVALUATION AND CONCLUSION

5.1 INTRODUCTION

This chapter is based on discussing the results obtained in the previous chapter comparing it to the information reviewed in the literature (Chapter two). The chapter is vital in that it will reveal whether or not Phoenix Solid Waste Management Practices are efficient or not. As indicated earlier, the Solid Waste Management consists of various processes, which include Characteristics (composition and generation), Storage Facilities, Collection and Transportation, Disposal Methods and alternative disposal methods. This chapter will look at these various processes in Phoenix and how efficient it is. The impacts of the processes will also be examined. It has to be stated at the outset that when evaluating the results obtained during this research, one has to bear in mind that South Africa is unique in that it has conditions that are prevalent in both developed and developing countries. Hence one has to be cautious and not generalise. As illustrated by Table 3.1, the income for the Phoenix area is exceptionally low. The majority of the people are in the low-income group. However, it is important to take note that although the majority of the people are from low income groups, there are a good proportion of people who are from the high income to middle income.

According to Reilly (1991), in most formal townships, refuse collection services already exist in the form of conventional door-to-door services with varying degrees of street cleaning services. Despite these services, many of the areas are generally untidy, extensively littered and have numerous informal dumps within their boundaries. This general lack of cleanliness indicates that the present collection programmes are often not effective. Phoenix is a formal township where refuse collection services exists. However, it will be proved that although these services are provided, they are inadequate. The present condition of the environment expressed by the respondents, local authorities and NGOs will give one a clear picture of the efficiency of the current waste practices in the Phoenix area.

5.2 HOUSEHOLD CHARACTERISTICS

5.2.1 Period of Residence

It is evident from table 4.1 that majority of the respondents in each of the communities lived in Phoenix for more than ten years (76%). These respondents are familiar with the problems associated with Solid Waste. They will be able to give valuable insight into this problem. It is also important to take note that community A and community B are new areas in Phoenix. This will explain why there is large number of people living less than ten years in these two areas.

5.2.2 Household Head

Table 4.2 indicated that majority of the household heads were male (91%) compared to the small number of female (9%). The results indicate that men dominate as the household heads in the Phoenix area. It is evident that majority of the women household heads (25%) were from community D.

5.2.3 Household Income

Table 4.5 indicated that more than half the Phoenix population earns less than R1500 per month (75%). This result supports the information from Statistics South Africa, which also revealed that more than half the Phoenix population earns less than R1500 (table 3.1). However, when examining each of the Phoenix communities, it is apparent that each of the communities has different percentages of income generation e.g. community A had twenty percent (20%) of respondents earning less than R1500 whilst eighty percent (80%) earning more than R1500 per month. Community D on the other hand revealed ninety-five percent (95%) of respondents earning less than R1500 and only five percent (5%) earning above R1500. This vast disparity will assist when comparing the level of income to waste characteristics. As indicated previously in table 3.1, Phoenix has income groups of high and low income. Community A and community D are ideal areas, which clearly indicates a high income group and a low income group. This information will prove useful when comparing generation rates and socio-economic characteristics.

5.2.4 Size of Households

Overall it is evident that the majority of the respondents (62%) in the Phoenix have between 5-7 household members. Most of the respondents in community A have between 2-4 household members. The majority of community D (40%) respondents have between 8-10 members. The household size for community D is high especially since the respondents are in a low income area.

5.2.5 Level of Education

As indicated above, community A (high income) and community D (low income) represents two income groups. Upon examining the level of education of community A and community D, the following can be deduced:

- The majority of respondents in community A have either a secondary (50%) or tertiary (45%) education.
- The majority of respondents in community D have only a primary education (60%).

This indicates that the level of education influence income generation i.e. the better education received, the greater the income generation.

5.3 WASTE CHARACTERISTICS

5.3.1 Generation Rates

According to Mayet (1994), there is a strong relationship between the amount of waste generated by a community and its income and concluded the following:

- The highest per capita generation of wastes emerged from high income zones
- The lowest per capita generation emerged from low income levels.

Stanners and Bourdeau (1995) also mentioned that increasing economic development was reflected in an increasing rate of waste production. Williams (1998) concluded that the higher per capita income countries tend to generate higher per quantities of waste. Pescod (1993) revealed that the amount of waste generated by households tends to vary according to levels of economic development. Cointreau (1982) also illustrated that wastes generated in developed countries are greater than in middle-income or developing

countries. According to Seholoholo (1998), waste generation rises with increasing economic growth and household income.

As mentioned previously, community A represented a high income area whilst community D represented a low income area. This information is useful, as it will allow one to see whether the income influences waste generation. As illustrated by table 4.9, the majority of the respondents in community A (60%) generated between 6kg-10kg of waste per week compared to community D (45%). According to Lombard (1994) indicated in table 2.10, high income areas generate 5.6 kg per week compared to low income areas that generate 1.4 kg per week. Hence the results obtained supports his conclusion that high income areas generate more waste than low income areas. The results also support the above researcher's conclusion that waste generation rises with increasing household income. Overall, it was revealed that household waste generated between 6kg-10kg (50%) was higher than that generated between 0-5kg (42%) (table 4.9). These results indicate that Phoenix has traits of both high income and low income areas.

Mayet (1994) stated factors such as infra-structural development in residential areas, lifestyles, attitudes, migratory patterns, levels of education and willingness to recycle, influence the generation rates of solid wastes. In terms of Phoenix, the majority of the respondents (75%) claimed that there are no recycling facilities. People's lifestyles in the modern day are based solely on convenience. Rubelli (2001) also stated that people want the easiest way to deal with their waste. People go to the shop and purchase items that are easily disposed e.g. a person will rather buy cooldrink in a plastic bottle rather than a glass bottle. Plastic is durable and would not break. In Phoenix, the respondents tend to purchase items in plastic containers rather than in glass. This is clearly supported by the waste composition of respondents in the Phoenix area (table 4.6).

5.3.2. Waste Composition

According to Kreith (1994), the composition of waste refers to different components of waste. It was found that developed countries waste consisted mainly of paper, metals,

glass and plastic and less putrescibles (kitchen waste) whilst developing countries consisted largely of putrescibles (kitchen waste), dust and ash and little paper, metals, glass and plastic (Palmer Development Group, 1995). According to Cointreau (1982), the compositional differences are accountable to economic, cultural, climatic and geographic differences among cities.

When examining Phoenix overall, the following waste compositional results were obtained (table 4.6): sixty eight percent paper, twenty percent metal, one hundred percent plastic, one hundred percent kitchen waste, forty five percent glass and ten percent other. In relation to the above researchers conclusion, it is vital that each of the types of waste is examined individually. Hence the results for each type of waste will be compared to table 2.11 produced by Gibbons *et al* (1992).

a) Paper

The amount of paper generated in Phoenix is sixty eight percent. By examining the percentage of paper composition in each of the communities of Phoenix, it will help to support or reject Gibbons et al (1992) statement that paper composition is more in high income areas than low income areas. Table 4.6, revealed that community A (75%) has a higher compositional rate of paper than community D (65%). Hence the results for generation of paper for high income areas are supported. Although community A had a large percentage of paper composition compared to community C, the difference was not vast. These results obtained for the composition of paper could be attributed to the following:

- There are no recycling programmes in the Phoenix area hence all the paper waste generated is put into the bins.
- Singh (2001) stated that paper is a viable recycling material but due to lack of awareness programmes and recycling facilities in the Phoenix area, people are forced to dispose their paper into bins.

b) Plastic

The amount of plastic composition in Phoenix (one hundred percent) is high (table 4.6).

Table 4.6 also indicates that the plastic composition is exceptionally high for community A (100%) and community D (100%). There are a number of reasons for such a large plastic composition in household wastes, which include:

- The Phoenix Township does not have any recycling facilities nor programmes to encourage recycling of plastics hence all the plastics generated end up in the bins.
- Almost all products purchased today are packaged in plastics.
- For convenience, most goods are packaged in plastic e.g. people will purchase the 2.5 litre plastic Coke which is easily disposed rather than the 1.5 litre glass Coke. The glass bottle is problematic in that one has to have a deposit and the glass bottle can easily break. Rubelli (2001) also stated that people are becoming lazy and would prefer things to suit their convenience. Another interesting thing is that the 2.5 litre is cheaper than the 1.5 litre Coke hence further encouraging people to purchase the 2.5 litre rather than the 1.5 litre Coke.
- Plastic bags are readily available e.g. If one has to go to the supermarket to buy groceries etc, they are given a plastic bag to put the items into it. Even the smallest item is packaged at the counter.
- Plastic bags are cheap and free.

c) Kitchen Waste

Firstly kitchen waste consists of vegetable matter, meats extracts and other food wastes. Reddy (1992) had found that domestic waste in the Phoenix area comprised mainly of fresh chicken, fresh vegetables, fish and organic waste. These finding complements the results obtained in figure 4.5, as all the respondents (100%) stated that their waste consisted of kitchen waste.

Table 4.6 revealed that community A (100%) and community D (100%) had the same response to the composition of kitchen waste. Mayet (1994) stated that people from high income areas purchase more pre-cooked or pre-packed food whilst those from low income areas purchase vegetable, as it is more affordable. The results thus obtained contradict Mayet's (1994) conclusion. The generation rates for kitchen wastes for both areas are exceptionally high and can be attributed to the following:

- Lack of composting programmes within the Phoenix community.

d) Glass

Gibbons *et al* (1992) revealed that the glass composition was greater in high income areas (4%) compared to low income areas (2%) (table 2.11). However, it is also noted that the percentage difference (2%) between these two income groups is not very high. Overall, the responses for glass composition (45%) for the Phoenix area is low compared to the other types of waste compositions. Table 4.6 indicated responses whereby community A (50%) had a higher percentage of glass composition compared to community D (35%). This result supports Gibbons et al (1992) above conclusion. However, it is important to take note that the glass composition for both these communities and Phoenix as a whole is high. This could be attributed to the following:

- Freeman (2001) found that people would prefer things packaged in plastic rather than glass. She found that individuals had complained that plastic packaging was safe rather than glass, which poses the danger of breaking and hurting someone.

e) Metal

The composition of metal (twenty percent) in the Phoenix area is low compared to other types of waste. Table 4.6 indicated responses whereby community A (45%) had a higher metal composition compared to community D (10%). These results support Gibbons et.al (1992) whereby a higher metal composition was found in high income areas (6%) compared to community D (10%). However, it is important to take note of the following:

- The waste collectors will not collect appliances, broken chairs etc (things that will not fit in the plastic bags). They will leave it on the kerb. Moodley (2001) also confirmed that refuse collectors would not pick up things that are not in the plastic bags. On the other hand most developed countries are able to put out their old and broken appliances which is picked up by the refuse collectors e.g. in America, refuse collectors pick up old and broken appliances, chairs, tables etc (Association of Municipal Engineers, 1991).

f) Other waste

Other waste can include ash, soil, wood, textiles, leather and rubber. As revealed by table 4.6, composition of other wastes in the Phoenix area is quite small (ten percent). It indicated that community A (10%) had the same low composition of other wastes compared to community D (10%). These results could be attributed to the following:

- In terms of ash and wood, all the residents of Phoenix have access to electricity hence there is no need for the burning of coal or wood for energy. In the low income areas in Gauteng, there is a high ash content in the waste because people use coal as an energy source (Palmer Development Group, 1995).

- Soil is hardly found in the wastes. This could be attributed to the fact that the waste is stored in plastic bags, which are then collected by workers and placed into the trucks. Soil found in large quantities are prevalent in areas that have communal storage such as skips. The trucks come and pick up these wastes from the skips and in the process pick up the soil. A good example is Kwa-Mashu whereby residents have a communal collection service. Their waste is put into these skips and then loaded onto the truck with machines (Rubelli, 2001).

- Theron (1994) also found that in townships, a large proportion of soil was found in the waste. The front-end loaders collect the waste as well as the soil. In the Phoenix area, rear-end loader compactor vehicles are used to collect the waste (Rubelli, 2001).

- Textiles, leather and rubber are mostly found in industrial areas. However, there are many small businesses that operate in the residential areas e.g. People start small businesses such as making clothes, upholstery and generate large quantities of waste. But most of these small businesses dump these on vacant land as refuse collectors do not pick up the wastes.

5.4 STORAGE OF WASTE

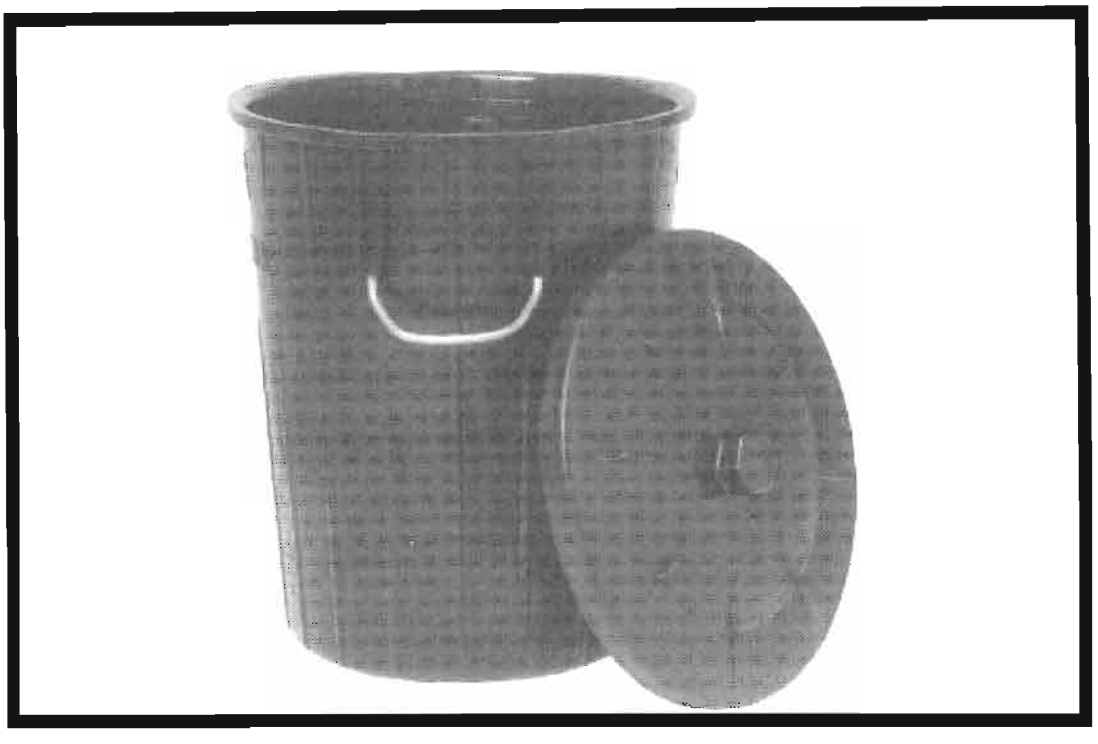
According to Scharff and Vogel (1994), the type of container used to store the waste generated from households, commercial and industrial premises depends on a number of factors which includes the frequency and efficiency of collection, amount of waste, type of housing, the density of collected wastes, collection vehicle type, vehicle usage and manpower. Pescod (1993) found that the use of non-standardised containers is the greatest cause of litter. Household waste is either stored or immediately disposed off (burning or burial). There are two basic forms of storage before collection or disposal: separate unit storage and communal storage (Scharff and Vogel, 1994). The non-standardised containers can range from temporary items such as cardboard cartons, plastic bags and crates to permanent containers such as plastic or metal bins. The standardised containers are usually plastic or metal bins with the name and address of the owner and with a lid (Cointreau, 1982). By looking at the above storage facilities and the factors involved in selecting the correct container for ones area, it can be easily decided whether the storage container was suitable or not for that particular area.

In the Phoenix area, the solid waste department provides two plastic bags, which is supposed to last for one week. All the residents in Phoenix have their own separate storage unit, which is on-site (Rubelli, 2001 and Singh, 2001). The household has one 85 litre plastic bin (plate 5.1) in which the plastic bag is placed (table 4.7). Hence the Phoenix area has temporary (plastic bags) and permanent (85 litre plastic bin) storage containers. Fourie (1997), found that in black local authority areas, 85 litre bins or plastic bags are used whilst in white local authority areas, the plastic bag, steel or plastic bin and the plastic wheeled bin are used. Phoenix illustrates the storage system of the black local authority areas.

The respondents (one hundred percent), Rubelli (2001) and Moodley (2001) stated that the waste collection frequency is once a week. The respondents had made a number of complaints regarding the storage and collection frequency. The plastic bags and the storage bin were insufficient and inappropriate for the following reasons:

a) The plastic bags were not enough. In fact respondents (eighty nine percent) in (table 4.27) stated that the refuse bags should be increased. When residents asked for extra bags, the refuse collector would not give more than two. Rubelli (2001) on the other hand stated that if people asked for extra bag, they were given.

Plate 5.1: Storage Containers



Source: Resource (2000: 17)

b) The respondents also stated that black plastic bags that were bought from street corners to be used to store the extra waste was not picked up during collection days. Rubelli (2001) and Moodley (2001) also concurred that black plastic bags that do not have the solid waste label would not be picked up. Rubelli (2001) stated that people should buy the extra bags bearing the solid waste label from the Solid Waste Department. He also claimed that the bags given to the residents are paid through their rates. He claimed that if solid waste collectors had picked up these nonlabelled waste bags, then all the residents would purchase these bags. This would make collection and transportation difficult, as more waste would be

generated. Hence the rounds the trucks make will have to be increased (Rubelli, 2001).

c) The respondents stated that the storage containers are not sufficient especially if more than two bags of waste are generated. Table 4.8 indicate that the majority of the respondents (74%) in the Phoenix area used more than one bag to store their waste. Table 4.8 indicated that community A (90%) used two to three bags per week compared to community D (70%). Plate 5.2 indicates that respondents who generate more than one bag of waste per week do not have adequate storage containers. The respondents also stated that the council did not give another container. They were sometimes forced to buy a new storage container. The lack of container creates problems for residents who use more than one bag i.e. when the first bag is full to capacity, it is removed from the bin, exposing the waste bag (Plate 5.2) to a variety of problems. Cats and dogs find this ideal to scavenge into. The animals tear the bags, displacing the litter. Cointreau (1982) stated that plastic bags are subject to being torn by scavenging animals. This can prove to be unhygienic as residents have now the task to one again pick up the waste and hope that the bag is not torn again before collection day. The majority of the respondents (74%) had complained about the scavenging of their exposed waste bags by animals in the area.

d) Residents also had problems during the summer seasons. It was found that when food wastes were put into the bins, residents were plagued with insects, maggots, flies and even mosquitoes. During the summer months, maggots and flies breed easily in the bins especially since collection is once a week. As mentioned earlier, Kwa-Zulu Natal enjoys a subtropical climate with the coastal regions experiencing hot and humid weathers during the summer months (KZN Tourism Board, 2001). These hot and humid conditions are ideal for the pests to breed especially where there is food. Booth *et al* (1994) stated that plastic bags tend to be inappropriate in hot climates as the humidity causes the bags to burst.

Plate 5.2: Lack of Storage Containers

e) As indicated previously, Phoenix residents have both temporary (plastic bags) and permanent containers (plastic bins). Many of the respondents had complained that there bins were stolen at least once e.g. the respondents living in the community B (Brookdale) have found theft of their bins to be a major problem. It was found that houses that were not fenced were ideal targets for bin thefts. The bins are costly items. The bins can cost up to one hundred Rand. Cointreau (1982) also stated that bins are relatively valuable items, attractive to thieves and can be used for alternative purposes such as food and water storage. The residents of community B live near the Bambayi Squatter settlement. The respondents claimed that residents from this informal settlement are the ones who were responsible for the thefts. They also claimed that they have reported the incident to the police but the problem of bin thefts still continues. The incidence of increased theft from homes in Brookdale (community A), Shastri Park and Trenance Manor was reported in the Phoenix Tabloid (January 2000).

f) The lack of bins for new homeowners is also a common problem in the Phoenix area. It was found that previous homeowners used to take their bins away, hence

leaving new homeowners (especially the first time home owners) without a bin. Initially the Metro council provided all residents with at least one plastic bin but for first time homeowners, they have to buy a new one or hope that the previous owners leave the old one. In Khayelitsha and Alexandra, residents continuously move from one place to another with the bins issued to them creating problems, as new bins have to be constantly issued (Palmer Development Group, 1995).

f) Some of the respondents claimed that sometimes they receive no plastic bags or just one. According to Rubelli (2001), three of the workers go ahead of the trucks to pick up the bags from each home and put it at a central point (Plate 5.3). Before they picked up the bags they would throw the new plastic bags into the yard. Sometimes they would forget or they might not give bags deliberately. The other reason is that they throw it into the wrong yard.

It can be concluded that residents are plagued with problems relating to storage facilities and the number of plastic bags that they receive.

Plate 5.3: Collection of Refuse Bags from Households

5.5 COLLECTION SYSTEM

As stated earlier there are a number of different types of collection systems, which include communal collection, block collection, waste exchange, on-site collection (bin collection, plastic collection) and kerbside collection. The kerbside collection occurs when collection crew collects waste in bins, bags and mobile containers that are deposited by the household at the kerbside at fixed intervals, usually once or twice a week. This service is high from the point of view of the user. This system requires a regular and well organised collection service (Franklin Associates, 1992). In the United States, the most common collection system used is kerbside collection whilst in India, the block collection is common (Cointreau-Levin, 1994). Pescod (1993) noted that in most developed countries, the level of service is once a week. According to Hope (1998), inadequate collection of waste usually leads to improper, even illegal, disposal practices.

In Phoenix, collection is once a week using the kerbside collection system. The council is responsible for the collection services in the Phoenix area. Each area in Phoenix has a specific day for collection e.g. the collection day for residents in community B is Tuesday (Gopal, 2001 and Moodley, 2001). The collection frequency (once a week) and collection system depicts conditions of developed countries. Rubelli (2001) and Gopal (2001) stated that three workers go ahead of the collection vehicle to collect the bags from the pavement in front of each household and then place it at a fixed location (Plate 5.4).

Plate 5.4: Central Location of the Collected Waste Bags

As indicated in table 2.3, the kerbside collection has both advantages and disadvantages. The residents need to ensure that the plastic bags are tied properly before putting it on the pavement so that roaming dogs and cats do not have access to it. Even the Keep South Africa Beautiful Campaign had found this to be a common problem in many areas (Keep South Africa Beautiful, 1997). Households need to know exactly which was the collection day. The residents have to ensure that the household waste is put on the pavements on time. Sometimes people put the waste out on the wrong day or late thus creating problems, which include:

- The plastic bags are likely to be ravaged by dogs and cats resulting in scattering of the wastes. This can also cause health and odour problems (Franklin Associates, 1992).
- The plastic bags are bound to serve as an obstruction to vehicles and pedestrians. -
- Keep South Africa Beautiful (1997) has also found that these plastic bags can cause road accidents e.g. on windy days, the litter can be blown on to the windscreen of cars, obstructing the driver's vision.
- The plastic bags are likely to result in littering of the street. This is worsened by the fact that street cleaning is not regular as stated by Moodley (2001).
- Food waste in the bags cause odours, which can be unhealthy and unhygienic especially if exposed to humans and animals.
- Some of the residents dispose the bags in vacant areas resulting in illegal dumping. Plate 5.5 illustrates the number of plastic bags disposed illegally on vacant land. As illustrated by table 4.21, it was found that sixty-eight percent (68%) of the respondents in Phoenix illegally dispose their household waste.

