DURBAN UNIVERSITY OF TECHNOLOGY

A SITUATIONAL ANALYSIS AND KNOWLEDGE, ATTITUDE AND PRACTICES (KAP) STUDY OF WASTE MANAGEMENT AND RECYCLING AT THE DURBAN UNIVERSITY OF TECHNOLOGY (DUT)

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A SITUATIONAL ANALYSIS AND KNOWLEDGE, ATTITUDE AND PRACTICES (KAP) STUDY OF WASTE MANAGEMENT AND RECYCLING AT THE DURBAN UNIVERSITY OF TECHNOLOGY (DUT).

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ABSTRACT

The Durban University of Technology (DUT) signed the Taillores Declaration (TD) in an attempt to deal with environmental issues and subsequently waste management challenges. A few projects have been initiated within the institution to realise the TD ten point action plans. Currently there is limited data regarding the status quo at DUT. A quantitative descriptive study was conducted to analyse the situation with regards to waste management and recycling practices and to evaluate the knowledge, attitude and practices (KAP) of students towards waste management and recycling at DUT.

An audit of the refuse receptacles was conducted and information obtained was plotted out on a map of two selected campuses. A questionnaire was used to collect data on the practices of waste management and recycling from nine departments. A total of 403 students from the Indumiso and Riverside campuses of DUT were recruited for the KAP study. The findings revealed that refuse receptacles are provided inconsistently and that there is a lack of planning around the provision of these receptacles. Departmental practices regarding waste management and recycling were found to vary from one department to the next. The KAP study results indicated that the students' knowledge regarding waste management and recycling is poor and their attitudes and practices towards waste management and recycling may be improved by education and enforcement of policy.

It is essential to develop a policy regarding waste management and recycling for DUT. In addition, a learning programme should be implemented for all new students entering DUT and during orientation.

DECLARATION

I, George Mdlozini, declare that the content of this research project is my unaided original work. Other people's works that have been used or quoted have been acknowledged by means of complete references. This work has not been submitted previously to the Durban University of Technology (DUT) or any other University.

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George Mdlozini (Student Number: 19704204) Date

DEDICATION

This research work is dedicated to God almighty, the Creator for creating the opportunity and circumstances that allowed for this work to be carried out to completion. Secondly I dedicate this study to my family for allowing me the space to engage in this work. I also dedicate this work to my colleagues who were always encouraging me and lastly to my friends for always being there as pillars of strength.

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My colleagues, for always encouraging me.

CONTENTS

CHAPTER 3: RESEARCH METHODOLOGY

CHAPTER 4: RESULTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION TO THE STUDY

Waste Management is defined as the systematic control of the generation, collection, storage, transportation, source separation, recovery, treatment and disposal of solid waste. Flies, rats and other vermin and disease vectors thrive in an environment of uncontrolled waste, which exacerbates poor health outcomes. In South Africa the waste management function is the responsibility of local municipalities and is administered through the National Environmental Management: Waste Act (Act No. 59 of 2008) (the Waste Act). The Act does not make any specific reference to public institutions with regards to waste management.

Waste management is not only a problem in developed countries but it is a major concern in developing countries as well. In South Africa it was only in 2008 that legislation was promulgated specifically for the management of waste. A National Waste Management strategy was developed to guide the management of waste in the country. Unfortunately it did not cater for Institutions of Higher Education. Institutions of Higher Education were left on their own to address the issues of waste management and recycling. For this to be effectively done, it is imperative to have a clear understanding of the composition and the dynamics around this activity. Despite the very diverse benefits of a suitable waste management system, the setting of a new waste management system is not an easy task (De Vega, Benitez and Ramirez Barreto 2008). Strange (2002) asserted that to mitigate the problems with waste management and recycling different strategies must be implemented to minimise waste. These strategies can only be appropriate if there is a clear understanding of these processes with a commitment from all involved stakeholders. In a Higher Education Institution it is imperative to ensure that both students and staff take ownership of a ‘green’ institution by practicing proper waste management and recycling.

1.2 BACKGROUND

The Indumiso and Riverside campuses are two campuses out of a total of seven campuses that make up the Durban University of Technology (DUT). These two campuses are the only ones that are based in the city of Pietermaritzburg, which is approximately 90km away from Durban. This quantitative cross-sectional study has three phases to it comprised of a walk-through survey; a situational analysis of current practices of waste management and recycling within the various departments; and a knowledge, attitudes and practices study of waste management and recycling among students at the Durban University of Technology.

1.3 RATIONALE OF THE STUDY

As one of the institutions of higher education that are signatories of the Talloires Declaration (1990), the DUT has an obligation to develop a strategy and policies to deal with environmental issues within the institution. The strategies and policies have to deal with the individual environmental aspects such as water pollution, air pollution and waste management etc. The development of policies requires that the current practices be fully understood. This can only be achieved through a situational analysis of the status quo regarding waste management and recycling at the institution. The knowledge, attitudes and practices of the community at large is to a greater extent dependent on the information to which the population is exposed. The development and delivery of a learning programme to all new DUT students is an attempt to ensure that the basic knowledge required by people who are going to participate in environmental issues is made available.

1.4 SIGNIFICANCE OF THE STUDY

The findings of the study can be used by the executive management of the DUT as a tool for the development of a policy document within the institution regarding waste management and recycling within the various departments. The findings of this research study will be used to determine the content of the learning programme which will be delivered at the orientation of first-year students entering the DUT.

1.5 PURPOSE OF THE STUDY

The purpose of the study is to conduct a situational analysis and knowledge, attitudes and practices study of waste management and recycling at the DUT.

1.6 OBJECTIVES OF THE STUDY

The objectives of the study are:

- To conduct a situational analysis of the current waste management and recycling practices of the academic departments at the Indumiso and Riverside campuses of the DUT.

- To conduct knowledge, attitudes and practices (KAP) survey regarding waste management and recycling amongst students at the DUT.

- To design a learning programme for delivery at the orientation phase for all new DUT students.

CHAPTER 2

LITERATURE REVIEW

Solid waste management is a problem in both developed and developing countries (Mbuligwe 2002). Tuncer (2008) affirmed that developing countries are challenged with waste management issues and that they need