Pescod (1993) added that in some developed countries, waste collection is more frequent as a result of the weather e.g. in warmer climates in Southern Europe, collection has to be more frequent to minimise the problems from odours. As indicated earlier many of the respondents stated that they experienced numerous problems during the summer months, which included odours, pests, flies, rats, maggots. In Phoenix, the summer is hot and humid. Hence food wastes kept in the bins for a week creates the above problems. Some

respondents mentioned that food wastes such as crab shells, fish, chicken wastes, were dumped, as they would cause odours if it were kept in the bins for one week.

Plate 5.5: Illegal Disposal of Waste Bags

5.6 TRANSPORTATION

Flintoff (1984), Scharff and Vogel (1994) emphasised that collection systems were highly efficient when the system (containers, vehicles and personnel) suited the local conditions such as population density, residential structures or traffic conditions. According to Habitat (1989), transportation can be classified into non-motorised transportation (handcarts, animal carts and tricycles) and motorised transportation. Motorised transportation depends on the collection services. It is divided into communal collection vehicles and kerbside or on-site collection vehicles. The kerbside collection includes the non-compactor, semi-compactor, or compactor vehicles. The compactor vehicles are designed specifically for purposes of compacting low-density compressible wastes usually common in high income areas. The vehicle is appropriate in areas where labour cost is high and a small crew is required. The major types of compactor vehicles include

the rear-loading hydraulic compactors, screw compactor trucks, side-loading hydraulic compactors, rotating drum compactors and paddle compactors (Habitat, 1993). According to Seholoholo (1998), in South Africa, compactor vehicles are commonly used in white local authorities whilst in black local authorities, vehicles range from tractor, trailers, open top tipper trucks, standard compactors and front-end loaders.

In Phoenix, 5 workers go to pick up the waste with the collection vehicles. The vehicle used is the Rear-Loading Hydraulic Compactor (plate 5.6).

Plate 5.6: Rear – Loading Hydraulic Refuse Truck

Source: Resource (1999: 18)

Five workers accompany the collection vehicle. Three go ahead to put the plastic bags in a fixed place on the pavement. The other two workers that accompany the vehicle pick the bags and place it into the truck. The truck goes out twice, picking up two loads per day and is in service from Monday to Friday (Rubelli, 2001). According to Moodley (2001), the vehicle moves fast and the two workers have to load the vehicle quickly. If

the bags tear and the waste is scattered, it is very hard for these workers to pick up the waste resulting in littering of the pavement. Moodley (2001) also stated that street sweeping is not done timeously. Keep South Africa Beautiful (1997) also found that careless loading of the bins frequently causes some of the rubbish to fall out of the dustbin and be left behind on the ground resulting in littering. The collected waste from the Phoenix area is then transported directly to the Bisasar Road dump site (Rubelli, 2001).

5.7 SCAVENGERS

According to Habitat (1989) and Cointreau (1982), scavengers collect wastes during collection sites or at the dumpsites. In developing countries, there has been an increased awareness of the usefulness of scavengers at different stages in the disposal process. It has been found that the earlier the scavenger can collect the material, the more profitable and successful the work is e.g. in Manila, the government supported recycling at the following levels which included scavenging:

- Waste collectors and scavengers were allowed to scavenge during collection days
- Dump scavenging was also allowed (Habitat, 1989).

According to Hope (1998), the presence of scavengers, who literally live on refuse dumps, is a feature of refuse disposal in many developing countries. In some countries, scavengers consist mainly of adult males organised or grouped into gangs or guilds. In other cultures, the scavengers are women, or whole families of men, women and children (Hope, 1998).

In Nairobi, scavengers were found to have contributed to a high degree of paper collection. Scavengers had fixed places (street corners, parking lots) where office people bring used papers. This type of collaborative work is effective as both parties benefit. The office get rid of their waste and the scavengers earn an income (Habitat, 1993)

From the results obtained, scavenging was prevalent in the Phoenix area. In fact all the respondents stated that scavengers was prevalent during collection days (see table 4.16). Moodley (2001) and Gopal (2001) found that scavenging was a common feature during

the collection days in the Phoenix area. The scavengers generally were women and children (personal observation, Gopal, 2001). Plate 5.7 reveals scavengers at the collection site.

Plate 5.7: Scavengers at Collection Sites

The scavengers usually start scavenging early in the morning before the worker start to collect and heap the waste. However, mixed responses were obtained from the respondents and local authorities with regards to whether the scavengers were useful or not. The majority of the respondents in the Phoenix area (83%) stated that scavengers were useful but they felt that ravaging through the bins was unhealthy and unhygienic. Some of these residents stated that they keep the foodstuffs such as chicken fat and meat extracts, which is given to the scavengers during collection days. The respondents also stated that the scavengers were useful in that they collect the broken furniture, chairs, which refuse trucks do not pick up. Hope (1998) stated that scavenging provide a source of income, feeds recyclable articles back into use thereby reducing the volume of waste that has to be disposed.

A squatter community uses the Frankdale disposal site in Cape Town as their primary source of income through scavenging. Moodley (2001) and the respondents stated that the scavengers generally picked up items such as foodstuffs and things that they could use (old shoes, bags, clothes etc). He also added that as long as they do not leave the bags open or hinder the collection process, he found them useful.

There were respondents (17%) and local authorities that did not approve of scavenging for the following reasons:

- The respondents felt that scavengers were intruding into their privacy as they sometimes discarded documents that were confidential.
- The respondents also claimed that scavengers sometimes left the bags open thus encouraging dogs and cats to ravage through the bin resulting in littering of the verge. This also created a problem for the collectors, as they were unable to pick up the scattered waste.

Rubelli (2001) stated that the scavengers were a nuisance to the collection workers as they were sometimes still scavenging through the waste when the collectors come. Singh (2001) stated that scavenging for food is a very unhealthy and unhygienic practice and strongly opposed such a practice. He also stated that such a practice could also be dangerous e.g. broken pieces of glass.

Scavenging in most developing countries take place on the dump sites. It was reported that 5000 scavengers work on the dump sites in Mexico (Cointreau, 1982). In Guatemala, there are approximately 2000 poor families who live on the city's dump so that they can earn a living (Warmer Bulletin, August 1995). At the dump sites, it was found that most of the workers generally collect a single material in order to obtain a saleable quantity. In Asia, the plastic recycling on dumps are fairly common (Habitat, 1989).

Some municipalities consider scavengers as a menace and also prevent them from scavenging on the dump sites e.g. the New England Road Landfill site has constructed a

fence around the landfill and have a 24 hour security which has prevented scavengers from the Sobantu settlement to scavenge on the site (Gangoo *et al* 2000).

Rubelli (2001) stated that scavenging at Bisasar Road is only allowed after 4pm and they are only allowed to scavenge for recyclable materials. He also added that they have a twenty four hour security, as there are numerous problems experienced:

- Previously, scavengers used to come in front of the trucks thereby hindering the workers.
- Scavengers used to scavenge for food but this is prohibited by the City Health Department hence workers were threatened not to bury the food stuffs.
- The scavengers also used to steal the wire from the fencing around the landfill sites, which they use.

Hope (1998) stated that scavengers living on the dump site can physically disrupt the landfilling process and they can be in danger of being injured or killed by trucks, bulldozers or the compactors.

5.8 RECYCLING

It was found that recycling is practised for numerous reasons, which include financial gain, energy conservation, litter abatement, reduction of the waste stream and conservation of raw materials (KZN Waste Management in Policy and Discussion, 1999). According to Moodley (2001), there are not many recycling programmes in the Phoenix area. There are few schools especially primary schools that promote these programmes. Singh (2001) also mentioned that recycling is more prevalent in schools rather than within the community. This supports Nxumalo (1999) when he found that recycling was prevalent more in Primary Schools rather than High Schools in the Edendale area.

The results revealed that seventy-five percent (75%) of the respondents were not aware of any recycling programmes in the area. The twenty-five percent (25%) that were aware of programmes had heard it from their children or at their religious institutions (see table 4.17). It is evident that merely the children and religious organisations do recycling in Phoenix. Singh (2001) stated that the proceeds obtained from the recycling are used for

the school or the church. Freeman (2001) stated that numerous recycling programmes were launched at schools. This was done in order for children to participate and take the message home. The programmes included brochures (appendix 2) and workshops.
Moodley and Rubelli (2001) found that religious groups also played a vital role in encouraging recycling programmes e.g. the Sai groups, Krishna Organisations and certain Christian Youth Groups also encourage and practice recycling e.g. plate 5.8 reveals a recycling bank within the premises of a church.

Plate 5.8: Recycling Bank within Church Premises

Currently, recycling banks are mostly found in schools. It was found that schools have become involved in the recycling activity and are co-ordinated by the regional affiliates of Keep South Africa Beautiful. These ventures proved to be successful, as it is conducted for educational and fund raising purposes (Palmer Development Group, 1995).

Initially the garden refuse centre was used as a depot. However numerous problems were experienced which included:

- Initially recycling banks for glass were given for free. Now it costs R1500 for the banks.
- For the cans, it was not working, as the collected cans had to be taken to their depots. There was not sufficient manpower.
- Initially Mondi, sponsored igloos at the Canehaven refuse site. Unfortunately, the igloos were taken away as it was abused by residents e.g. a cigarette was thrown into the igloos setting it alight.
- Regarding plastics, it was vital to separate them and not contaminate them.
- Paper is a good source of revenue in terms of recycling. There is a recycling firm located in industrial park (appendix 3). However, residents need to transport the paper to the company. Those residents, who can make a living, are unable to do so, as they do not have a vehicle (Singh, 2001).

Interestingly enough, it was found that the majority of the respondents (93%) were interested in recycling initiatives. However, many of them stated facilities (waste bags, bins), recycling programmes, incentives, kerbside facilities should be provided so that recycling can work. Moodley (2001) and Singh (2001) have also stated that in order for recycling to work, such facilities and awareness programmes need to be provided. Poultney (2001) stated that there is great potential for recycling in the Durban area especially residential areas. However, lack of facilities, sponsorships and subsidiaries are making the recycling difficult to carry out.

The respondents had given suggestions on the types of recycling programmes, which they preferred (see table 4.18). The prevalent recycling programme in the Phoenix area was the Buy-in-centre (36%). According to Rogoff and Williams (1994), buy-in centres are places where people can take their recyclable items and are paid for them. However, it should be noted that igloos are usually found in drop-off sites such as parking lots, city landfills, shopping centres, schools etc. Therefore the drop-off sites are the most preferred recycling programme.

5.9 HOUSEHOLD WASTE MINIMISATION

The Waste Minimisation division was set up in May 1995 with the overall objective of saving valuable landfill space and promoting Integrated Waste Management. Integrated Waste Management involves the following:

- **Waste Minimisation** – To avoid creating waste in the first place, or excessive waste
- **Composting** – Valuable organic materials are diverted from the waste stream, before collection, to compost heaps and vermiculture farms.
- **Recycling** – Glass, cans, paper, cardboard, plastics are collected after use and returned to recycling companies who process them into articles which are resold to consumers (Freeman, 2001).

5.9.1 Reuse

According to Williams (1998), re-use involves using a product or package more than once or re-using it in another application e.g. re-using plastic carrier bags and glass containers. The results obtained reveal that the respondents (one hundred percent) had practised re-use but did not realise it (table 4.19) e.g. the re-use of glass jars and, packets. Another interesting method of re-use practised was the deposit system. However, very few residents used the system, as it was more convenient to buy items that were in plastic bottles. William (1998) also stated that the deposit refund systems had declined as a result of the introduction of new materials and consumer preferences (plastic bottles).

5.9.2 Recycle

The twenty-five percent (25%) of the respondents that did practice recycling was as a result of their children. The schools encourage children to bring in old newspapers. Certain religious organisation also encouraged recycling e.g. Krishna movements, Sai Groups, certain churches (Catholic Church situated on the corner of Northcroft and Esselen Crescent - plate 5.8) As indicated by plate 5.8, the recycling bin is inside the premises of the church. This is useful as someone from the church organisation is responsible for the maintenance of it.

5.9.3 Reduction

In terms of reduction, a mere fifteen percent (15%) practised it but also did not realise it e.g. use own of shopping bags or the reuse of plastic bags rather than buying or taking another bag from the supermarket. It was found that a number of the people going to the fruit and vegetable market practised this method as they took plastic bags from home. Most of them did it to save on buying another bag but it was still a good initiative.

5.9.4 Composting

According to Herbert (1993), small scale composting at home occurs when recycling yard waste and kitchen wastes such as leaves, grass clippings, fruit and vegetable scraps are used as a nutrient rich soil supplement for the garden. Fourteen percent (14%) of the respondents stated that nearly all the kitchen wastes except the meat wastes are thrown in the backyard (see table 4.19). Many of the respondents had complained that the soil in the area was very infertile and hence it was difficult to grow vegetables. Thus they resorted to throwing the kitchen waste in the yard. One respondent was very proud of his garden, as he had revealed it to me. He also mentioned an interesting fact that with his garden he is able to obtain vegetables and fruits free, as he now does not need to buy these items.

According to Diaz *et al* (1993), windrows are applicable to someone who has a large garden. However, the researcher found that from the respondents (14%) who claimed that they practised recycling, very few had large gardens. According to Moodley (2001), majority of the houses in Phoenix had limited yard space. Hence it was interesting to note that this fourteen percent (14%) of the respondents did make use of the space in their yard. Therefore, if one wants to achieve something, there are no limits.

According to Diaz *et al* (1993), many environmentalists are concerned with the high levels of heavy metals in the finished compost, rendering it unsafe. A number of the residents that had animals (dogs or cats) had given the meat extracts rather than throwing it into the bin. In fact these residents were also found to be taking out one bag per week. Also residents who had maids will collect the meat and chicken extracts which was given to the maids. They too used to take out one bag per week.

5.10 WASTE DISPOSAL

5.10.1 Sanitary Landfill and Incineration

According to Williams (1998), waste disposal can take the place in an uncontrolled or controlled manner. Uncontrolled disposal could take the form of illegal dumping or open burning. Controlled disposal of waste usually takes place by means of sanitary landfilling or incineration. In developed countries, the most common method of disposal is sanitary landfilling and incineration. In most developing countries, sanitary landfills are practised due to environmental considerations and a lack of suitable landfill space e.g. in the United States, the lack of landfill sites, strict disposal legislation and environmental legislation has made municipalities and states to practise sanitary landfilling (Cointreau, 1982). In Japan on the other hand, incineration was found to be the most sanitary method to treat wastes (Hershkowitz and Eugene, 1988).

In South Africa, the main form of waste disposal is through sanitary landfilling. Although there is no legislation that relates directly to waste disposal, there is little legislation in South Africa that relates directly to the environmentally acceptable development, operation and closure of landfills (Race Relations, 1994). Rubelli (2001) stated that refuse collected from the Phoenix area is taken to the Bisasar Road dump site where sanitary landfilling is practised. He stated that incineration occurs only for medical wastes. Hence controlled disposal of waste is prevalent for the Phoenix area. Rubelli (2001) also stated that with the formation of the unicity, the closing down of the Verulam and La Mercy dump site is going to put tremendous pressure on the Bisasar Road Landfill site. He suggested that a new landfill site should be sited and a transfer station built. He also added that the council does not support the move as they claim that they do have sufficient money.

5.10.2 Illegal Waste Disposal

Cointreau (1982) has found that open dumping seemed to be the most prevalent form of disposal in developing countries. Songsore (1992) also found that illegal dumping was very common in developing countries e.g. in Ghana dumping was a problem due to the

limited capacity of the waste collection service. Cointreau-Levin (1994) also stated that when adequate refuse removal services were not provided, illegal dumping becomes a common feature in these areas e.g. in Bangkok, uncollected solid waste accumulate around homes and in canals. In Phoenix, uncontrolled dumping is also practised. Hence one will notice that Phoenix has characteristics of controlled and uncontrolled dumping. This is further explained by using the results obtained and the local authority views.

5.10.2.1 Prevalence of Illegal Waste Disposal

Firstly, all the respondents (table 4.20) claimed that their area was characterised by illegal waste disposal. Moodley (2001) and Singh (2001) also claimed that the Phoenix area is characterised by illegal dumping. From personal observation of the five areas (community A, community B, community C, community D, community E) selected, the researcher found that dumping was prevalent (plate 5.9 - 5.12) In fact, the researcher had visited all the twenty five units and at least one illegal dumping site was found. Sometimes in a particular unit, more than one illegal dump sites were found. Freeman and Singh (2001) had also supported the claim that Phoenix is characterised by illegal waste disposal. Rajpal (1999) also found that Phoenix was characterised by illegal waste disposal. The respondents (59%) claimed that the illegal dump sites were less than 199 metres from their home (table 4.22). This indicates that the illegal dump sites were close to the respondent's homes.

Plate 5.9: Community A (Woodview)

Plate 5.10: Community B (Brookdale)

Plate 5.11: Community C (Longcroft)

Plate 5.12: Community D (Rockford)

Plate 5.13: Community E (Grove-End)

5.10.2.2 Types of Illegal Waste Disposal

According to the Eilrich *et al* (1997), the following materials are disposed off illegally:

- Construction and demolition wastes, bricks, concrete, timber;
- Abandoned automobiles, autoparts and scarp tyres;
- Household trash - kitchen wastes, paper, plastic, broken crockery;
- Bulky wastes – disused domestic appliances, furniture;
- Garden refuse – tree cuttings, grass cuttings;
- Medical wastes from pharmacies, surgeries etc.

The types of wastes disposed in the Phoenix area received multiple responses from the respondents. The respondents claimed the following (see table 4.21):

- Ninety-seven percent (97%) garden refuse (plate 5.14).
- Eighty-three percent (83%) rubble (plate 5.15).
- Sixty-eight percent (68%) household wastes (plate 5.16)
- Fifty-four percent (54%) other wastes
- Seventy-three (73%) factory waste
- Twenty-five percent (25%) old appliances and furniture (plate 5.17).

Plate 5.14: Garden Refuse Disposal

Plate 5.15: Disposal of Rubble

Plate 5.16: Household Wastes

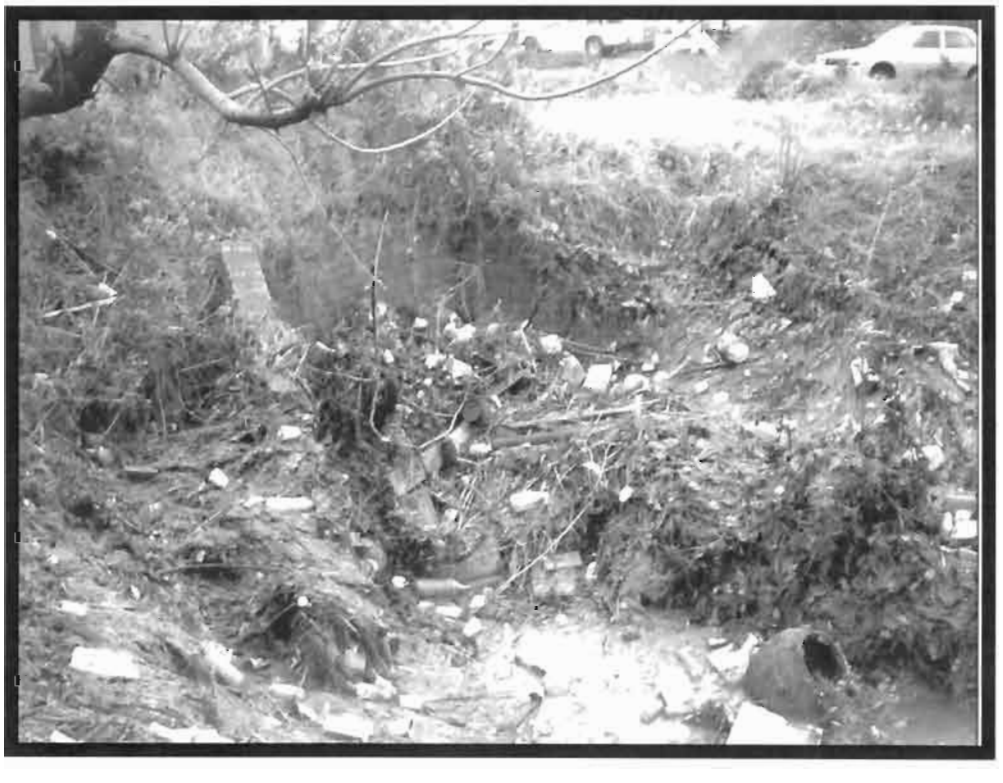


Plate 5.17: Old Appliances and Furniture

According to Moodley (2001) and Singh (2001), the following wastes were disposed in the area: domestic refuse, rubble, garden refuse and factory wastes. With regards to why different types of wastes were illegally disposed, could be attributed to the following:

- It was found that the majority the respondents (93%) were not aware of the green bag programme. Rubelli (2001) claimed that the green bags were advertised in many newspapers including the Daily News, Metro Beat. Singh (2001) also claimed that he was aware of such a programme. The minor proportion that was aware had heard about the programme at work and from friends and relatives living outside Phoenix. The researcher had also found that the majority of the respondents (82%) were not aware of the Garden Refuse site in Canehaven whilst a minor proportion (18%) were aware of the site. From the eighteen percent (18%) of the respondents that were aware of the site, only three percent (3%) used the site. The prevalent reasons for not using the site was transportation and cost. As indicated by table 4.23, a minor proportion of the respondents (18%) used their vehicle to dispose their wastes. The majority of the respondents (83%) used

a barrow or got the garden worker to manually dispose the waste in the vacant areas. It is important to note that the illegal disposal sites were closer to the respondent's home (table 4.22) hence making it easier to dump the wastes.

- Moodley (2001) stated that rubble was a major disposal problem. He added that there was only one disposal site for the residents of Phoenix, which was located in Springfield. He concluded that this was not adequate. Singh (2001) also found that residents dump rubble at the nearest vacant area. He stated that cost involved in disposal of the rubble was high hence people resorted to illegal dumping.

- Singh and Moodley (2001) have found that within the Phoenix area, there are numerous small businesses such as upholstery, dressmaking, carpentry, and panelbeating. The majority of these businesses dump their waste at the nearest vacant area (Moodley, 2001). Rubelli (2001) stated that textiles, woods etc were taken to the garden refuse site. As revealed in the analysis only eighty-two percent were aware of a garden site in the Phoenix area. The researcher found that one small business had resorted to burning the textile wastes, as they were not aware of the garden refuse site.

- Some of the residents had forgotten to take out their waste on collection days. Since they were unable to keep the waste for another week, they resorted to illegal dumping. When people use bags bought from the roadsides, they know that it would not be collected by the refuse trucks hence they dump it. Another interesting thing revealed by the residents was that foodstuffs such as fish remains, crab shell etc were dumped as refuse collection was only once a week and residents could not put in the bins as it would stink (as found earlier).

- Other wastes include wastes from shops, markets, vendors, butcheries, fisheries, garages and community halls. For example, in community B (Brookdale), the vacant plot near the market is extremely untidy, as illegal dumping of wastes is prevalent. Even in community A (Woodview - Redgewood), the area near the

shopping complex has illegal dumping. Moodley (2001) stated that the area near the Westham shopping complex was also rife with illegal dumping. He had also found that the Joosab Centre had contributed to a large degree to the illegal dumping in the Esselen Crescent area. In Brookdale, there is a market place, which contributes severely to the illegal dumping in the surrounding vacant area (Plate 5.18)

- A small percentage of respondents (25%) claimed that broken appliances and furniture was illegally dumped in the Phoenix area. These results can be attributed to the prevalence of scavengers. These scavengers generally pickup the broken appliances for their own use (see table 4.16).

Plate 5.18: Illegal Dumping near the Market Area

Some of the respondents had admitted to dumping certain wastes in their area:

- The respondents (16%) claimed that they dumped broken appliances (table 4.12) in open spaces. Many of the respondents claimed that the refuse truck do not pick up the broken appliances and chairs hence they resorted to dumping the waste. It

is important to note that the rate of disposal is quite minimal. This could be attributed to the fact that scavengers present in the Phoenix area (table 4.16) collect these items.

- The respondents (32%) stated that they disposed their rubble in open spaces (table 4.13) (plate 5.19). They stated that it was cheaper as they did not have the money to hire a vehicle to take the rubble to Springfield. Those that claimed that they had contractors (16%) could not verify where the contractor disposed the rubble.

Plate 5.19: Disposal of Rubble

- The respondents (24%) stated that they disposed their garden refuse in open spaces (table 4.14). As mentioned earlier, the majority of the respondents (93%) were not aware of the green bag programme. Rubelli (2001) claimed that the green bags were advertised in many newspapers including the Daily News, Metro Beat. Singh (2001) also claimed that he was not aware of such a programme. The minor proportion that was aware had heard about the programme at work and

from friends and relatives living outside Phoenix. The researcher also found that the majority of the respondents (82%) were not aware of the garden refuse site in Canehaven whilst a minor proportion (18%) was aware of the site. From the eighteen percent (18%) of the respondents that were aware of the garden refuse site, only three percent (3%) used the site. The prevalent reasons for not using the site was transportation and cost. This illustrates that the location and the number of sites were inadequate.

Singh (2001) found that people from other areas such as Ottawa used the garden refuse sight. Rubelli (2001) also found this scenario to be common e.g. residents from Queensburgh made use of garden refuse site in Chatsworth. The researcher found that the majority of individuals using these facilities had vehicles or could afford contractors. Moodley (2001) and Singh (2001) also found that people with vehicles and money used these garden refuse sites.

Hence it is clear that Phoenix is characterised by Illegal Dumping. The reasons for such vast scale dumping are numerous but the lack of Solid Waste Management Practices is clearly evident.

5.10.2.3 Offenders of Illegal Waste Disposal

According to Illegal Prevention Guidebook (1998), offenders can include: Construction and demolition workers, waste management companies, industries, factories, hardwares, scrap collectors and local residents. Multiple responses were obtained from respondents in the Phoenix area with regards to the offenders of illegal waste disposal:

- The respondents (78%) claimed outsiders were responsible for the illegal waste disposal in their area.
- Builders and contractors (74%) were also found to be guilty of dumping.
- Seventy-one percent (71%) claimed that factories were also responsible for the illegal dumping in the area.
- The respondents (65%) also mentioned that the local residents themselves contributed to the dumping in the area.

- Fifty-two percent (52%) of the respondents claimed that people from shops, garages, butteries, fisheries, vegetable stalls, vendors and community centres were also responsible for illegal dumping e.g. Moodley (2001) stated that the supermarkets were responsible for the illegal dumping in the Westham and Gem city area.

It possible that the types of wastes disposed can determine the offenders. From personal observation and the plate already viewed, the following can be concluded:

- Household wastes broken appliances, chairs – outsiders, local residents, markets;
- Cardboards, Plastic cups – supermarkets, community halls;
- Tyres – factories, small businesses (mechanics and panel beaters);
- Leather and Fabric – small businesses and factories;
- Garden refuse – local residents and outsiders;
- Rubble – builders, local residents and outsiders.

5.10.2.4 Factors Contributing to Illegal Waste Disposal

According to Nel (1996), communities that resort to illegal waste disposal are those with limited access to convenient, affordable facilities or services and recycling programmes. Lombard (1990) stated that townships with inadequate waste removal services result in illegal waste disposal sites in and around the township. According to Hope (1998), inadequate collection of waste usually leads to improper, even illegal disposal practises.

According to all the respondents the frequency of waste removal in the area was once a week. This can create problem as mentioned earlier, that some residents might miss the refuse removal day, hence they have no choice but to illegally dispose their household waste. In fact as illustrated in table 4.15, the respondents have stated that they have resorted to illegal dumping for numerous reasons (revealed above). It is also important to take note that seventy-four percent (74%) of the respondents had more than five members in their family (table 4.4) and the Solid Waste Department only gives two bags but collects the refuse once a week.

In fact over half the respondents (58%) stated that the removal service was poor whilst thirty six percent claimed it was satisfactory (table 4.11). A small percentage (6%) stated that the service was good. The respondents had also given reasons for claiming the services was poor, which included:

- The frequency of collection was not adequate;
- Insufficient refuse bags especially where large families were involved;
- Insufficient storage containers;
- Wastes such as broken appliances and furniture were not picked up by refuse collectors.

Hence one can conclude that that two refuse bags are insufficient, the collection frequency and services is not adequate.

Gowans (2000) stated that unsecured properties including undeveloped lots, abandoned structures, industrial facilities and remote spaces are potential target areas for offenders of illegal dumping. Moodley (2001) and Singh (2001) stated that in Phoenix, vacant land was the prime target for illegal dumping. From personal observation, this was revealed e.g. community D (Rockford) had numerous isolated places.

Poorly lit areas, roads and alleys are also prime targets for illegal dumping (Gowans, 2000). Moodley (2001) stated that in Phoenix he found that quite roads and dead-end roads were prime dumping areas. A good example is the dumping area situated in community E (Grove-end) near the swimming pool. Upon visiting the area, it was revealed that it was a dead-end, poorly lit and was hardly used by residents (plate 5.20). Dumping on the road was very prevalent (personal observation).

Thirdly, the Illegal Prevention Guidebook (1998) stated that those areas with a lack of alternative Waste Disposal systems tend to experience a higher incidence of illegal dumping. As illustrated in table 4.17 and mentioned earlier, seventy-five percent (75%) of the respondents were not aware of any recycling programmes in the area. The twenty-five percent (25%) that were aware of recycling were from their children's school or at

the religious organisations. Moodley (2001) and Singh (2001) also stated that there was a lack of recycling initiatives in the Phoenix area.

Plate 5.20: Dumping in Dead-End Roads

Moodley (2001) also added that as a result of only one garden refuse site in Phoenix, which was not ideally situated and was insufficient, people resorted to illegal dumping. Rubelli (2001) stated that the greenbags should be used for the collection of garden refuse. As illustrated earlier, the majority of the respondents (93%) were not aware of this programme. When the respondents were explained about the system, they refused to accept it as they stated that they could not pay R23 for R12 bags.

Rubble and tyres are prohibited form entering the landfill site (Rubelli, 2001). According to Moodley (2001), although effort was made to either minimise or control illegal dumping, the problem was exacerbated by the lack of a legal disposal sites in Phoenix. As indicated in table 4.22, the illegal disposal sites were closer to the respondent's home rather than the legal disposal sites. Bradshaw and Chadwick (1980) stated that areas where there is no land on which domestic refuse or commercial refuse can be easily

disposed, other disposal methods are used e.g. burning of garden refuse and illegal dumping. From table 4.15 it is evident that respondents resort to burning and illegal dumping.

According to Moodley (2001), a number of environmental programmes regarding illegal waste disposal have been embarked on such as Adopt-a-Spot Project (appendix 4). However, it seems that these programmes were ineffective as all the respondents claimed that they were unaware of such programmes. This could be attributed to the fact that the programmes were embarked on in certain areas of Phoenix (Stanmore). As stated by Singh (2001) earlier, the majority of environmental programmes occurred mainly in schools. Freeman (2001) also acknowledged that most of the environmental programmes are held in schools.

Fourthly, the Environmental Protection Agency (1998) stated that illegal dumping is a problem in many areas because of lack of effective legal codes or ordinances prohibiting illegal dumping or burning of wastes. Also fines given that are less than the costs for proper waste disposal encourage offenders. According to Fuggle and Rabie (1996), there are several issues in the Solid Waste Legislation and its application that needs to be addressed such as:

- The by-laws relate primarily to the protection of public health and prevention of nuisance as opposed to facilitating the management of solid waste.
- Legislation is not aimed at avoidance, source separation or stimulating re-use or recycling.
- At the level of local government, there is no uniform set of by-laws for waste management.

According to Moodley (2001) with the lack of effective laws, people are more likely to resort to illegal dumping and burning of garden refuse. He also added that the prosecution rate of offenders of illegal dumping was minimal. He stated that residents were afraid to testify when offenders denied the act of dumping, resulting in the offender going free. It can be concluded that with the lack of facilities and effective laws, people are more likely to illegally dispose of their waste.

5.10.2.5 Awareness Programmes

It was found that all the respondents were unaware of environmental programmes in the area. However, Moodley (2001) claimed that there are several environmental awareness programmes to try and curb the problem of illegal dumping. Some of these programmes included the Adopt-a-Spot Project, Notices, and Pamphlets (appendix 4). The lack of awareness could be attributed to the concentration of the programme only in certain areas. According to the Illegal Prevention Guidebook (1998), community programmes have proven effective in addressing the problem of illegal dumping.

Freeman (2001) has also stated that they have embarked on environmental awareness programmes using pamphlets. However, it is targeted only in schools in the hope that children can take the message home. The residents (75%) did not hear of recycling programmes (table 4.17). However, it was found that the majority of the respondents (93%) were interested in recycling programmes within the area whilst a minor proportion (7%) were not interested. The ninety-three percent (93%) that were interested stated that they would separate the waste as long as facilities are provided. They also suggested incentives, competitions, sponsorships etc.

According to the Environmental Protection Agency (1998), the following applications of practice has proven effective in combating Illegal Dumping:

- Cleanup programmes that requires planning, resource and implementation;
- Keeping sites clean by putting up signs, lighting, barriers, and beautification;
- Community programmes, which involve community participation;
- Education programmes, which include communication, target audiences, available resources and ordinances;
- Dedicated enforcement and prosecution;
- Field operations including appropriate training, authority and equipment.

The multiple responses obtained with regards to changes needed to curb or combat the problem of illegal waste disposal are as follows (table 4.27):

- Seventy-nine percent (79%) of the respondents claimed there is a need for prosecutions;
- Eighty-nine percent (89%) of the respondents claimed that there is a need to increase refuse bags;
- Seventy-three percent (73%) of the respondents stated that the removal frequency should be increased;
- Ninety-four percent (94%) of the respondents strongly wanted the area to be developed;
- Eighty-eight percent (88%) of the respondents stated that there is a need for more awareness programmes;
- Finally ninety-six percent (96%) stated that there should be more disposal sites.

5.11 IMPACTS OF SOLID WASTE MANAGEMENT PRACTICES

According to Lombard (1996) solid wastes impact both the natural and human environment. The major problems occur as a result of uncollected waste and illegal dumping. It is important to take note that the human and natural environment is closely linked. This implies that inadequate solid waste management impacts on the natural environment, which inevitably affects the human environment and vice versa.

Uncollected waste can lead to blockages in stormwater drains. The water cannot drain and thus it becomes contaminated. This water exposes residents to a number of diseases such as cholera etc (Shamrock, 1995). Also wastes that are dumped in vacant areas near a drain or in a stream are bound to create such problems (plate 5.21). Sixty-two percent (62%) of the respondents stated that wastes found near or within drains and manholes caused major problems during the rainy seasons (table 4.25). As a result of the drains been blocked by waste, the water begins to end up in people's home or on roads making it difficult to drive. Moodley (2001) stated that every time it rained, the Parks and Garden Department had to clear drains to prevent any flooding of homes and roads. Plate 5.22 reveals the blocked drain as result of illegal dumping. It was also found that children play near these areas and people use the area to commute e.g. Woodview Educare is situated

near an Illegal Dumping Site. This is dangerous as the children are exposed to the risks posed by the dump site such as injury and diseases (plate 5.23).

Plate 5.21: Dumping of Wastes in Streams

Plate 5.22: Blocked Drains

Plate 5.23: Woodview Educare

According to Cointreau (1982), in many developing countries, people tend to dump their wastes in streams or rivers resulting in stagnant waters. Contaminated water thus poses health risks both to people within the immediate area and further afield e.g. children playing in the canals of Khayelitsha are at serious risk of contracting a disease (Wright, 1992). Moodley (2001) stated that residents, outsiders, factories etc dump wastes in the canal near the Phoenix Highway. Many of the respondents (84%) particularly those living near streams or rivers stated that water pollution was prevalent as a result of illegal dumping or uncollected waste.

According to Hardoy *et al* (1992), wastes that are burned release harmful toxins and suspended particles into the air. As revealed earlier in table 4.15 respondents were found to burn their garden refuse and old furniture and appliances. The respondents (46%) have also claimed that air pollution occurs as a result of illegal dumping (figure 4.12). Moodley and Singh have (2001) found that residents that live near the illegal dump sites take it upon themselves to set alight the wastes. It was also found that wastes that are buried under the sand, produces a gas as it rots. If not properly controlled, the gas can

explode (Rubelli, 2001). Moodley (2001) also found that residents using the dump areas to commute tend to leave lighted matches or cigarettes in the area.

Children (playing) and adults (commute) that use the dump areas are likely to be injured. The Woodview Educare has an illegal dumping site near the centre (plate 5.9 and plate 5.23). Children are exposed to broken glass, rusty cans etc (Hope, 1998). Singh (2001) found that dumping in pathways are also very common in certain parts of Phoenix (plate 5.24). This can be dangerous for people and children using these pathways. It was noted that animals are also at risk as they ravage through these dump sites which might be harmful to their health. Uncollected waste is aesthetically unpleasant both visually and due to the smell from the rotting waste. The respondents (100%) stated that the dumping areas were unaesthetic (plate 5.25) whilst eighty one percent (81%) stated that terrible odours were emitted from these sites especially in summer. Moodley (2001) stated that dumping is very unattractive and creates a poor image of the area. A resident living close to an illegal dump site stated that he could not study, eat or sleep during the day without the inference of flies and the pungent odour (Sowetan, 2001).

Plate 5.24: Illegal Dumping on Pathways

Plate 5.25: Unaesthetic Environment

According to Hardoy *et al* (1992), the concentrations of organic waste attract pests such as flies, rats and cockroaches, which can be carriers of certain diseases. Respondents (79%) complained of the rodents and insects that were prevalent at dumping areas even at drains that were blocked.

According to the Environmental Protection Agency (1998), illegal dumpsites serve as magnets for continual waste disposal and criminal activities. There was an unborn baby found in an illegal dump site in Lenham. In Eastbury, the vacant land that was used for dumping was found to be a hive for criminal activities (Phoenix Tabloid, 2001). Moodley (2001) and Singh (2001) both conferred that illegal dump sites were a hive for criminal activities.

5.12. CONCLUSION

From the data revealed, one will notice that Phoenix does have a waste collection service in place. But Phoenix residents have a number of problems with the current solid waste management practices. Residents, NGOs, Keep Durban Beautiful Association and Local

authorities have admitted that there are flaws in the current Solid Waste Management Practices. From the data collected, the impacts of the inefficient collection services are clearly evident on the natural and human environment. It is without any doubt that the current Solid Waste Management Practices are lacking and there is a need to look at the alternatives before it is too late. Respondents have also stated their dissatisfaction and have even made suggestions, which prove valuable when making the recommendations.

CHAPTER SIX
RECOMMENDATIONS

6.1 INTRODUCTION

According to Krueger (1999), recommendations, goes beyond interpretations, placing greater emphasis on obtaining multiple perspectives on the meaning of raw data, as well as various views regarding future courses of action. At this level, consideration is given to practical consequences of alternative interpretations. As illustrated throughout the literature, South Africa's Solid Waste Management problem is increased daily but no changes have been made to rectify the problems. The greatest challenge for South Africa is to manage the situation with all its constraints and opportunities in such a way that the environment is not threatened unnecessarily. As revealed in the previous chapter, the current Solid Waste Management Practices in the Phoenix area is inadequate. Hence, the researcher will make recommendations that can help community, local authorities and Non-Governmental Organisations in changing the current situation so that the harmful effects from solid wastes are minimized.

6.2 PROVISION OF ADEQUATE WASTE FACILITIES

6.2.1 Storage Containers

From the report, it has been found that many residents have stated that the storage containers are inadequate especially since the collection is once a week. Local councils should ensure that residents have storage containers. Extra plastic bags should be given to residents who need them especially those that have large families. The stealing of storage facilities can be alleviated, if residents chain it to their homes or put their names and address on the bins.

6.2.2 Collection Frequency and Transportation

Initially the council used to collect household waste twice a week. At present, the frequency is once a week. The frequency during summer should be increased to twice a week as respondents have revealed that it is difficult to keep food wastes (chicken, fish

and meat extracts) in the bin. In fact council should give residents another storage container as collection is once a week and residents have been found to take out more than waste bag per week. The extra storage container will alleviate the problems created by the dogs and cats. The refuse trucks should not refuse to collect broken chairs etc and nonlabelled refuse bags as people tend to illegally dispose these wastes in vacant areas.

The waste transportation facility is quite reliable. Moodley (2001) stated that the truck moves too fast during collection times, resulting in workers not been able to pick up all these wastes. The driver should therefore move at a pace that is convenient for the refuse pickers so that waste bags are not left behind and spillages are properly picked up.

6.3 SCAVENGERS

6.3.1 Scavengers at Collection Sites

According to Habitat (1989) and Cointreau (1982), scavengers collect waste at collection sites or at the dump site. It was also found that the earlier the scavenger can collect the material, the more profitable and successful the work is e.g. in Manila, scavengers were allowed to scavenge on collection days (Habitat, 1989). Seholoholo (1998) stated that scavenging near the source is more profitable rather than at the disposal site. As indicated by the respondents of Phoenix, there is a prevalence of scavengers during collection days. The majority of the respondents did not have a problem with them. However, there are numerous ways that scavenging can be beneficial and safe to both the scavengers and the households:

- Households refrigerate the food such as chicken fats, meat extracts etc and give it to the scavengers on collection days;
- Scavengers need to ensure that waste bags are properly tied after going through the bag;
- Local councils and recycling companies should work with these scavengers;
- Households should help scavengers by collecting recyclable material separately for them e.g. separate newspaper and plastic for the scavengers;

- This collaborative work helps scavengers produce a source of income and reduces the amount of waste entering the general waste stream;
- The households should ensure that broken glass, bottles etc should be buried rather than placed in the plastic bags. It endangers the health of the workers and scavengers;
- Scavengers should ensure that they go through the bags before the workers come or before the refuse truck arrive. They should not hinder the collection process in any way;
- Collection workers should not scold or prohibit the scavengers from going through the refuse bags.

6.3.2 Scavengers at Disposal Sites

According to Rubelli (2001), the scavengers at the disposal sites are problematic for numerous reasons, which include:

- Scavengers run onto the dump sites when food is brought to be disposed;
- Scavengers are found to be in constant danger of being run over by the bulldozers;
- Scavengers threaten the drivers of the trucks not to bury the food;
- The security guards at the gates are constantly harassed when the scavengers are not allowed to scavenge;
- The scavengers living near the dump sites also destroy the wire fencing around the disposal site;
- Scavengers are exposed to numerous health hazards particularly when they scavenge for food.

As indicated above scavengers near the disposal site cause numerous problems. Hope (1998), also indicated that scavengers exposed to numerous diseases (scurvy) and that their presence can physically disrupt the landfilling process and they are in constant danger of being injured or killed by the trucks or bulldozers. However as revealed in many countries, they can prove extremely useful when it comes recycling. Habitat (1989) had found that scavengers contributed to a high degree of paper collection. Ohnesorgen (1993: 20) stated that "scavengers are, in a sense, a resource because they recycle solid waste and cities have to learn to work with them and train them, not work against them'.

Hope (1998) also stated that scavengers could not be ignored instead solutions should be investigated to allow them to scavenge without causing harm to them or affect the landfill process. Some of the solutions proposed include:

- An intermediate site should be found close to landfill;
- Scavengers should be encouraged to scavenge for recyclable materials;
- Contractors should get involved in this process so that scavengers can be paid for their recyclable materials;
- Protective clothing such as gloves, masks, overalls and boots should be supplied to the scavengers;
- Food stuffs from supermarkets that are good should be given to the scavengers rather than burying it e.g. Rubelli (2001) had found that certain supermarkets bring in goods for disposal as result of power failure. He stated that 95% of the food is good but due to the Health Department Regulations, scavengers are unable to collect the foodstuffs. Therefore, in such a situation these scavengers should be given a chance to collect the food before it is disposed.

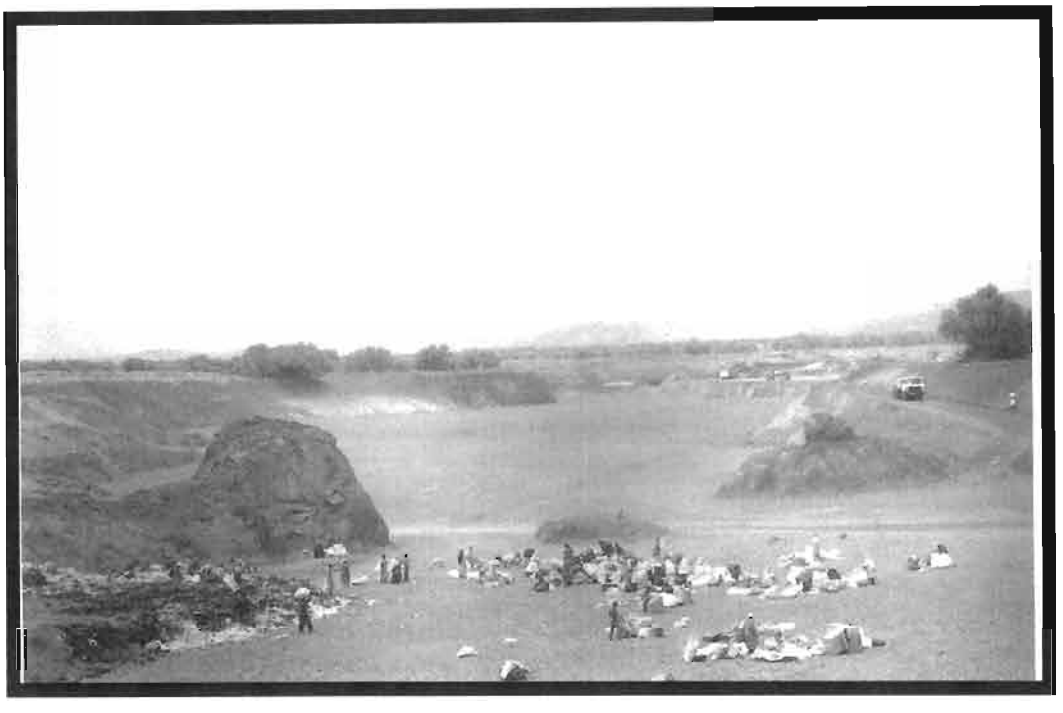
An excellent example of cooperation and collaborative work between scavengers and local authorities is maintained at the Hatherley Landfill site (plate 6.1). This can prove to be useful example for local authorities and scavengers in the Durban area. People are allowed on-site to earn a living through recycling. The following rules have to be abided by the scavengers who, were allowed twice a week on the site:

- No squatting was on-site or sleeping overnight.
- No smoking on-site.
- Customers delivering condemned food or foodstuff were strictly left alone.
- The collection areas should be kept clean and tidy.
- There are two safety officers who ensure that these rules are followed (Resource, 2000).

Since there is a vast amount of recyclable material entering the waste stream in the Phoenix area, scavengers should at least be allowed to scavenge for the recyclable materials. In doing so, they would be able to generate an income to support themselves. The scavengers can be given rules regarding scavenging at the Bisasar Disposal site e.g.

they can scavenge during certain times of the day so that they do not get in the way of the workers.

Plate 6.1: Scavengers at Hatherly Landfill Site



Source: Resource, (2000: 23)

6.4 LEGISLATIONS

According to Lombard (1999), there is a need for an integrated legislation in South Africa based on an environmentally caring policy supported by a definite strategy to control all the elements of the waste management system. He added that a well-planned and adequately staffed regulatory authority structure is required to ensure that, on the basis of good local control, the country's waste can be managed. According to Parkin (1995), South Africans are notoriously apathetic and will therefore require some form of enforceable legislation. He added that there is a lack of legal enforcement of littering bylaws and responsibility for paying for services. Seholoholo (1998) also made some excellent suggestions regarding the formal waste system so that it can at least be managed properly and the amount of material entering the formal waste stream ca be recycled. According to Mbande (1997), legislations on:

- The Polluter Pay Principle should be implemented;
- A clause should be amended on the Environmental Bill, which stipulates clearly regulation or law;
- The Environmental Bill should state clearly the role of the municipality, communities and various enterprises involved in waste management should be clearly defined and co-ordinated;
- The Environmental Bill should stress a partial separation at source for recycling purpose. Producers should be advised to try as much as possible to produce recyclable materials and packagers should avoid over packaging as a means of waste minimisation;
- Although the National Environment Secretariat has formulated the Environmental Bill, a comprehensive waste management policy should be formulated in order to avoid dealing with waste materials in different, fragmented laws. The process of waste management policy formulation will facilitate the promulgation of waste management legislation and accompanying regulations. These should enforce environmental education and awareness.

As indicated by the above researchers, there are number of issues that needs to be dealt with regarding the current legislation system dealing with Solid Waste Management Practices.

6.5 ENVIRONMENTAL AWARENESS PROGRAMMES

The Minister of Traditional and Environmental Affairs in his opening address at the Local Agenda 21 Conference 1997, stated that the primary aim of environmental education was to empower people, so that they can make informed choices about their daily activities and the impact that their activities have on their environment (Nxumalo, 1999).

6.5.1 Schools

Freeman (2001) has indicated that most of the environmental awareness programmes in the Phoenix carried out by Keep Durban Beautiful Association was mainly directed towards children in schools. She also added that it took place mainly in primary schools.

Nxumalo (1999) found that environmental education should be taught from primary, secondary and at tertiary level. He also added that the curriculum should be designed to include environmental issues such as solid waste management, pollution, etc. In Phoenix schools, numerous changes need to be made to include environmental issues in the school programmes:

- Environmental education should take place at all levels of education (primary and secondary);
- Curriculums should include environmental issues so that children can become more aware of their environment;
- Teachers should get children involved in projects dealing with taking care of the environment e.g. school children from Crossroads, Western Cape embarked on a cleaning campaign of their environment (Resource, 2000) (plate 6.2);

Plate 6.2: School Participation

Source: Resource, (2000: 15-17)

- Children should be encouraged to participate in environmental competitions e.g. the ESKOM Eduplant 2001 – Schools Permaculture Competition (appendix 5);
- In 1997, the Plastics Federation of South Africa embarked on a campaign to help address the problem of littering. The campaign included environmental exhibitions, workshops and the production of educational materials for schools

(Plastic Enviromark, 2000). These types of exhibitions and workshops are needed in the Phoenix schools so that the awareness of our environment is increased;

- In Jamaica, it was found that teaching children about Solid Waste Management, was a powerful strategy in developing the students' knowledge, skills, willingness and ability to participate in activities to manage solid waste (Hope, 1998).

It is important to note that schools can play an effective role in conveying the message of Solid Waste Management. In the Phoenix area, there is the potential to harness the potential that schools can contribute in the Management of Solid Waste e.g. curriculums can be developed so that incorporate issues relating to Solid Waste Management. Children from an early age can be encouraged to practice recycling and convey the message to their parents.

6.5.2 Community and Religious Institutions

Environmental Awareness programmes should target the community as a whole. As respondents (100%) have indicated in each of the communities, that there are no environmental awareness programmes in their area. The respondents (88%) have indicated (table 2.27) that environmental programmes are needed in the Phoenix area. The community needs to become educated about the role of responsible waste disposal and management. The Environmental Awareness Programmes should include the following:

- Religious organisations and youth group should include the environment as an important aspect in their teaching e.g. The Sai Groups and Christian Church groups were found to include environmental issues such as recycling, cleaning the environment in their teachings (Singh, 2001);
- Keep Durban Beautiful should include not only schools in their environmental programmes but also religious institutions;
- Environmental Programmes embarked in Phoenix should include all the communities in Phoenix rather than concentrating it in one area only. A good initiative was the Phoenix Environmental Fair held by the Phoenix Environmental Committee (appendix 3). However, the flaw of the fair was that it was concentrated only in the Grove-end and Stanmore area;

- Companies need to include communities in any environmental programmes especially in the Phoenix area. An excellent example is the Plastic Environmental Campaign, which was launched to create environmental awareness among the public and to publicise the anti-littering message. Communities had embarked on a coastal clean up day of the Hout Bay (plate 6.3). In Kimberely, residents volunteered to clean their environment (Plastic Enviromark, 2000) (plate 6.4);

Plate 6.3: Community Participation – Hout Bay

Source: Plastic Enviromark, (2000: 2)

Plate 6.4: Community Participation - Kimberely

Source: Plastic Enviromark, (2000: 4)

6.6 METHODS OF WASTE MINIMISATION

As illustrated throughout the report, respondents have complained of the inadequate collection services. Refuse collection might exist in the Phoenix area, however with the problems mentioned by the respondents and local authorities changes have to occur. Based on the literature the researcher suggested one of many recommendations, which is the concept of 'Waste Reduction' especially when dealing with issues relating to Solid Waste Management.

The researcher felt that by embarking on the concept of waste reduction, many of the problems revealed by respondents could be minimized. Lombard (1999) stated that the waste reduction is severely needed in the growing context of the South African situation. He added that the waste industry has an opportunity to be a major contributor to job creation, if only, a national goal was set to reduce the waste volume produced by all e.g. reduction of current tonnages by 40% within the next five years. Therefore as illustrated, there is vast scope for the waste reduction programmes. Waste minimisation can involve methods, which include reuse, recycle, composting and reduce.

As revealed in figure 4.10, people are practicing these methods, in small amounts and do not even realize it. This is what local authority and businesses need to harness. There is an opportunity for such methods to be applied in the Phoenix area. Singh (2001) stated that there is a potential for using waste minimisation methods in the Phoenix area. Freeman (2001) has also stated that waste minimisation methods are desperately needed in South Africa. The following methods can be explored in the Phoenix area:

6.6.1 **Waste Reduction**

South Africa can become a serious player in the domestic waste reduction scheme, if a reduction goal is set e.g. 25% reduction within the next five years (Resource, 1999). According to Keep South Africa (1997), the best way to deal with waste is not to produce so much in the first place. There are numerous ways that one can reduce waste:

- The majority of consumer goods have unnecessary packaging. People can ensure that they avoid buying over-packaged goods. In Bangkok, it has been proposed

that tax be added to packaging goods so that manufacturers are encouraged to minimize the amount of packaging (Porter and Grogan, 1998). So far in South Africa, such initiatives have not been embarked on. Therefore, policy makers need to look at such alternatives and see how it can be implemented in South Africa;

- People should buy goods that will last e.g. purchasing of cloth nappies, razors with replaceable blades and glassware. People should avoid disposable products where possible;
- Products such as washing powder, toilet paper and cereals can be bought in larger quantities, saving on packaging, energy consuming shopping trips and money.
- People should buy goods made from recycled materials e.g. toilet paper and plastic buckets (plate 6.11);
- Reuse plastic bags e.g. use own shopping bag rather than taking another plastic bag from the supermarket.

As indicated above, people from all works of life can reduce their waste consumption in numerous ways.

6.6.2 Re-use

This method is very simple and as revealed in table 4.19, the respondents of Phoenix are practicing it but do not realise it. An excellent example of re-use is happening in the Orange rivers where the residents have declared war on plastic. People of this town are resorting to using bags that are re-usable (Opperman, 2000) Such initiatives should be embarked on a large scale. There are numerous ways that the residents of Phoenix can practice re-use which include:

- Old clothes or household items should be given to charities or scavengers. There are several schemes run by the voluntary sector in SOFA in Bristol which demonstrated that Civic Amenity Sites and bulky household waste collections can be operated to maximise the re-use and repair of domestic goods;
- Old jars and plastic containers can be used for storing things in (make ideal pots for seedling) e.g. cooldrink bottles can be reused as a ice water bottle or glass jars can be used to store sugar and teabags;

- Re-use envelopes by sticking labels over the old address;
- Plastic bags can be used for grocery or vegetable buying.

As indicated above, there are numerous ways that one can adopt to reduce waste generation through reuse.

6.6.3 Recycling

According to Goeschl (1988), waste management without recycling is wasted management. He added that the ideology of growth and the principles of throw-away society have greatly affected the natural ecological cycles and that this needs to be changed. Studies have revealed that 80% of solid waste generated in South Africa is recyclable (Resource, 1996). Lombard (1994) has stated that there is vast scope in recycling but there are limited incentives and subsidies to encourage the movement of recovered materials. As illustrated by table 4.6, the types of wastes going into the bins can be recycled. Singh (2001) also stated that wastes going into the bins should be recycled. Shand (1993) suggested some guidelines for local authority involvement in recycling, which can be utilised by the Phoenix local authority:

- Local authorities need to first recognize recycling as part of an integrated approach to waste management;
- Lobby for a national policy on recycling;
- Liaise with volunteer groups and the business sector to develop recycling activities;
- Produce a recycling directory of recycling collectors and receivers to facilitate networking;
- Appoint a Recycling Officer to promote and develop recycling activities;
- Inform the public of the actual and environmental costs of waste disposal.
- Advertise recycling schemes in each area;
- Liaise with business and volunteer groups to ensure the effective location and operation of recycling depots;
- Finally, establish affordable and accessible facilities for recycling.

The following ways are suggested to encourage recycling in the Phoenix area are:

- Government needs to amend the current legislation and include recycling as part of the Waste Management Practices e.g. in certain parts of the United States (California, Florida, New York), there are mandatory recycling goals, separation of materials and collection centres (Bureau of National Affairs, 1994);

- Recycling industries should be subsidized so that recycling banks are freely made available to the public. The local community of Phoenix can start recycling using the drop-off sites which can be located within the community such as parking lots, abandoned lots or the city landfill. These sites should be developed with the help of local authorities and the industry. An excellent initiative is in California whereby shopping centres had drop-off sites. People brought their recyclable materials when they came to do their shopping (Henstock, 1983);

- For Drop-off site to be efficient, the recycling industries need to ensure that separate containers for each recyclable material is available for the residents e.g. separate containers for glass, cans and paper (plate 6.5). It is very important that someone be responsible for the containers. Singh (2001) mentioned that the lack of manpower results in the igloos being abused and misused;

Plate 6.5: Recycling Bins

Source: Resource, (1999: 20)

- The schools in Phoenix should not only be the target for recycling programmes instead the community, as whole should be targeted. As revealed, the majority of the respondents (93%) was interested in recycling programmes. According to Nxumalo (1999), fifty-three percentage (53%) of primary schools in the Greater Edendale area are involved in recycling projects;

- Community leaders, local authorities and recycling industries of Phoenix need to unite so that recycling initiatives are productive e.g. a successful operation of the glass and paper recycling in the Greater Soweto brought together the community, Western Metropolitan Local Council and the Glass Recycling Association. (Resource, 2001: 34-35).

- Incentives should be provided such as money for the collection of recyclable material. There should be sufficient and ideally located Buy-Back Centres within the Phoenix area. Singh (2001) stated that when recycling was initiated, the proceeds were used for the community. An excellent example of recycling took place at Skuilkrans Primary School (plate 6.6). Children were encouraged by their teachers to separate their household waste and bring the recyclable materials to school. The income generated from selling the recyclable material was used for the school (Leitch, 2000).

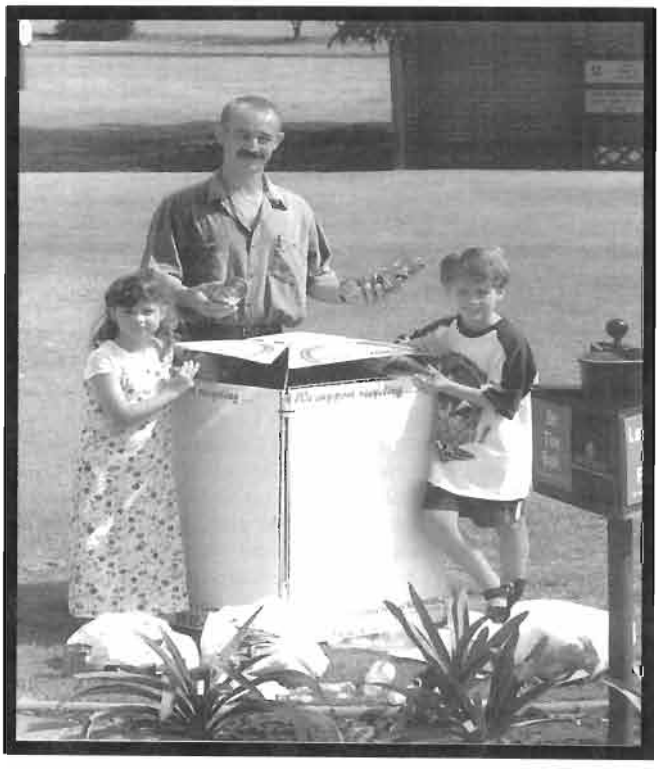
- The Phoenix community groups need encourage recycling amongst the members e.g. girl scouts, religious groups can have charity drives to collect recyclables and sell it to buy-back centres.

- Kerbside programmes can also be embarked in the Phoenix area. However, it is important to note that there are several factors that need to be changed in order for this programme to be successful for instance:
    - The local authorities and recycling industry needs to give its full support for the kerbside programme. According to Carless (1992), it can be very expensive to initiate the kerbside programme in residential areas.

Plate 6.6: Children of Skuilkrans Primary School

Source: Leitch (2000: 34-35)

Plate 6.7: Separation Refuse Bin



Source: Ashpole (2001)

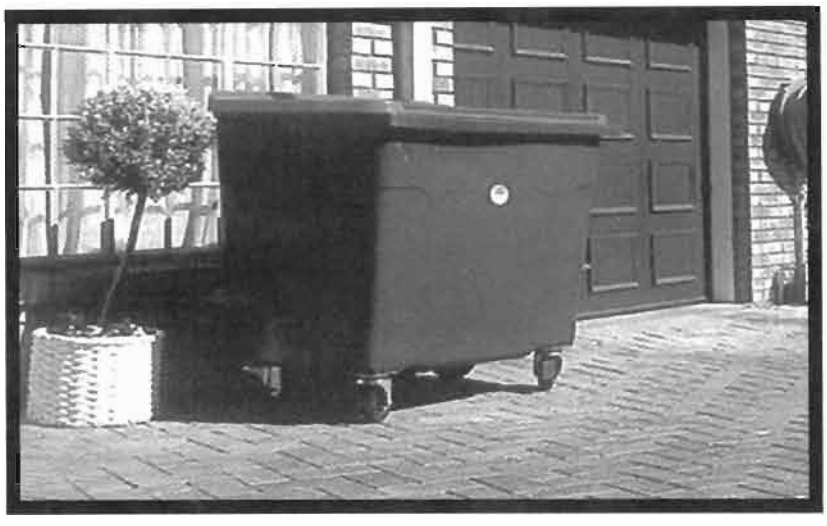
- The residents need to separate their waste at home level. Residents need to have a multibin system. Claude de Speville had developed source separation refuse bin, which is ideal for refuse separation. This is an excellent facility, which can be used for household waste separation by residents in the Phoenix area. This will encourage households to participate in recycling programmes embarked on in the Phoenix area (plate 6.7) (Ashpole, 2001);
- Education programmes need to be in place so that people become aware of recycling activities;
- Legislations is needed to carry out this programme e.g. in New Jersey, it is mandatory to use curbside programmes (Carless, 1992). Hunter (2000) cited in Resource (2000, 15-17) stated that there is no recycling legislation in South Africa that compels businesses and individuals to participate in recycling initiatives. Hence, there is a strong need for recycling legislation to be in place in South Africa.

- The multibin system can be shared with a neighbour thereby limiting the cost of a container. The frequency of waste collection will be immensely reduced if such a system is installed. The majority of Phoenix houses are attached hence sharing the containers will be convenient. Plate 6.8, indicates an excellent example of a recycling bin where two neighbours can share.

- The Recycling industry can create jobs for the vast unemployed people in the Phoenix area. According to Hunter (2000) cited in Resource (2000: 15-17), the paper recycling industry has grown over the last five years. He added that more than 5000 people are involved, either as individual hawkers or as owners of small collection businesses, in supplying Mondi with waste paper (plate 6.9). Moodley (2001) stated that there is great potential for the recycling in the Phoenix area especially since there is a large number of people who are unemployed.

Therefore it is clear that in order for any of these suggestions to take place, the industry and communities need one hundred percent full support from the government.

Plate 6.8: Shared Recycling Bins



Source: Resource (1999: 18-21)

Plate 6.9: Mondi's Recycling PaperBarrows

Source: Resource (1999: 19)

6.6.3.1 Glass Recycling

Glass can be recycled forever without any deterioration in quality (Durban Solid Waste, 2001). In Phoenix glass recycling can be successfully carried out. As indicated by table

4.6, respondents (45%) in the Phoenix area do generate glass in their waste. There are two ways that recycling can be carried out:

- The deposit refund system should be encouraged. In a deposit refund system, a buyer pays at the time of purchase of a normally discarded item a nominal fee, which can then be recovered when the item is returned to a collection centre.
- Glass recycling igloos can be located at shopping centres and schools so that residents can easily deposit the bottles.

6.6.3.2 Can Recycling

Recycling of cans can be encouraged in the Phoenix area with the cooperation of shopping centres and schools. These areas should ensure that they have separate recycling containers for cans to be deposited. This makes it easier and less time consuming for the recycling industry to collect and process.

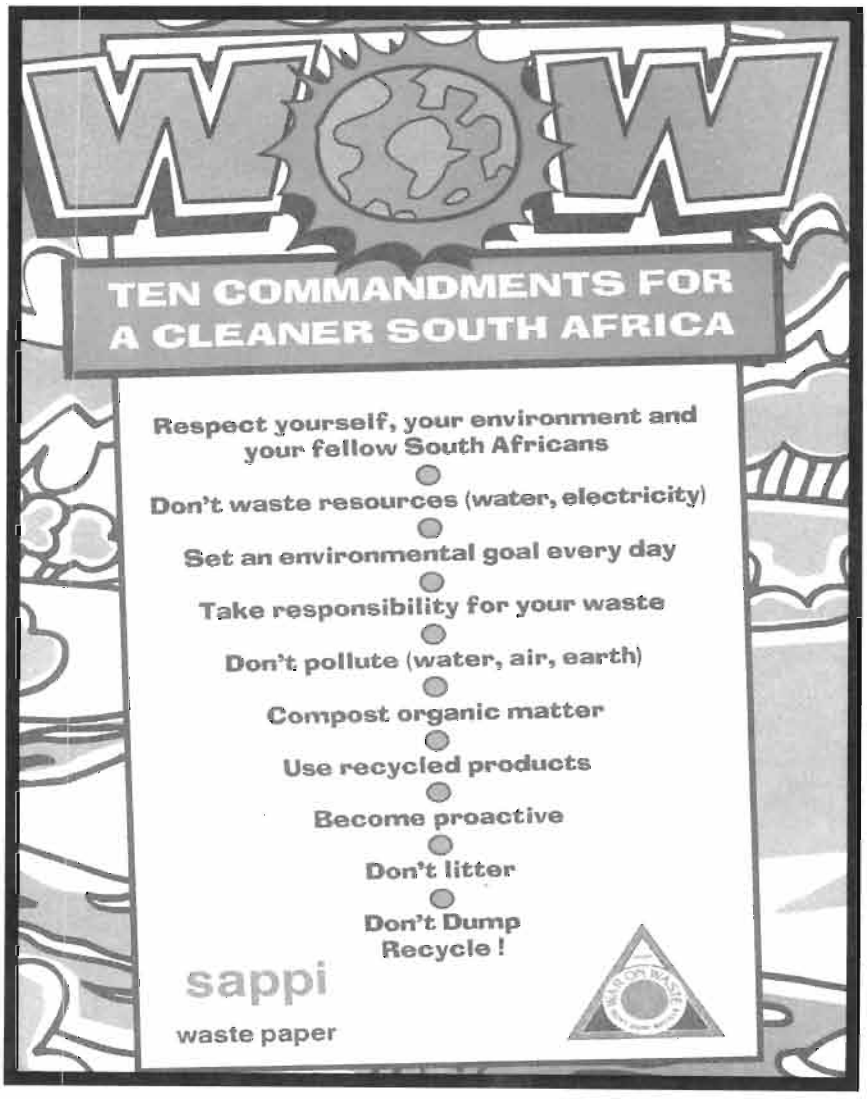
6.6.3.3 Paper Recycling

According to Singh (2001), paper recycling is one of the most profitable businesses. As indicated by table 4.6, a large percentage of the respondents (68%) stated that they had paper in their waste. It was also found that South Africa has a consistent growth in the recovery of waste paper for recycling. In 1999, 720000 tones of waste paper were recovered. Hunter (2000) cited in Resource (2000: 15-17) stated that paper recycling is creates job opportunities for many people. Hence it is apparent that paper can be recycled in the Phoenix area and that there is a potential to even generate an income especially for the unemployed. According to Skeate (1993) cited in Municipal Engineer (1993: 6-7), Sappi has launched a programme called War on Waste (WOW) (plate 6.10), which proved to be very successful e.g. school children were given WOW bins to take home so that paper is deposited in these bins before it reaches the general waste stream. When bins are full, it is brought to school for storage until it is collected by Sappi. Businesses have also becoming involved in recycling initiatives e.g. OK bazaars countrywide have WOW bins in their offices (Municipal Engineers, 1993: 6-7). Phoenix residents, schools, local authorities and businesses need to embark on the above such projects.

6.6.3.4 Plastic Recycling

Plastic is light, durable, versatile and resistant to moisture, chemicals and decay. These same qualities make them difficult to dispose. The plastic recycling industry is relatively a small industry as the main problem is separating the plastics in six resins. This separation enables manufacturers to produce high quality products (plate 6.11). The residents of Phoenix need to purchase such recyclable products thereby supporting recycling (plate 6.11).

Plate 6.10: War-on-Waste



Source: Municipal Engineers (1993: 6-7)

Plate 6.11: Recycled Products

Source: Plastic Enviromark (2000: 4)

Collectors obtain the plastics from shops, factories and landfill sites and sort this into the six resins. The Green Cage is a successful initiative run by the plastics industry. The large cages are situated in convenient sites for the entire community (Speville, 2000) (plate 6.12).

Plate 6.12: The Green Cage

Source: Speville (2000: 16-17)

As indicated by table 4.6, the majority of the respondents (100%) stated that they had generated plastic in their waste. This plastic needs to be recycled rather than ending in the dump site. These green cages need to be located in the Phoenix communities so that they can participate in the recycling of plastic. It is also important to take note of the plastic bag legislation that prohibits the supply of carry bags of thickness less than 80 microns (Speville, 2000). This legislations impacts the manufacturer, supplier and the consumer in the following ways:

- Manufacturers have to use more plastic to make thicker bags. These thicker bags can be recycled;
- The manufactures sell the bags at an extra cost to the supplier (supermarket);
- The supermarket, which usually gives the bags freely, will have to start charging customers;
- The consumer will be forced to re-use old bags.

This legislation is an excellent way to deal with the current plastic generation in the general waste stream.

6.7 COMPOSTING

Composting organic waste is relatively simple providing that the 'green' kitchen and garden waste is separated from the remainder of the household waste. Source separation is the key to reducing any contamination by non-biodegradables, heavy metals or chemicals (Chas, 1990). For many years, compost and manure were the only sources of plant nutrients in South Africa. However, the introduction of the chemical fertiliser has reduced the composting practice (Schliemann, 1980). Composting can prove very valuable to the soil. As illustrated by table 4.6, one hundred percent (100%) of the respondents stated that refuse contains kitchen waste. The respondents have also indicated they have generated garden refuse. Garden refuse can also be used for composting. Composting in the Phoenix area can be practiced at home or in the community. This depends on the available land space that each resident has on their property e.g. people with tarred or paved yards should practice composting within the community whereby an ideal site is allocated so that these residents can deposit their organic waste.

People that have yard space should practice recycling within their property. It was found that residents were practicing the windrows method but do not realise it i.e. they threw the organic wastes (eggshells, vegetables) in the back yard and tilled the soil. This material is an excellent source of nutrients for the soil. According to Du Plessis cited in Resource (2001: 35), compost improves the physical condition of the soil structure and ensures a steady release of nutrients, especially nitrogen. Therefore, residents need to be informed about backyard composting. A good example explaining composting is one that was produced by the Durban Solid Waste Department (appendix 7). The composting guideline should be given to all the residents of Phoenix so that they can practice recycling in their own yards. The residents of Phoenix also need programmes that allow them to practice composting e.g. The food Garden Foundation Programme can prove to be useful in the Phoenix area (appendix 8). This programme encouraged people to grow their own vegetables and use waste as a viable compost material for their soil.

Moodley (2001) has stated that they would like to start a composting programme in the Phoenix area but lack a location. In Phoenix, there are many vacant plots, which are neglected. Therefore, suitable land should be allocated for composting. Garden refuse is one of the biggest problems in the Phoenix area. By allocating an area for composting people can bring their garden refuse to the site. They can even compost their own garden refuse.

A joint venture between Boland municipality and Microgo consist of transforming garden waste into top class compost. This venture has proved to be successful. Now Microgas aims to produce enough compost to supply local market demands (Resource, 2001). The Phoenix community can achieve this level, if they get support from the local authorities, industry and the residents.

Therefore, as illustrated from the above recommendations, if the residents of Phoenix are encouraged or given a chance to practice waste reduction methods, then some or all the problems experienced by the current collection system can be reduced.

6.8 SUGGESTIONS FOR ILLEGAL WASTE DISPOSAL

It has been revealed by the respondents, local authorities and non-governmental organisations that inadequate Solid Wastes practices in the Phoenix area has resulted in the biggest problem, which is illegal waste disposal. Throughout the report, residents have even admitted to resorting to illegal dumping as a result of the inadequate waste facilities. It is within this context that the researcher will try looking at ways to curb and combat the problem of illegal dumping, which in process will help to reduce the effects on the environment both human and natural.

In South Africa, refuse removal costs approximately R160 million per year of which 75 million is required to remove litter. It costs R40 per ton to remove waste from bins and R650 per ton to pick up illegal wastes (Keep South Beautiful Association, 1997). Phoenix residents pay between R1 to R 19 per month for removal services (table 4.10). Moodley (2001) has also stated that it cost the Parks and Garden Department approximately R100000 per month to clean up illegal dumping in the Phoenix area. Hence it is revealed that initiatives need to be put in place so that costs revealed above can be limited and the money can be used in more fruitful ways.

According to the to the Environmental Protection Agency (1998), an effective illegal waste programmes must address the following factors in the area where it is implemented:

- Leadership and Support by Officials;
- Cooperation among authorities, communities and industry;
- An Integrated Approach;

Lombard (1999) also suggested the above factors needed to deal with waste management issues, which will be examined especially since it deals with Waste Management in South Africa

6.8.1 Leadership and Support by Officials

Local politicians and high level officials must make prevention programme a priority and support them with adequate funding, access to equipment and labour resources. The

existing law needs to be amended so that stricter measures can be taken against offenders of dumping. However, laws are inadequate without commitment from high level authorities for enforcement e.g. Police Officers, Law Enforcement Officers etc need to ensure that regulations regarding solid waste is obeyed.

Moodley (2001) and Rubelli (2001) stated that the Management of Solid Waste needs to be made an important issue in our community and our country as a whole. Support rendered by our current Minister, Mr. Vali Moosa is encouraging. The Minister has agreed that solid waste management issues need to be addressed. He stated that solid waste management deserved more attention in South Africa since it impacted on the quality of life of people. His major contribution, is the banning of certain plastics with regard to their thickness (Speville, 2000). Moodley (2001) stated that support from councillors within the Phoenix area especially when it comes to environmental issues is needed. The residents look up to these councillors. When environmental awareness programmes are initiated, the help of the councilors is essential especially if a programme is to be implemented for and within the community. It is therefore advisable, that local councilors and politicians are encouraged to support environmental programmes. Officials support from police is vital in terms of fines for offenders. Moodley (2001) has stated that there is only one Law Enforcement Officer (Parks Enforcement Officer) in Phoenix, which is insufficient, compared to the dumping that is taking place in the Phoenix area.

The senior players in the socio-economic and political milieu must be committed to a policy or programme that they support (Reconstruct Development Paper, 1999). This is vital especially in the Phoenix area. Local Politician, Omie Singh had taken up the issue of illegal waste disposal in the Phoenix area (Phoenix Tabloid, 2001). However, this campaign only occurred during the election period. Therefore, it is advisable for local politicians to be committed to preventative programmes.

In Johanesburg, illegal dumping problem costs up to R80 million per year to manage. Both residents and companies are responsible for the illegal dumping. The Metropolitian

Police Services, came together with resident and civic associations and chambers of commerce to try to combat the problem of illegal dumping. Pikitup as a company has also pledged to manage waste disposal in the city, placing emphasis on recycling and community education, job creation and environmental management (Resource, 2001). This type of cooperation between companies, local authorities, police services and residents are desperately needed in the Phoenix area.

6.8.2 Cooperation among Authorities, Communities and Industries

Local authorities such as the police, health, environmental, public works and sanitation departments must pool their resources and work together with local communities in the Phoenix area. A good example of co-operation maintained between authorities, communities and industries is that of the Hillbrow Recycling Project and the Springs Community. The new Enviro Recycling Centre in Hospital Centre in Hillbrow is funded by Collect-A-Can, Mondi Paper, Coca-cola, Consol glass, Trirom trading (plastic recyclers) and Africa Recycling has come together to establish a recycling programme. This programme is proving to be effective in that it is providing a job for a depot manager, staff as well as 45 independent informal recyclers. Even the recycling programme, collaborated with the Springs City Councils Department of community services and Mondi recycling is an excellent example of collaboration between role players has resulted in jobs for the unemployed (Resource, 1996).

Moodley (2001) has stated that Phoenix has a high rate of unemployment and this was illustrated in table 4.5. If cooperation between authorities, communities and industries are maintained in Phoenix as illustrated in Hillbrow and Springs, so too can the unemployed be given a chance to earn an income through recycling (Resource, 1996).

Freeman (2001) has stated that businesses, schools have been approached to participate in the 'Adopt-a Spot' project, which is an anti-litter beautification and educational campaign aimed to involve businesses and schools to cleanup and keep their areas clean (appendix 4). Moodley (2001) and Freeman (2001) stated that the Whetstone Primary School was successful in keeping the area around the school clean.

It can be concluded that cooperation among authorities, communities and industries are vital for any environmental programme to be successful.

6.8.3 An Integrated Approach

There is a need for an integrated approach in relation to illegal prevention programmes, which should focus on the following:

6.8.3.1 Clean-up Efforts

There is a need for a clean-up project in many of the communities of Phoenix that requires resource and implementation effort. Freeman (2001) has found that if the wastes in the vacant areas are not cleaned up, people will continue to dump. The dumping will become normal, as the area is already polluted. Nel (1996) had found that many South Africans are familiar with living close to an open space which is turned into a waste dump overnight. Labour resources can be sort from communities, youth groups and schools. The New Spirit Organisation (Chicago) coordinates cleanup days. The event has resulted in the removal of 166000 tons of wastes from the inner city areas. In Hout Bay, residents from the Imizamo Yethu and Harbour village have initiated clean-up days at the banks of Hout Bay Harbour (Plastic Enviromark, 2000). Moodley (2001) stated in Phoenix, the Sai Groups embark on clean-up campaigns. He stated that these groups were dedicated to cleaning up the Phoenix. However, Phoenix is a large area and if all groups come together to form clean-up missions, it might prove valuable. Freeman (2001) had found that the Mahatma Gandhi School also embarked on clean-up missions in and around the school.

Phoenix needs disposal sites for wastes, which refuse trucks, do not collect. Moodley and Rubelli (2001) have revealed that the garden site in Phoenix is inadequate in terms of location. The respondents also suggested more disposal sites (table 4.27).

6.8.3.2 Keeping Sites Clean

It was found that illegal dumping sites continue to experience problems after clean-up operations (Environmental Protection Agency, 1998). It can be concluded that there is a

need for special measures to be undertaken, including signs, lighting and barriers to reduce or eliminate continued illegal waste disposal in the Phoenix area.

a) Signs

The use of 'No Dumping Signs' can be effective in preventing illegal dumping and creating awareness of laws. Signs need to be placed in dumping areas to inform people of fines, penalties and that the area is under surveillance. In Illinois 'No Dumping Signs' have been effective in creating awareness that illegal dumping is not tolerated (Environmental Protection Agency, 1998).

b) Lighting

There is a need for proper lighting in areas that have illegal dump sites. This will prevent midnight dumping and increase the visibility of crimes and the chances of offenders being caught. Moodley (2001) has also suggested that there is a need for more lightning at dumping areas such as Grove-end.

c) Barriers

There is a need for construction of barriers that will limit access of vehicles into illegal disposal sites. As revealed by table 4.21, respondents (83%) stated that rubble is illegally dumped. In order for rubble to be dumped, people need their own vehicles. Therefore, if access to dump sites is limited, the illegal dumping of rubble becomes difficult. Moodley (2001) stated that in Longcroft, a barrier using sand was constructed so that people could not dump their wastes over the banks. In Chicago, vertical steel beams protruding a few feet above the ground have proven to be an effective barrier at over 500 locations (Typrin, 1999).

d) Landscaping and Beautification

There is definite need to cleanup illegal dumping sites and make them into constructive features such as parks, gardens etc. The respondents (94%) in table 4.27 have suggested that illegal dump sites needs to be developed. Painting murals, establishing gardens are needed in communities were dump sites are prevalent (Singh, 2001).

6.8.3.3 Community Outreach Programmes

a) Community Programmes

There is a need for community programmes that will organise special waste cleanup events and support community - oriented policing. The aim of community involvement is to teach residents what could be done to prevent illegal waste disposal, how and why they should get involved and who to contact for assistance or to report an incident.

b) Community Event

There is a need to organize events such as `Clean Sweeps' and cleanup days to collect and properly dispose of illegal wastes in the Phoenix area. In New Jersey, the Clifton's Cleanup Programme, which consists of events and programmes intended to cleanup and maintains areas subject to illegal waste disposal, has proved to be effective. It was found that the programmes had a significant visible impact on the cleanliness of the city, street, parks and neighbourhood (Environmental Protection Agency, 1998).

c) Community Oriented Policing

There is a need for an effective community oriented policing whereby officers communicate and co-operate with residents with regard to reporting crimes and identifying offenders. According to Moodley (1999), the residents were very helpful in reporting offenders of illegal waste disposal after they were included in projects. However, the problem arises when the offender denies dumping the waste. Then the offender has to be taken to court and the witness has to be present. Hence, most of the witnesses refuse to testify. The majority of the witnesses fear being victimised by the offenders. The local authorities are unable to punish the offenders neither are they able to give a fine. In Chattanooga, the Citizens Task Force proved effective when they made recommendations to improve community policing, strengthen penalties and establish drop-off sites for bulk wastes. As a result the city provided residents with `Sparks Wagons' free of charge to haul loads of waste to a landfill (Environmental Protection Agency, 1998: 14).

6.8.3.4 Effective Education and Outreach Programmes

In the Phoenix area, there is a need for an implementation of an effective outreach and education programme. For the programme to be successful, the behaviour of the target audience needs to be changed or sustained depending on the circumstances. This will allow one to determine which information media is appropriate and the best way to explain concepts. It is vital that members of the target audience are involved in the development of outreach material. The following should be considered during the development of educational materials:

A Simple Message: A clear, simple message must be developed so that target audiences can relate to e.g. 'NO DUMPING' or 'NAIL A DUMPER'. The message needs to be supported by convincing audiences to comply e.g.

- Listing fines and penalties;
- Indicating that areas are under surveillance e.g. pamphlets given to residents in the Stanmore area informing them about illegal dumping (appendix 9). The notices that were put up in areas where illegal dumping was rife. This had prevented illegal dumping in that particular area e.g. notices put in certain areas of Longcroft, had drastically minimised the rate of illegal waste disposal (appendix 10). Moodley (2001) stated that when people became aware that the area was under surveillance, they generally did not dump;
- Showing photographs of illegal waste disposal sites and
- Listing proper disposal sites and practices.

For messages to be received by target audiences there is a need for the use of multimedia efforts such as newspapers, billboards, television etc. There is also a need to get a feedback from the residents that will assist in the continuation of current programmes and the development of future efforts e.g. a 24-hour hotline.

The Solid Waste Authority of Central Ohio's 'NAIL A DUMPER' programme included a 24-hour hotline and dedicated investigation team and a strong prosecution record proved

very successful. Over 5000 complaints were received, eight percent (8%) resulted in criminal activities were filed and over 1000 cases have been prosecuted (Typrin, 1999).

6.8.3.5 Targeted Enforcement

a) Ordinances

There is a need for much stricter laws that will regulate waste management and prohibit illegal waste disposal in the Phoenix area. These ordinances need to impose heavier fines, incarceration, vehicles impoundments, and cost recovery for site cleanups and revocation of licences. According to the Environmental Protection Agency (1998), a creative use of money obtained from penalties can contribute to a prevention programme. The following are required to sustain such a law:

- Sufficient Resources;
- Trained Enforcement Officials;
- Clear lines authority and
- Timely prosecution and support of the judicial system.

In Illinois city, penalties for illegal waste disposal without a permit can include fines up to $ 2000, 6 months in jail and up to 200 hours of community service. This method proved very effective as the number of offenders dropped. According to Moodley (2001), the adoption of high spot fines was very effective as people realise that it costs more to illegally dispose their wastes.

6.8.3.6 Enforcement and Prosecution

a) Enforcement Officers

There is a need for dedicated enforcement and prosecution personnel in Phoenix. Moodley (2001) has stated previously that Phoenix has only one Law Enforcement Officer for the entire Phoenix area. This indicates that Phoenix needs more of these officers. They should be trained in and educated about the laws relating to the environment. These officers can also assist in locating offenders of illegal dumping. Such collaboration encourages co-operation and reduces the burden on an individual organisation. The Detroit Environmental Enforcement Project that consisted of officials from the law, police, public works, water, environmental, communication and planning

departments was very effective. The programme resulted in 100 arrests. The Trash Task Force who used their personal vehicles to conduct surveillance and enforce illegal waste disposal laws was very effective. In 1996 and 1997, the Task Force made over 100 arrests, towed 21 vehicles and made over 1600 investigations (Environmental Protection Agency, 1999).

b) Prosecution

There is a need for a prosecutor who is able to handle the prosecutions in the Phoenix area. As revealed earlier by Singh and Moodley (2001) it is difficult to prosecute offenders as witnesses of the offence do not want to go to court. In St. County, The Illinois Environmental Protection Agency works closely with the local State Attorney's Office to prosecute environmental cases. This programme reputation served as a major deterrent to illegal waste disposal and has led to the cleanup of many sites (Environmental Protection Agency, 1998).

6.9 CONCLUSION

According to the South African Constitution, the people of South Africa have a right to an environment that is not detrimental to human health. However, over the past few years, it has been found that the rapid growth in population, urbanisation and industrialisation has led to a sharp increase in waste generation rates thereby placing pressure on the environment. This increase in waste generation has also placed enormous pressure on service provision in South Africa. Local authorities are found to be unable to cope with such a demand and the existing resources are breaking down.

There is a strong need to improve the current waste management practices in South Africa. The challenges facing waste management in South Africa will require a dual commitment from those involved in producing waste and those disposing of waste. Public Education and awareness of waste management issues and an understanding of the respective roles of the community, the business sector and the authorities are essential for the implementation of an effective waste management system.

In light of the above, the researcher conducted the study that examined the Solid Waste Management Practices in the Phoenix area. The Solid Waste Management Practices encompasses the storage, collection, disposal and waste reduction methods. Hence the researcher examined all the above methods and services employed in the Phoenix area. It was evident from the study that the Solid Waste Management Practices was inadequate and has caused severe impacts on the natural and human environment in the Phoenix area. One of the major impacts caused by the inadequate services was Illegal Dumping. The above conclusion was arrived at, by carefully assessing the types of wastes disposed, the generation rates, the storage facilities, the collection services, disposal options, waste minimisation options, impacts on the human and natural environment and environmental awareness programmes. The impacts of Illegal Dumping in the Phoenix area was also examined in detail as it was found to be a severe problem as a result of the current Solid Waste Management Practices.

Finally, the researcher provided some recommendations by consulting local authorities, residents and research done both in developed and developing countries. It is hoped that these recommendations might, one day, prove useful to communities, local authorities and planners especially in the Phoenix area who are looking to improve their current Waste Management Practices.

As indicated by the research conducted, it is evident that solid waste impacts on both the human and natural environment in the Phoenix area. The following sentiments conveyed by Sri Swami Sivananda (1990: 115) should be something that people not only in Phoenix but all over the world need to realise before it becomes too late.

"There is an immediate and urgent need for serious rethinking about how the earth's resources ought to be conserved so that we might still survive. We are compelled to realise that everything we do affects our future in some way".

REFERENCES

1. Ashpole, M (2001) "Cleanup South Africa" **Journal of Institute of Waste Management – Resource,** Vol. 3(1), P29-30.

2. Association of Civil Engineers – Institute of Civil Engineers (1991) **Recycling Household Waste: The Way Ahead,** Britain: Fygate Publishers.

3. Bartone, C; Janis, B and Fredrick, W (1990) **Investments in Solid Waste Management: Opportunities for Environmental Improvement,** World Bank, April.

4. Bhide, A.D and Sundaresan, B.B (1983) **Solid Waste Management in Developing Countries,** New Delhi: Indian National Scientific Documentation Centre.

5. Bonomo, L and Higginson, A.E (1988) **Investments in Solid Waste Management: Opportunities for Environmental Improvement,** London: Academic Press.

6. Booth, A; McCullum, J; Mpinga, J and Mukute, M (1994) **State of Environment in Southern Africa,** South Africa: Penrose Press.

7. Bradshaw, A.D and Chadwick, M.J (1980) **The Restoration of Land – The Ecology and Reclaimation of Derelict and Degraded Land,** Great Britain: The Pitman Press.

8. British Glass Recycling Company (1996) **Fact File**, Sheffield: BGRC Press.

9. Bureau of National Affairs (1994) **Solid Waste Recycling – A Complete Guide** United States: Bureau of National Affairs.

10. Carless, J (1992) **Taking Out The Trash – A Nonsense Guide to Recycling,** United States: Island Press.

11. Chas, B (1990) **The Sustainable Management of Solid Waste,** United Kingdom: The Local Government Press.

12. Chaudhary, C.M (1991) **Research Methodology,** Motherland: BSA Publishers.

13. Cointreau, J.S (1982) **Environmental Management of Urban Solid Wastes in Developing Countries: A Project Guide,** United States: International Bank of Reconstruction and Development.

14. Cointreau-Levin, S (1994) **Private Sector Participation in Municipal Solid Waste Services in Developing Countries,** United States: World Bank.

15. Cook, W (1994) "Glass Recycling" **Warmer Bulletin,** February, P14-15.

16. Crittenden, B and Kolaczkowski, S (1995) **Waste Minimisation: A Practical Guide,** Rugby: Institution of Chemical Engineers.

17. CSIR (1991), **The Situation of Waste Management and Pollution Control in South Africa – Executive Summary,** Pretoria: Department of Environmental Affairs.

18. Curzio, Q.A; Prosperetti, L and Zobali, R (1994) **The Management of Solid Waste in Europe Economic, Technological and Environmental Perspectives,** Netherlands: Elsevier Science B.V.

19. David, H "Municipal Recycling – A Public Sector Environmental Success Story" **Public Administration Review**, August 1999, V59 (4).

20. Department of Environmental Affairs and Tourism (1999) **Waste Management in South Africa - Memoradumn to The Portfolio Committee,** National Assembly: Private Members Legislation.

21. Department of Environment and Welsh Office (1995) **Making Waste Work,** London: HMSO.

22. Diaz, L.F; Savage, G.M; Eggerth L.L and Golueke C.G (1993) **Composting and Recycling: Municipal Solid Waste,** United States: Lewis Publishers.

23. Durban Solid Waste Department (2001) **Waste Management Practices,** Keep Durban Beautiful Association: Durban.

24. Eilrich, F; Docksen, G.A and Sloggett, G (1997) **A Guidebook for Community Convenience Centres: One Solution to Illegal Roadside Dumping,** United States: Oklahoma State University.

25. Environmental Protection Agency (1998) **Illegal Dumping Prevention Guidebook,** United States: EPA.

26. Feates, F and Barrett, R (1994) **Integrated Pollution Management: Improving Environmental Performance,** Europe: McGraw Hill.

27. Feinstein, M (1992) **Composting in the Context of Municipal Solid Waste Management,** New York: Wiley Liss Inc.

28. Fernandez, B (1993) **Solid Waste Management,** Jamaica: Underground Water Authority.

29. Flintoff, F (1984) **Management of Solid Wastes in Developing Countries,** Geneva: World Health Organisation.

30. Flowerdew, R and Martin, D (1997) **Methods in Human Geography: A guide for students doing research projects,** London: Addison Wesley Longman Limited.

31. Foster, S and Herata, R (1988) **Groundwater Pollution Risk Assessment,** Geneva: World Health Organisation.

32. Fourie, L (1997) **Towards a Better Environment,** New Horizons, Vol. 3(2), P4.

33. Francis B.M (1994) **Toxic Substances in the Environment,** New York: Wiley and Sons.

34. Franklin Associates Ltd (1992) **Characteristics of Municipal Solid Waste in the United States,** United States: Environmental Protection Agency (EPA).

35. Freeman, S (2001) **Personal Communication**: Waste Minimisation Officer – Keep Durban Beautiful Association, June-July.

36. Fuggle, R.F and Rabie, M.A (1996) **Environmental Management in South Africa,** Cape Town: Jutta and Company Limited.

37. Furedy, C "Social Aspects of Solid Waste Recovery in Asian Cities" **Environmental Sanitation Reviews,** 1992, Vol. 4(36) P3-5.

38. Gangoo, A; Jensen, K.L; Rajpal, L and Sveinsson, S (2000) **Evaluation of Waste Management Practices for Townships in Pietermaritzburg,** Industry and Environment in South Africa - April 2000.

39. Gibbons, F.J.G; Hall, B.E and Hoiden R.D (1992) **Some Experiences with Waste Management,** Johannesburg: University of Rand Afrikaans.

40. Goeshcl, R (1998) "Waste Management without Recycling is Wasted Management", **Municipal Engineer**, August Vol. 19(8), P36-41.

41. Goldstein, N "Biocycle Nationwide Survey – The State of Garbage", **Biocycle**, April 1997, P60-67.

42. Gopal, L (2001) **Personal Communication**: Area Cleansing Officer – Solid Waste Department, June.

43. Government Gazette (1998) **Draft White Paper on Integrated Pollution and Waste Management for South Africa – A Policy on Pollution Prevention, Waste Minimisation, Impact, Control and Remediation,** Volume 398

44. Gowans, J (2000) "Foul Deeds in the Dead of Night", **Sunday Tribune**, March 12, P8.

45. Greenwood, N and Edwards J.M.B (1973) **Human Environment and Natural Systems: A Conflict of Domaine,** United Stated: Environmental Protection Agency.

46. GVRD Compost Resource Manual (1993) **Future Steps to a more livable Region,** British Columbia.

47. Habitat (1989) **Solid Waste Management in Low-Income Housing Projects: The Scope for Community Participation,** Nairobi: United Nations Centre for Human Settlements.

48. Habitat (1993) **Refuse Collection Vehicles for Developing Countries**, Nairobi: United Nations Centre for Human Settlements.

49. Hall, E.J and Ball, J.M (1989) **Planning Strategies for Solid Waste Management,** Institute of Waste Management: Seminar on Waste Management in South Africa.

50. Hans, B (1993) "Residents unhappy over lack of services", **Sowetan**, February, P7.

51. Hardoy, J.E; Mitlin; Satterthwaith and David (1992) **Environmental Problem in Third World Cities,** London: Earthson Publishers.

52. Haygarth, N and Naidoo, H (1995) **Population and Housing in the Durban Metropolitan Area**, Department of Housing: Durban.

53. Henstock, E.M (1983) **Disposal and Recovery of Municipal Solid Waste: A reviewed realistic options facing the public, authorities and industry,** London: Butterworths.

54. Herbert, A (1993) "Planning to Compost", **Waste Management,** June, P34-36.

55. Hershkowitz, A and Eugene, S (1998) "Garbage Management in Japan: Leading the Way" **Civil Engineering**, August, P49-52.

56. Holt, G (1995) **Opportunities and Barriers to Metal Recycling,** Recycling Advisory Unit: National Environmental Technology Centre.

57. Hope, E.T (1998) **Solid Waste Management – Critical Issues for Developing Countries,** Jamaica: Canoe Press.

58. Jithoo, S (1987), **The Dynamics of the Indian Firms in Durban Proceedings at a Conference: Aspects of Family Life in the South African Indian Community,** Occasional Paper No.20, Durban: University of Durban-Westville.

59. Jolley, R.L and Wang, R.G (1993), **Effective and Safe Waste Management-Interfacing Sciences and Engineering with Monitoring and Risk Analysis,** United States: Lewis Publishers.

60. Joubert, T (1999) "Promoting Integrated Resource Management in Southern Africa" **Journal of the Institute of Waste Management –Resource,** Vol. 3(1), P22-25.

61. Keep South Africa Beautiful Associations (1997) **Create a Cleaner Community,** Randburg.

62. Kish, L (1965), **Survey Sampling,** New York: John Wiley and Sons.

63. Kreith, F (1994) **Handbook of Solid Waste Management,** United States: R.R Donnelley and Sons Co.

64. Kroger, A (1994) **Solid Waste Management in South Africa and Germany,** South Africa: Local Government Board.

65. Kropman, R (1984), **Regional Approaches to Solid Waste Management in the Witwatersrand,** Johannesburg: University of Witwatersrand.

66. Krueger, R.A (1998), **Analysing and Reporting Focus Groups Results,** United States: Sage Publications.

67. KZN Department of Traditional and Environmental Affairs and KZN Portfolio Committee on the Environment (1999) **KZN Waste Management Policy and Discussion Document,** Durban: KZN Department of Environment and Tourism.

68. KZN Tourism Board (1998-2000) **The History and Cultures of Durban,** Durban: KZN Department of Environment and Tourism.

69. Lardinois, I (1993) **Organic Waste Options for Small Scale Resource Recovery**, Amsterdam: Tool.

70. Leedy, P.D (1993) **Practical Research – Planning and Design,** United States: Simon and Schuster Company.

71. Leitch, J (2000) "Amazing Waste Story 'POPUP' in Pretoria", **Journal of Institute of Waste Management – Resource**, Vol. 2(3), P34-35.

72. Levy, P.S and Lemeshaw, S (1991) **Sampling of Populations and Methods and Applications,** New York: John Wiley and Sons.

73. Lofaso, A "New York! New York City Kerbside Recycling Programme", **Warmer Bulletin,** No. 41, May 1994, P6-7.

74. Lombard, R (1990) **The Challenge of Holistic Waste Management in South Africa,** Presented at Green Management – Cape Town, September.

75. Lombard, R (1994) **A Report on Recycling Paper in South Africa,** Cape Town: Department of Environmental Affairs and Tourism (DEAT).

76. Lombard, R (1996) **Appropriate Waste Management Technology in Developing Communities,** Cape Town: Lombard and Associates.

77. Lombard, R (1999), "Resource Recovery in South Africa", **Regional Conference on Integrated Solid Waste Management** – South Africa.

78. Macozama, D "A look at waste Management from Three Perspectives", **Journal of the Institute of Waste Management – Resource**, Vol. 2 (3).

79. Matsuto, T and Tanaka, N (1993) **Data Analysis of Daily Collection Tonnage of Residential Solid Waste in Japan,** Japan: Waste Management and Research.

80. Mayet, M.A.G (1994) **Domestic Waste Generation in the Urban Core of the Durban Functional Region,** Durban: University of Natal.

81. Mbanda, C (1997) "Solid Waste Management in Developing Areas – Where are we going? " **Africon**, East London, P1-10.

82. Moodley, P (2001), **Personal Communication:** Manager of the Parks and Garden Department, July –August.

83. Mouton, J (2001) **How to succeed in your Masters and Doctoral Studies: A South African Guide and Resource Book,** Pretoria: Van Schaik Publishers.

84. Municipal Engineer (1993) "South Africans join in the War against Waste", **Journal of Engineers – Municipal Engineer**, P6-7.

85. Myburgh, G.S (1991) "Environmental Law in South Africa with particular regard to the Management of Waste: An Analysis of the Present position and portable future trends" **Seminar on Environmental Waste Technology,** October 22-24.

86. **Natal Witness**, June 1996.

87. Nel, M (1996) "Illegal Dumping: Culture of Environmental responsibility needed", **Muniviro,** Vol. 13(2).

88. Nxumalo, F.T (1999) **Waste Management through Recycling and Composting: A Case study of some schools in Greater Edendale, Pietermartizburg, KZN,** Pietermartizburg: University of Natal, MSc Thesis.

89. Ohnesorgen, F "Sorting out Solid Wastes", **Public Management**, March 1993, P9-12.

90. O'Leary, P and Walsh, P (1992) **Solid Waste Landfills,** Madison: University of Wisconsin.

91. Opperman, M (2000) "Death if Plastics", **YOU Magazine**, June, P16-17.

92. Palmer Development Group (1995) **Evaluation of Solid Waste Practice in Developing Urban Areas of South Africa,** Cape Town: Palmer Group.

93. Parkin, J (1995) **A Recycling Overview: Using Durban as a Case Study,** Durban: University of Natal.

94. Pescod, M.B (1991-1993) **Urban Solid Waste Management,** Copenhagen: World Health Organisation.

95. **Phoenix Tabloid**, June 1999.

96. **Phoenix Tabloid**, January 2000.

97. **Phoenix Tabloid**, August 2001.

98. Plastic Enviromark (2000) "Cleanup South Africa", **Newsletter for Plastics Environmental Initiatives**, November 9, P1-7.

99. Porter, L and Grogan "Emerald City looks tomorrow", **Biocycle**, 1998, Vol. 39(5), P86.

100. Poswa, T "Curbing Umtata's Littering Problem", **Resource – Journal of the Institute of Waste Management,** February 1997, P9-10.

101. Poultney, D (2001) **Personal Communication,** Consultant –Consol Glass, August 2.

102. Rabinovitch, J "Curitiba: Towards Sustainable Urban Development", **Environment and Urbanisation,** Vol. 4 (2), October 1992, P62-73.

103. Rajpal, L (1999), **An Investigation into Illegal Waste Disposal in the Phoenix Area**, Durban: University of Durban-Westville, U.P.

104. Race Relations (1994) **Race Relations Survey 93-94,** Johannesburg: South Africa Institute of Race Relations.

105. Ramphal, N (2001) **Personal Communication:** Acting Professional Officer – Durban Metro Housing, July- August.

106. Reconstruct – Development Paper (1999), "Environment is no longer a back-seat issue", **Sunday Independent**, P11.

107. Reddy, K.V (1992) **An Assessment of the Management of Waste in the Durban Municipal Area and the future needs and requirements of landfilling** Durban: University of Natal.

108. Reilly, S (1991)"Refuse Services for Black Urban Areas", **Resource - Journal of the Institute of Waste Management**, March, P12-13.

109. Resource (1996)"Street Children Cleanup Hillbrow Streets in New Recycling Project", **Journal of the Institute of Waste Management**, November.

110. Resource (1999) "Set a Goal – Recycle - Create jobs", **Journal of the Institute of Waste Management**, September.

111. Resource (2000) "Plastic Recycling in South Africa", **Journal of the Institute of Waste Management-Resource**, May, P23-24.

112. Resource (2000) "Cleanup South Africa", **Journal of the Institute of Waste Management - Resource**, November, P15-17.

113. Resource (2001) "Compost brings new life to Boland", **Journal of the Institute of Waste Management – Resource**, May, Vol. 2(12).

114. Resource (2001) "Recycling Agreement Benefits Council and Community", **Journal of the Institute of Waste Management – Resource**, February, Vol. 3(1), P34-35.

115. Resource (2001) "Waste Management in Johannesburg gets a Clean Start", **Journal of the Institute of Waste Management – Resource**, May, Vol. 3(2), P35.

116. Rogoff, J.M and Williams, J.F (1994) **Approaches to Implementing Solid Waste Recycling Facilities,** New Jersery: Noyes Publishers.

117. Rubelli, T (2001) **Personal Communication,** Area Coordinator- Solid Waste Department, June –August.

118. Scharff, C and Vogel, G (1994) **A Comparison of Collection Systems in European Cities,** Waste Management and Research, 12, P389-404.

119. Schliemann, G.K (1980) **Compost on Farm,** Stellenbosch: Department of Agriculture and Fisheries.

120. Seholoholo, M (1998) **Solid Waste Management in Low and High Income Residential areas of Maseru: A Comparative Study of Maseru West and Seapoint**, Pietermartizburg: University of Natal, MSc Thesis.

121. Shamrock, J (1995) "The Pollution potential of waste in developing communities in South Africa compared with the waste from affluent communities", **Paper Presented at Kingston**, Jamaica.

122. Shand (1993) **Guidelines for Waste Management in SA: A handbook for Local Authorities**, South Africa: Ninhan.

123. Singh, S (2001) **Personal Communication**, Chairman of Keep Phoenix Beautiful Association, July-August.

124. Smout, M.A.H and Rajah, D.S (1993), **The Journey to Work from Phoenix,** Durban: Institute for Social and Economic Research.

125. Songsore, J (1992) **Review of Household Environmental Problems in the Accra Metropolitan Area – Ghana,** Britain: Stockholm Environment Institute.

126. Speville, C (2000) "Plastic Bag Legislation – An Environmental Consumerism Perspective, **Journal of the Institute of Waste Management – Resource**, August, Vol. 2(3), P16-17.

127. Stanners, D and Bourdeau, P (1995) **Europes Environment – The Dobris Assessment,** Copenhagen: European Environmental Agency.

128. Statistics South Africa (1996) **Census in Brief – The People of South Africa Population Census – 1996,** Pretoria: Statistics South Africa.

129. Stefoff, R (1991) **Recycling,** United States: Chelsea House Publishers.

130. **Sunday Independent**, 10/10/99.

131. **Sunday Independent,** 19/10/99.

132. Tangri, N "Press release from New Zealand" 10 December 2000.

133. Theron.P.L (1998) "Municipal Solid Waste – A Position Paper", Presented to SCOWSA Sanitation Sub-Committee, August, P43-45.

134. Turner, W.D (1994) **An Investigation Into Post Consumer Recycling,** Durban: Department of Civil Engineering.

135. Typrin, K (1999) **Illegal Dumping in the United States,** United States: Environmental Protection Agency.

136. United Nations Environmental Programme (1993) **Environmental Data Report – GEMS Monitoring and Assessment Research,** London: Blackwell Publishers.

137. United States Environmental Protection Agency Region (1998) **Illegal Dumping Prevention Guidebook,** Chicago: Wastes, Pesticides and Toxic Division.

138. Van Wyk, J.A (1993) **Letter to Constituent,** Minister of Environmental and Water Affairs.

139. Von Schoenberg, A (1993) "Pay - as –Throw Charges in Germany", **Warmer Bulletin**, No. 36, February.

140. Warmer Bulletin Information Sheet "Plastics Recycling", **Journal of World Resource Foundation**, No. 32, February 1992.

141. Warmer Bulletin, **Journal of World Resource Foundation**, No.18, August 1993.

142. Warmer Bulletin, **Journal of World Resource Foundation**, No.36, February 1993.

143. Warmer Bulletin Information Sheet "Paper Making and Recycling, **Journal of the World Resource Foundation,** No. 43, March 1994.

144. Warmer Bulletin, **Journal of World Resource Foundation,** No.46, August 1995.

145. Warmer Bulletin Information Sheet "Markets for Waste Paper", **Journal of World Resource Foundation,** No. 50, June 1996.

146. Wentz, C.A (1995) **Hazardous Waste Management,** New York: McGraw Hill Inc.

147. Williams, P.T (1998), **Waste Treatment and Disposal,** England: John Wiley and Sons.

148. Wilson D.G (1987) **Problems of Solid Waste Pollution,** Cambridge: Masschuttes Institute of Technology.

149. Wright, C (1992), **The Environment Impact of Outdoor Recreation,** Canada: Department of Geography.

150. Zwane, V (2001) **Personal Communication**, Correspondent at Collect-A-Can, July-August 2001.

APPENDIX ONE:

RESEARCH QUESTIONNAIRE

UNIVERSITY OF DURBAN-WESTVILLE

RESEARCH QUESTIONNAIRE – CONFIDENTIAL

1. Household Head

Male	Female

2. Highest Standard of Education of Household Head

Primary	Secondary	Tertiary

3. How long have you been a resident of this area?

1-5 years	6-10 years	11-15 years	>15 years

4. How many members are there in your family?

2-4	5-7	8-10	>10

5. Total Income per household per month (i.e. How much do you get per month)

<R500	R500-R1000	R1001-R1500	R1501-R2000	R2001-R2500	>R2500

6. How much do you pay for waste services per month?

R1-R19	R20-R29	>R29	Not Sure

7. How much waste does your household generate per week

One bag	Two bags	Three bags	> Three bags

8. How much of waste do you generate per week in kg (approximate value)

0-5kg	6kg-10kg	11-15kg	Not Sure

9. What types of waste does your household generate?

Paper	Metal	Plastic	Kitchen	Glass	Other

10. Where do you store your waste?

Plastic bag in Bin	Plastic Bag	Drum /Bucket	Other

11. What is the frequency of waste removal in your area?

Once weekly	Twice weekly	Once monthly	Twice monthly

12. How do you rate the removal service?

Poor	Satisfactory	Good	Very good

Give reasons for your answer above

_____

13. How do you dispose off the following wastes?

Types of Waste	**Open Space**	**Contractors**	**Burn**	**Other**	**Not Applicable**
• Rubble					
• Broken Appliances					
• Garden Waste					

14. Do you know about the green bags that are used for collecting garden refuse

Yes	No

15. If yes, where have you heard about these bags?

_____

16. Are you aware of the garden refuse centre in Phoenix situated in Canehaven?

Yes	No

17. Does your area have scavengers during the waste removal days?

Yes	No

18. If yes, do you consider them to be a problem or are they useful?

_____

19. Are you aware of any recycling programmes in your area?

Yes	No

20. If yes, how do you rate these programmes?

Poor	Satisfactory	Good	Very good

21. If No, do you think that there should be recycling programmes in your area?

Yes	No

22. If yes, what type of recycling scheme would you prefer to have available?

A recycling centre in your neighbourhood, with different igloos for you to sot and separate all your recyclable items into	
A Collection centre run by a school or community hall, in support of the school or another community project	
A buy-in centre for recyclable items	
None at all	

23. Which of the following waste methods do you currently practice?

Compost	Re-use	Reduce	Recycle	None

24. Is your area characteristic of illegal waste disposal?

Yes	No

25. If yes, what types of wastes are disposed off illegally?

Rubble	Household waste	Garden refuse	Factory/ Industrial Waste	Old appliances/ Furniture	Other

26. How far is the open space from your home where you found people to dump their waste?

< 100m	100m-199m	200m-299m	>300m

27. What means of transportation have you found people use to take their waste to these open spaces?

Vehicle	Barrow	Manually

28. Who are responsible for the illegal disposal of such wastes?

Residents	Outsiders	Squatters	Factories / Industries	Builder / Contractors	Other

29. Which of the following impacts are prevalent in your area because of the illegal waste disposal?

Odours	Unaesthetic	Rodents / insects	Drain damage	Stream Pollution	Air Pollution

30. Has your community approached authorities on the problem of illegal waste disposal?

Yes	No

31. If yes, how are the authorities reacting to the illegal waste disposal?

Prosecution	notices	Remove waste	No reaction

32. What suggestions do you propose to try and combat illegal waste disposal?

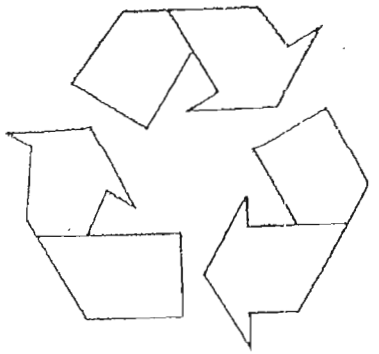
_____

APPENDIX TWO:

DURBAN SOLID WASTE NOTICE FOR A CLEANER ENVIRONMENT

for a cleaner environment

REDUCE
REUSE
RECYCLE
RESTORE



What we throw away doesn't just disappear...

DSW

Reduce...

Yearly DSW collect 600 000 tonnes of rubbish which is landfilled at the Bisasar Road sanitary landfill site.

The best way to deal with waste is not to produce so much in the first place. We can all take responsibility for the waste we produce by following some guidelines:
reduce at source...reuse or restore, and as a last option incinerate or landfill.

Here are practical ideas on ways we can all help the environment.

Reduce at source...

Cut down on waste when out shopping:

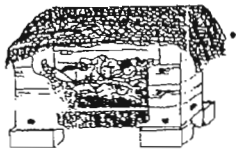
- Use your own shopping bag or reuse plastic bags rather than take yet another plastic bag from a supermarket.
- Avoid buying over-packaged goods.
- Buy products made from recycled materials, or packaged in them.
- Choose products in packaging that can be recycled - it usually takes less energy to create recycled products than like ones from raw materials.
- Think twice about using one-use disposable items like paper plates and plastic cutlery.

Of course we can't avoid producing some waste, but that doesn't mean it all has to go straight into the rubbish bin:

- Donate old clothes or household items that are still in good condition to charities. Any old textiles can also be shredded and used for cleaning cloths.

Reuse...

- Use old jars and plastic containers for storing things in (they make ideal pots for seedlings, as do waxed beverage cartons).

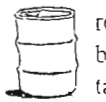


- Make your kitchen and garden refuse into compost, or start a worm bin.
- Re-use envelopes by sticking labels over the old address, make sure you use both sides of notepaper.

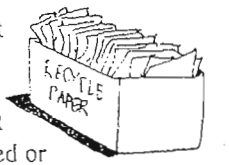
Recycle...

Recycling means more than putting cans, bottles and paper into banks - it takes a bit of effort before you actually recycle!

Glass: Remove all tops, lids, corks and metal foil. Wash and rinse all bottles and jars before placing in the banks - remembering of course to reuse the water.



Cans: both steel and aluminium can be recycled. Wash and crush cans first before putting them in collection containers



Paper: ensure paper you put into the banks is clean - and read the instructions on the sides of the banks to find out what type of paper is accepted or phone any of the paper recyclers for advice.

Recycle...

Be considerate when you visit recycling sites - if the banks are full, don't dump materials for recycling at the site - bags full of bottles, cans and paper left lying makes the site look dirty and discourages a positive view of recycling. Also once you have placed the items in the collection containers don't leave any packets or rubbish lying around. Put them into the nearest rubbish bin, or take such waste home.

Natural resources are saved if we use recycled materials instead of using more raw materials.

What DSW is doing to help...

DSW is taking practical steps to make recycling more accessible to the public and schools by producing and distributing awareness literature such as educational school manuals and teaching tools

DSW is also introducing formalised drop-off sites, encouraging the establishment of buy-back centres by recyclers and lending support to local recycling initiatives.

Contact these recyclers to find out what can be recycled and where your nearest recycling depot/entrepreneur is located:

Cans:

Collect-a-Can 031-7005935

Glass:

Glass Recycling Assn (011) 8270338

Restore...

Paper:

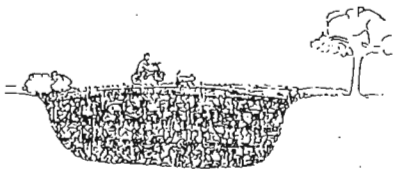
Mondi Recycling 031-2060650

Sappi 0800-221-330

These recyclers and collectors can also advise you on the latest prices being paid for recyclable materials.

Contact Recycling Office, DSW on (031) 3031665 or f. 3033969 for any advice on recycling, reuse or integrated waste management teaching tools.

Remember if you are a school you can also obtain your free copy of the "Lets's Reduce and Recycle Manual for Solid Waste Awareness" simply by booking an afternoon workshop with DSW on (031) 3031665



Incineration or Landfill...

Waste is incinerated or landfilled as a last option.

Although incineration will produce energy, some water vapour will also be produced in the process and ash will remain afterwards which in turn needs to be landfilled correctly. It is essential to incinerate certain types of waste such as medical or confidential waste - to ensure safe disposal.

Resource..

DSW has a waste incinerator and Lindsay Strachan, the Disposal Engineer can be contacted on (031) 2631372 for any advice on the disposal of waste in this way.

DSW also landfills municipal solid waste from households, commercial businesses and light industries. The DSW Customer Service line can be contacted on (031) 3024804 for advice on the above.

This leaflet is produced by:

Durban Solid Waste
188 Argyle Rd
Durban

PO Box 1038
DURBAN
4000

(T) 031- 3031665 (F) 031- 3033969

DSW

APPENDIX THREE:

INCOME FROM HOUSEHOLD WASTE

That you can make money from waste. A number of household items go into bins and then to landfills. We will buy certain wastes from you and reduce pollution in the process. The money you earn will go into your pocket or to a charity of your choice. For the moment we are looking for the following wastes:

CARDBOARD *(Boxes)*

ALUMINIUM CANS *(differentiated with magnets)*

STEEL CANS *(Beverages)*

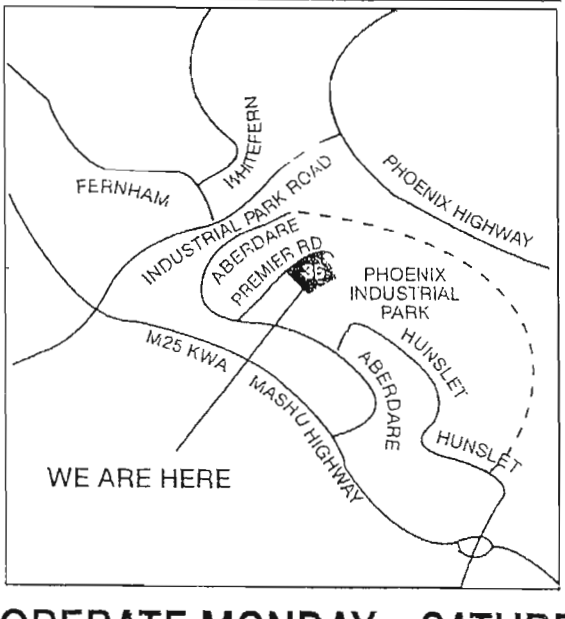
OIL CANS

TINNED FOOD CANS

WASTE PAPER

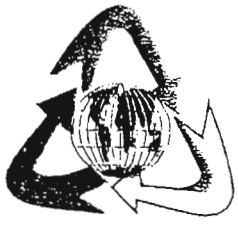
You bring and we will pay per kilogram. If you stockpile any or all of the above at your home please phone us and we will pick it up. If you have a bakkie and wish to get into business with us do not hesitate to contact us. Our details are below

WHERE?



SANSUBKA RECYCLING INDUSTRIES cc

36 PREMIER ROAD
PHOENIX INDUSTRIAL PARK
TELEPHONE: (031) 5005683
A/H TEL. & FAX No.: (031) 2628633
CELL: 082 6582 131



WE OPERATE MONDAY – SATURDAY

APPENDIX FOUR:

ADOPT-A-SPOT PROGRAMMES- AN ENVIRONMENTAL PARTNERSHIP

Adopt-A-Spot / Verge

An environmental partnership programme

YOU TOO can make a DIFFERENCE

The Keep Durban Beautiful Association together with the relevant municipal departments of the North and South Central Councils are inviting interested parties to join them in their exciting partnership programmes viz.:

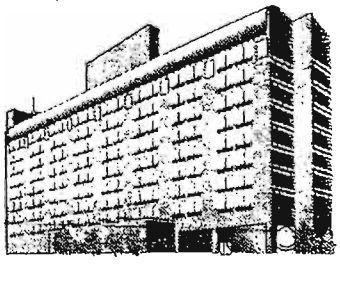
ADOPT-A-VERGE

This programme is targeted mainly to residents and small businesses who has a strip of verge outside their premises. An acknowledgement plaque will be presented to committed participants.

ADOPT-A-SPOT

This project is a partnership between any concerned individual, school, ratepayers' associations, religious groups etc. and the KDBA.

The following areas can be adopted



APPENDIX FIVE:

THE ESKOM EDUPLANT 2001 SCHOOLS PERMACULTURE COMPETITION

OFFICIAL ENTRY NO.

THE ESKOM EDUPLANT 2001

SCHOOLS' PERMACULTURE COMPETITION

ENTRY FORM

Thank you for requesting an entry form for the Eskom EduPlant 2001 Competition.
To enter you must read the enclosed information sheet, fill out this form carefully and post it to:
EduPlant, PO Box 2035, Gallo Manor 2052, GAUTENG.
www.eduplant.org.za

ENTRIES MUST REACH US NO LATER THAN 15 AUGUST 2001

CATEGORIES (mark 'X' to show which category you are entering)

- ☐ Novice (new or planned) - for schools that have recently implemented a Permaculture project at their school, or wish to implement one in the near future
- ☐ Intermediate - for previous EduPlant finalists who have not yet won a prize.
- ☐ Advanced - for schools that have implemented and maintained a permaculture project at their school for a period exceeding 12 months and/or have been a previous EduPlant winner. N.B. You must include details of other schools you have introduced to Permaculture, as well as financial statements of your project.

IT IS VERY IMPORTANT TO WRITE CLEARLY AND PROVIDE DETAILS SO THAT WE CAN CONTACT YOU QUICKLY IF YOUR SCHOOL IS CHOSEN AS A FINALIST.

SCHOOL DETAILS

School name: _____

School registration number: _____ Medium of instruction _____

Primary school, combined school, or high school: _____

School street address: _____

Town: _____ Code _____ Province _____

School Postal Address: P O Box: _____ Town _____ Postal code: _____

School telephone: (code) _____ (number) _____ School fax: (code) _____ (number) _____

Principal's name: _____

Principal's telephone: (code) _____ (number) _____ (Cell) _____

Project Leader's name: _____ _____ How many learners _____ educators _____

and community members _____ e or will be directly involved? Total _____ Attach list of names.

Project leader's telephone: (code) _____ (number) _____ (Cell) _____

Does the school have a feeding scheme? _____ Feeding scheme co-ordinator's name: _____

Feeding scheme co-ordinator's telephone: (code) _____ (number) _____

In which district is your school: _____ District office tel: (code) _____ (number) _____

In which region is your school: _____ What is your nearest major centre? _____

How far are you from this centre? _____ km. Regional office tel: (code) _____ (number) _____

P R O J E C T

HOW TO ENTER

Read through the entry form first before answering all the questions. If you need help call Food & Trees for Africa or any of the other help lines.

You can use more paper for your entry if there is not enough space for you on this form. You should send in drawings, maps, photographs or any other material that supports your entry. You may also write an essay on your project but you must answer these questions.

If you have been an EduPlant finalist before it is important to give a brief history of your project and how you have spent your prize money.

It is important that you think about the advantages of a sustainable, food rich and healthy environment and look at how to create this at your school. Remember to consider what resources you already have and what surrounds your school, eg. rivers, forests, farms, markets, etc. The enclosed information sheet will give you some ideas, but be sure you come up with your own and **do not just copy it.**

LOOK AT YOUR SCHOOL CAREFULLY AND ANSWER THESE QUESTIONS

1. Is your school rural _____ peri urban _____ urban _____
2. What is the total area of your school grounds? _____ What is the size of your garden? _____
3. How much rain do you get in one year? (in mm) _____ When does it rain? _____
4. Where does the school get water and how do you harvest, conserve and/or manage your water? _____

   _____

   _____

   _____
5. Do you have electricity? If not what energy do you use at your school? _____
6. What kind of soil do you have at the school? _____
7. How do you improve the soil without using chemicals? _____

   _____

   _____

   _____
8. How does your school recycle waste such as paper, cans, glass or organic material? _____

   _____

   _____

   _____
9. What natural resources do you have at your school and how do you use or conserve them? _____

   _____

   _____

   _____
10. When did you start your project and what was your school like before you started? _____

    _____

    _____

P R O P O S A L

11. What does you school look like now? _____

12. Describe what plants and/or food you grow at the school? _____

13. Have you sold any produce from your project?_____To whom?_____
Income received? _____ Over what period (month, season, year)?_____

14. Do you have an outreach project? Provide details. If not, how does your project involve educators, learners, parents and members of the surrounding community? _____

15. Describe how your school includes your project in the eight learning areas of the outcomes-based education curriculum

16. Describe how permaculture can be used to generate income and which of these ideas have you applied? _____

17. Describe the biggest problems/challenges in your project?_____

18. What plans have you made to care for your project after hours and during the school holidays?

APPENDIX SIX:

INVITATION TO THE PHOENIX ENVIRONMENTAL FAIR

The Phoenix Municipal Environment Committee cordially invites you and your family to the PHOENIX ENVIRONMENTAL FAIR for a day of fun filled activity.

DATE: Saturday, 14 August 1999
TIME: 08:00 - 14:00
VENUE: Stanmore Park (on Grove End Drive)

The aim of the Environmental Fair is to encourage our community to become more aware of the environment and that each one of us has a role to play in keeping our environment clean for each other.

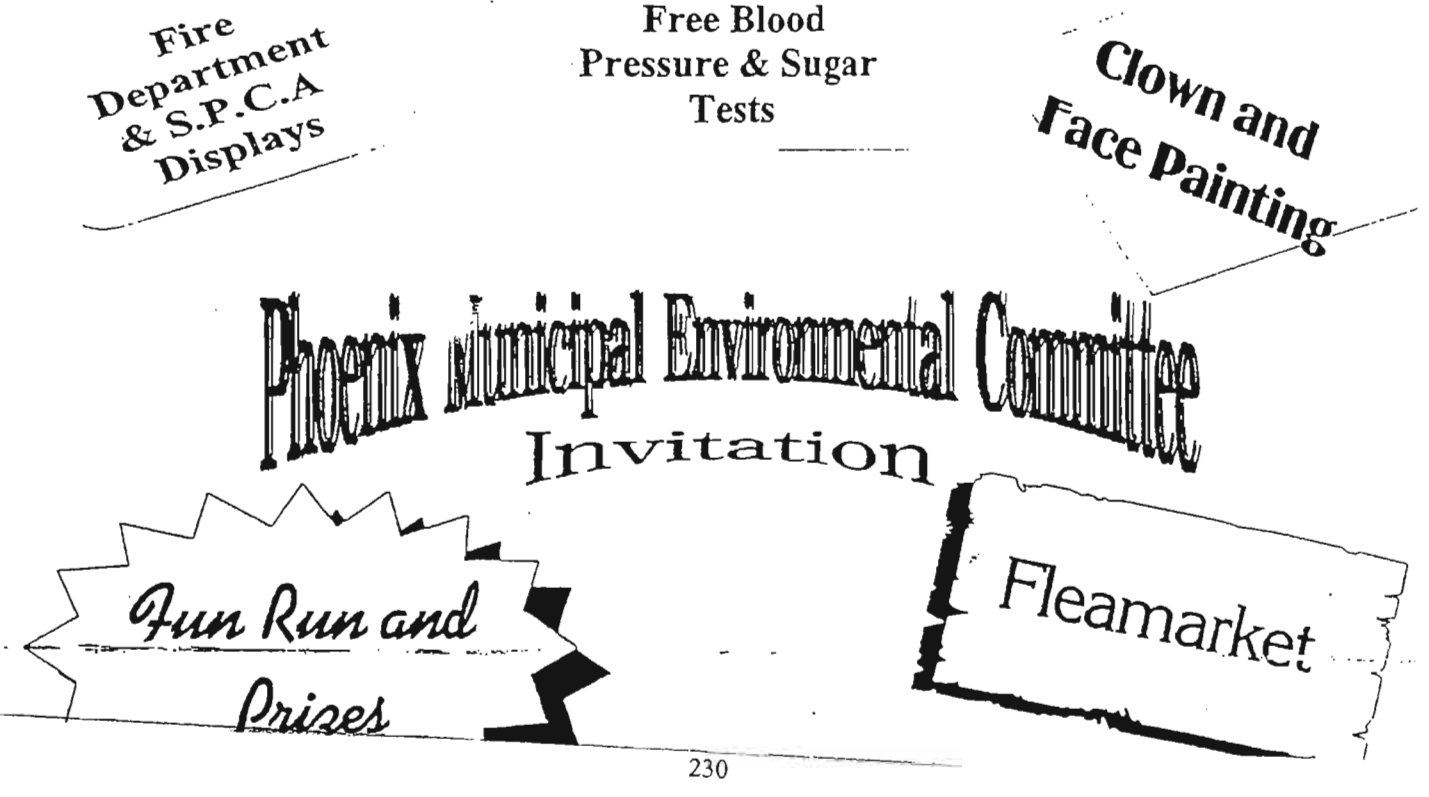
The Fair will also give you an opportunity to be introduced to the many services that are provided for you the community. So come along and enjoy 100 % fun.

Thank You and we look foreward to meeting with you on this day.

PHOENNIX MUNICIPAL ENVIRONMENT COMMITTEE

JleR/dcg/1828D/1

6



APPENDIX SEVEN:

GUIDELINES TO COMPOSTING

- A soil fertilizer - encouraging a vigorous root system.
- A mulch - if applied around plants it will smother small weeds and prevent the surface soil from drying out.
- A peat substitute - for use in potting mixtures.

Composting Step by Step

1. Construct your compost heap on soil, not on any concrete or hard surface. Beneficial bacteria will move from the soil into the heap.

2. Lay down alternate layers of garden waste, soil and manure. A fungus condition is then set up.

3. Wood ash and a sprinkling of lime every 30cm or so can be included.

4. Keep moist but not wet. Watering is a matter of judgement, add more to a heap composed of dry matter, than one with a lot of green matter.

5. Twiggy matter helps in aerating the heap. Aeration can be assisted by driving an iron rod vertically into the heap to make several holes.

6. After 21 days the heap is turned over and watered layer by layer. Here the fungus stage ceases and bacteria become active in breaking down matter.

7. After another 21 days the process is repeated. The bacteria action becomes general and the mass crumbles, less watering is required.

8. During the next 40 days, the mass attracts atmospheric nitrogen and at this stage compost is usually ready for use.

Note:
There must be neither an unpleasant smell nor flies at the compost heap, both are indicative of incorrect making. (This can also be a result of over - watering).

Worms can also be used to process vegetable waste into compost and rich potting soil. As the worm ingests solid and organic matter, its worm casts return nutrients to the soil including phosphorous, potassium, calcium and magnesium in soluble forms for plants.

The Composting Process

Living organisms are responsible for the composting process. When collected together under suitable conditions, animal and vegetable waste starts to break down.

This happens with the aid of many tiny micro-organisms such as bacteria, fungi and algae.

A compost heap provides an environment where this natural process can be speeded up.

In a compost heap the organisms start to feed on softer, more succulent ingredients. Their numbers increase rapidly and so the rate of decomposition speeds up.

As a result of this activity, heat is produced and temperatures can reach 70 degrees Celsius. This kills most weed seeds and diseased material.

Once all the tender bits have been broken down, the rate of activity slows down and the heap starts to cool.

Other creatures such as worms, beetles and centipedes move in to help digest the tougher materials.

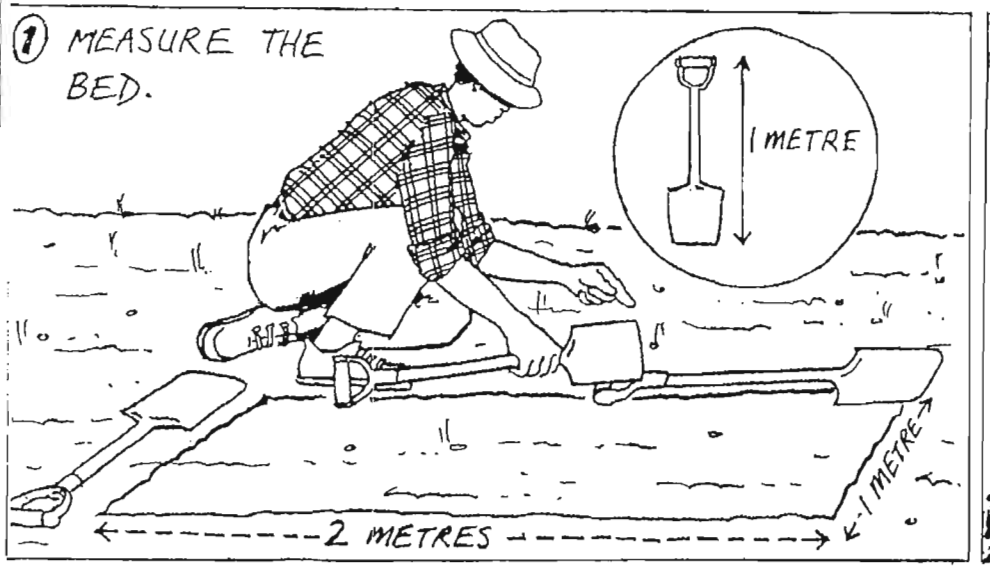
By the end of the process, most of the original ingredients of the heap have been broken down and mixed together.

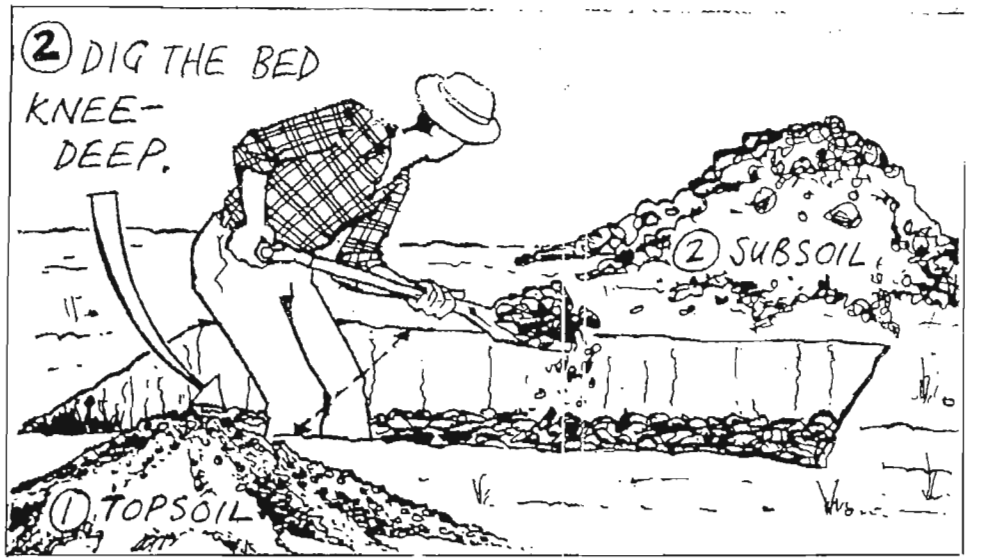
APPENDIX EIGHT:

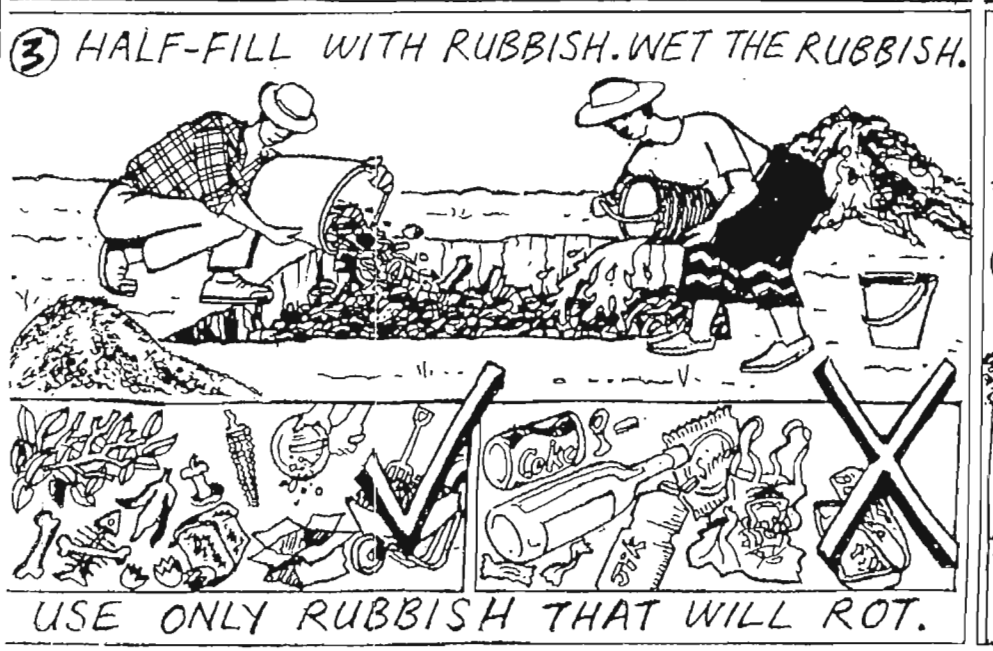
FOOD FOR GARDEN FOUNDATION

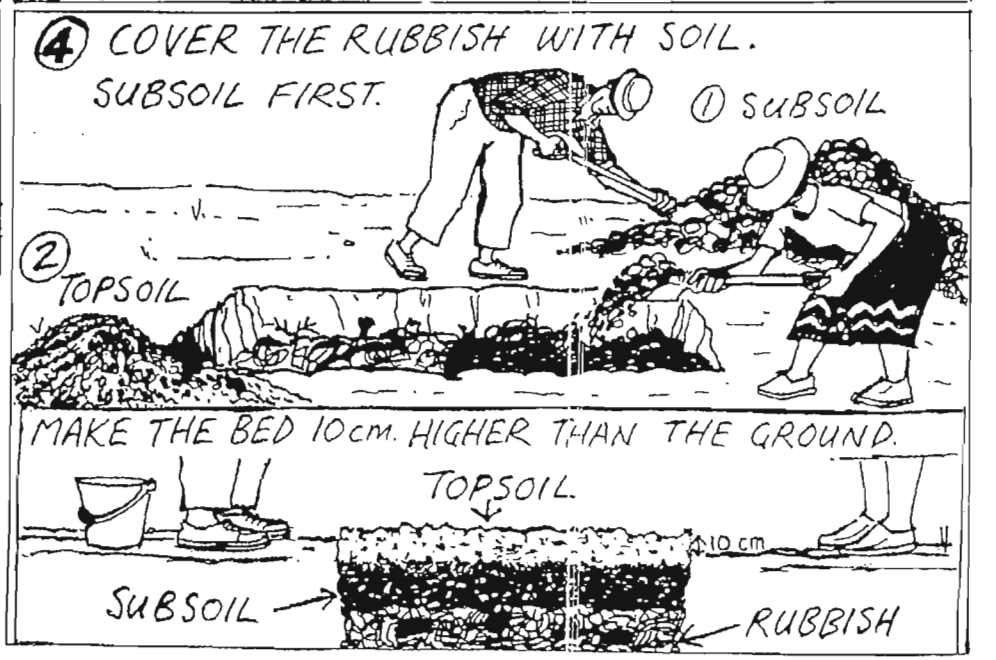
FOOD GARDENS FOUNDATION

GROW YOUR OWN VEGETABLES USING THE EASY FOOD GARDENS METHOD -FILL YOUR STOMACH, STAY HEALTHY AND SAVE MONEY!

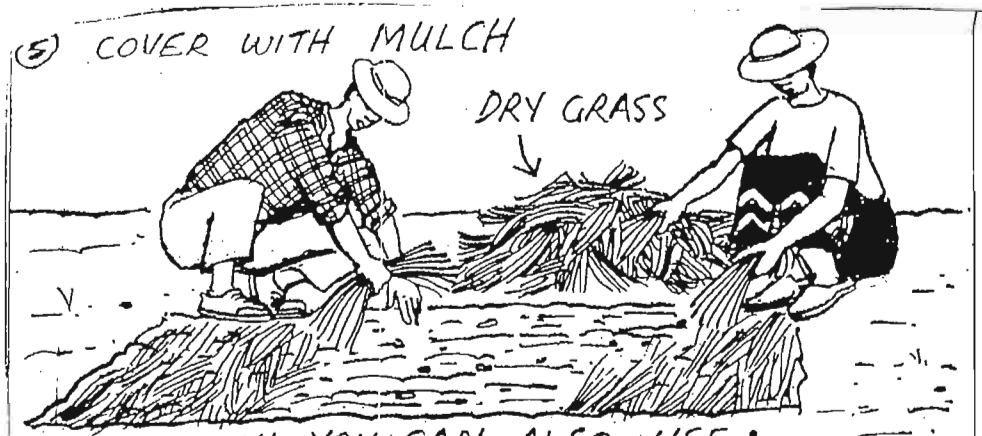




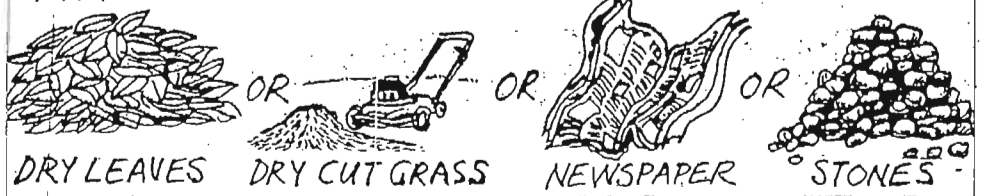




(5) COVER WITH MULCH

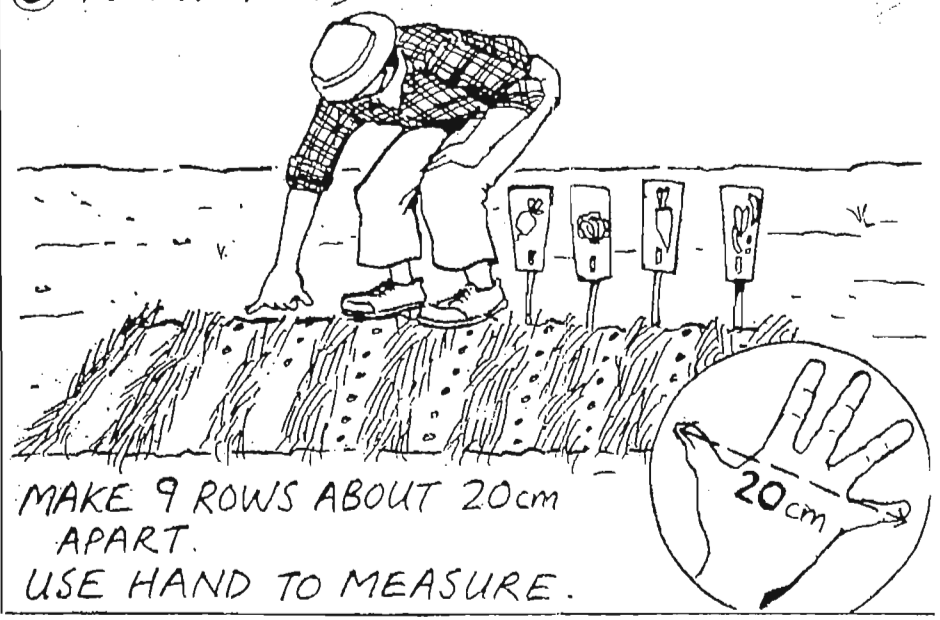


FOR MULCH YOU CAN ALSO USE:



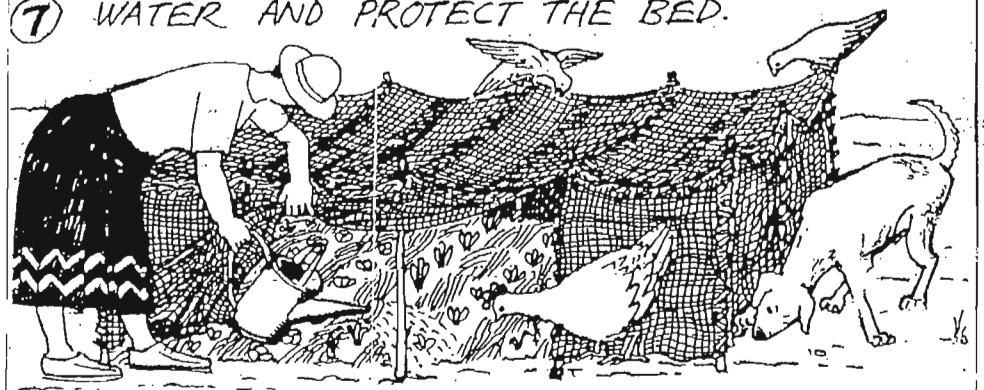
DRY LEAVES DRY CUT GRASS NEWSPAPER STONES

(6) PLANT 4 OR 5 KINDS OF VEGETABLES.

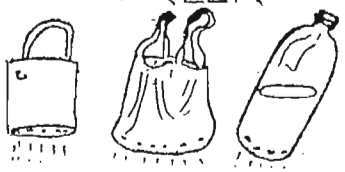


MAKE 9 ROWS ABOUT 20cm APART.
USE HAND TO MEASURE.

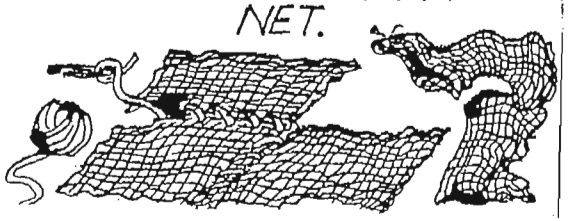
(7) WATER AND PROTECT THE BED.



MAKE YOUR OWN SPRINKLER



AND YOUR OWN NET.



The Food Gardens method is good –

- it improves the soil
- it saves water
- you can grow many vegetables in a small space.

FOR MORE INFORMATION AND FOR CHEAP SEED, WRITE TO

FOOD GARDENS FOUNDATION

FOOD GARDENS FOUNDATION
BOX 41250
CRAIGHALL 2024
OR PHONE (011) 880-5956

APPENDIX NINE:

DURBAN UNICITY PAMPHLET ON ILLEGAL DUMPING

ILLEGAL DUMPING

HELP TO KEEP YOUR CITY CLEAN

Illegal dumping is taking place in the vicinity of your premises.

Do you know who the culprits are?

If so please notify the Horticultural Area Manager or Law Enforcement Officer on telephone _____.

Any information will be appreciated and treated in the strictest confidence.

It is in your interests and those of the environment to ensure that all refuse is correctly disposed of.

Why should you have to pay for your neighbours' anti-social habits?

Durban Unicity

Issued by the Technical & Administration
Branch of the Parks Department
Durban Metropolitan Unicity Council

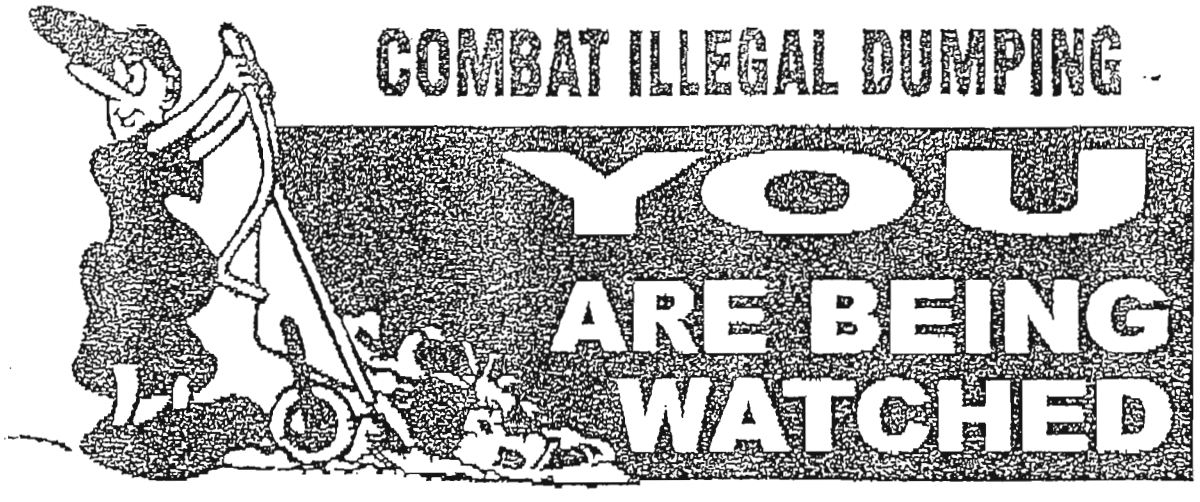
APPENDIX TEN:

ILLEGAL DUMPING NOTICE BOARDS

NOTICE

DUMPERS BEWARE

THE COMMUNITY TOGETHER WITH THE CITY COUNCIL HAS JOINED FORCES TO COMBAT ILLEGAL DUMPING



ILLEGAL DUMPERS WILL BE PROSECUTED !!

REPORT ILLEGAL DUMPING TO : PARKS DEPARTMENT
: DURBAN SOLID WASTE
: CITY POLICE
: CITY HEALTH
: SAP-PHOENIX

BE A PROUD MEMBER OF YOUR COMMUNITY

STOP DUMPING

APPENDIX ELEVEN:

TRANSCRIPTS

Name: Trevor Rubelli

Position: Area Coordinator North

Date: 3 August 2001

There are 3 Garden refuse sites: Phoenix, Riverside, Maluka Road.
Newlands, Duffs Rd, Avoca, KwaMashua, Intuzuma, Inanda, Greenwood park do not have garden refuse sites. People say that they want these sites but they do not want it near their area. First, have to get a site, then go in and have to operate the sites. This site is the not a transfer station. In Chatsworth they have two transfer stations, however the residents do not use it (Unit two). People from outside the Chatsworth area use this facility (e.g. Queensburgh residents do not pay rates Durban but take their garden refuse to this site). People living within half a kilometre generally use this facility with the help of their garden worker. The domestic worker would not go further if there were a closer area to dump their waste.

He found that only shopowners only use these facilities in Canehaven. Canehaven sites is open from 6oclock in the morning to five at night.... However, "I think that a number of people are not aware of this facilities. Need to inform people". This site should take other wastes. However they do not take waste that will cause and odour e.g. if a person is cleaning out their fridge and does not want to keep the waste, as it will cause smells, this is not allowed at the sites. As if they collect this waste, it will stink this area. (Especially in summer, some wastes cause a lot problems in terms of odours).

Environmental Awareness Programme
Phoenix Environmental Forum.

Keep Durban Beautiful run by Roy Sookdeo (area representative for the Phoenix area) who is heading the programme on Adopt a verge, adopt a garden and adopt a highway. Give residents two bags but they will collect all the waste hence more than one bag can be given if requested. Five workers go to pick up the waste. Three goes ahead of the trucks, they go and get the bags and heap them up in one place. They also give the bags

after collecting from each house. The remaining two moves with the truck and picks up the bags from the heap and loads it on the truck. Compactor truck is used. Trucks go out two loads a day. – Monday to Friday. Phoenix site is serviced only in the weekends – implies that this facility is hardly used. On the other hand at the Riverside Rd, have two had two trucks a day to come and empty the waste. People bring their wastes constantly. Riverside people practice recycling. Politicians have a big role to play with regards to waste disposal. They determine whether an area requires site for garden refuse. When politician were approached regarding building garden refuse sites in the KwaMashu, Newlands etc areas, they stated that the money could be used in a better way. That is why there are only three sites in the North central area. Maluke site near the Redhill cemetery was built to relieve the pressure on the site at the Riverside Rd.

The waste from the Phoenix area is taken to Bissarr Road. There are three dumping sites: The Bissarr Rd, the Marianhill, and the La mercy site. The La mercy one is going to close down due to the Gateway Complex. There is going to be only two operational sites. A transfer station is going to be built behind Flanders Rd. This was due to the increased haulage as result of the La-Mercry dump site is going to close down and Tongaat, Verulam, Phoenix, MT Edgescombe will all be bring there waste to Bissarr RD dumpsite. However, the council refuses to build this transfer station as too much of money required Asked for 309 million for the disposal site – Metro Unicity and given 19 million – not enough for trucks. Garden refuse come to Bissarr Rd.

Has practised composting with water department. Mixed the garden refuse with chicken litter etc. However, there is no market for it. Tried to get the private sector involved – Gromor and he sitting mountains of chicken litter from Rainbow etc in the Camperdown area. He supplies games, parks and garden department but there are still vast quantities of this compost. Limited resale for composting in South Africa. In too export but it is expensive to bring in into countries such as Saudi Arabia hence resorts to cheaper compost – chemical composting.

Recycling industry is not working because – send a ton of glass to Consol in Pretoria and they will pay R80 but the transportation (railway track alone) will cost R120. Mondi Paper buys recycled paper but it is cheaper to buy virgin newspaper. This comes from printing press from New York, London, Canada in ship loads – this is much cheaper than picking up paper from igloos etc. SA newprint is 40% recycled. In overseas, they use virgin material – they sell it to us – we use it which makes it 40% recycled – SA newprint is worth to make toilet rolls, egg boxes.

Germany was prepared to supply SA all the glass requirements and they were prepared to pay R 80 to Consol and bring it to Consol in Pretoria free of charge. However, govt. prevented this, as many people would put out of jobs –45000 people. Consol did have a depot in Durban (Prospecton) – however it closed down, cost of labour expensive and work stoppages.

Using current system and separating waste. Scrap the existing vehicles. Have to have a fleet of vehicles- to pick up each waste. Need a place to waste the recyclable – going to be costly. Recycling can work only if it subsidised or people needs to pay. Household pays approx. R19 per month to collect waste (currently). Illegal dumping that occurs in Sea cow lake (dead –end Crow Place) Inspector was sent there to fine the offenders. Inspector was chased, as the residents living in the squatter settlements want this wood etc to use for heat, stoves etc. But the councillor D. Ganesha held a meeting and sent a letter to the council to prevent this dumping as created problem of rodents, odours, want the place to be cleaned and erect boards stating illegal dumping area. Double standards – the squatter wants the woods and residents want this dumping to be stopped.

Cost of disposal at the dump site in Bissarr road. Pay R10. Charge -first 100kg is free. Charge on an escalation rate. Rotten fish, sheep heads etc are frequently dumped in Chatsworth, Phoenix, etc. Scavengers are common on the Bissar. They are problematic hence only allow them in certain areas and from 4h30 only to pick up recyclable materials and not food due to health laws etc. Get cases where certain supermarkets bring in their waste due to power failure. They are insured hence they can dispose the waste.

But due to the city health Department does not allow it. The scavengers break into the dump site to collect the food.

Get scavengers on collection days. The areas in Kwa mashu, Intuzuma etc get private contractors to collect waste. Contractors do not do Phoenix. Small contractors such as Dave Olefso who makes boats collects plastic bottles at the Stables. He uses it for floatation – 2lt cooldrink bottles. But the bottles have to be clean. In order for recycling to work, it has to have a sustainable market. One of the most dangerous wastes if domestic waste due to the number of different waste types put into the bin – this is very toxic.

Private companies incinerate medical wastes.

'The landfill sites are only not going to be there forever, need to look at alternatives so that the life of the landfill is extended. Let not wait till we forced to, let try now'. Landfill will last up to 150 years. The methane gas emitted from the landfill site is not utilised instead it burned and wastes whereas it could be used for generation of electricity. However, govt. has only allowed ESKOM to generate Electricity. ESKOM should merge with councils dumps to harness this energy source rather than it been wasted

Name: Solly Singh

Date: 6 August 2001

Position: Chairman of Keep Phoenix Beautiful Association

Facilities are not adequate. Not enough bins. Education is not sufficient. Illegal dumping is a cause of insufficient and inadequate facilities. There is only one site for garden refuse in Phoenix. Parks Board has to clean up the dumping. Garden refuse is hardly used by people. People from other areas use the site e.g. from Parkgate and Ottawa. The laws enforced in these areas are strict hence, most people use the Caneside Garden refuse site.

The site in Woodview was used as a dumping site. The Woodview Ratepayers Association fenced this site so that cars do not gain access to dump their waste.
The collection is adequate. Many recyclable wastes are put in the bins, which are unfortunate. There needs to be changes made. The garden refuse site initially was used to as a depot for recyclable materials. People used to bring their recyclable materials to this area. Schools involved, Sai groups (religious organisation), Krishnas organisation also practised recycling. KPA educate people about recycling, environmental awareness etc. KPA started in 1988.

Today people are collecting cardboard as it is viable and paper. Education has been successful. Cardboard brings in revenue. Glass started successfully, however after change in management. Igloos were initially given free, however after change in management, they asked for R1500. Could not pay for the igloos as this was a voluntary organisation and any money made was given back to the community. Hence, they took the igloos back. In Umhlanga Rocks there is good recycling programmes because of the number of sponsors that they attained e.g. from Shops such as Pick and Pay etc. Money collected from the bottles collected is put back into the community – Umhlanga. If one get sponsors, it can be promising.

Cans, needed manpower, hence were not working. Collect the cans and then take it to the depot whereas with the paper and glass, the company used to collect. Smash the cans

check to see if it is working. Plastic did work but there was a lack of manpower. Plastic collected was see through, packets. Had to go and check the correct plastics were placed etc – lack of manpower – people used to throw cigarettes in the igloos – an entire igloos was burned. Programme stopped. Cardboard is good revenue. Collect and store and get contractors to collect – Maydenwarf. – Phoenix industrial park has a company that collects these recyclable materials. Only one recycling company in Phoenix, unfortunately only people with vehicles are able to go to these areas. A lot of waste is going into the garden refuse sites. Trevor stated that household's wastes are also collected at the site. Rubble and tiles etc is not allowed in this garden refuse site. Phoenix Childcare also practices recycling. Paper can work in terms of been recycled.

However, one has to make it easy for them and one has to throw something back into the company. In addition, people attitudes have to change. Incentives need to be thrown into the community to encourage people to practice recycling. Scavengers – need to avoid this – because it is dangerous – unhealthy. People should take out the wastes they need to give (especially foodstuffs) to the scavengers rather than make them ravage through the bins.

Kitchen waste is problematic, as one can not keep the wastes for too long as it causes odours. Especially foodstuffs such as chicken waste, crab etc. It will cost the council too much to start collection twice a week. If there were a bin next to the house for garden refuse a lot of other stuffs are going to go in these bins. Need to educate people about the environmental impacts of waste disposal. Spoke about premaculture – plant your own food garden in schools –educate children – wins prices – sponsored by big companies such as ESKOM etc-

KPA could not be maintained because of lack of voluntaries, lack of interest – which is why start in schools. Never heard of the green bag collection for garden refuse –KPA. Sarah looks at Integrated Waste Management –Old Phoenix, Behind the swimming pool. Starwood – costs 30 million a year to clean up these areas. Low income areas, people are afraid to do any wrong. Woodview high income areas, people dump a lot, Procedure of

reporting Illegal Dumping: fill an affidavit, take parks department – fine him – If offender refuses – go to court- Also when one reports the dumping, they harassed, threatened etc. Low income is supportive to the education programmes. When approach an offender, they abuse you etc,

When one sees a offender (dumping) take the offenders number plate – vehicle, the time and what is dumping and take it to Preggie. Solly has to sign and affidavit. Preggie issues a spot fine. If the offender refuses, then Solly has to appear in court. Besides fining the offender, he has to pick up the litter. If he does not pick it up, them Preggie picks it and bills it to the offender. R500 for fines. This is expensive. People should be educated about the where they can dump your waste, the impacts of this dumping.

There is an area on Canehaven and Woodview. The youths would like to adopt the place to keep the place clean. Coca Cola will sponsor the place. Fill a form look at the positive and negative and negative impacts – have a meeting to assess the boy's initiatives to adopt this place. As it is the resident close by is rejecting this idea as he claims that he would not like a group of boys hanging out in near his home. They make a lot of nice. In addition, these boys have drawn on his wall. This painting is beautiful however it is done on private property. Community will come together to decide the issue. Suggestion: Can use the place to install facilities such as games, sporting facilities. Beware that the place does not become a depot for drugs etc. The area near Gora Shop in Woodview was littered by the shop owners themselves. Now this has stopped as the area is used for other purpose, e.g., a temple. These illegal dumping areas are a hive for criminal activities.

Initially the Woodview Park was an area for dumping ground. It was plagued with illegal dumping. A woman was found dead in this area. The residents came together and to the initiative to make the area into a park. This combated the illegal dumping. However due to the lack of manpower, this area has numerous problem such as alcoholism, fights, theft, damage to property, noise Law does not do anything about this problem. Ghandi Park was also once a place for dumping. But now this place is changed into a memorable Park. The Keep Phoenix Beautiful is lacking power.

Job creation through picking up litter. This is working well in a number of areas such as Bambayi. Contractors are used to come and pick up this waste in the outer areas of Phoenix. Phoenix Executive Forum has a legal body. Council has expressed a interest in forming a recycling depots – advertised this in the paper – There should be a depot in Phoenix – However these depots are only available in central areas – if such an initiative has to take off, one has to do it permanently – need the manpower etc.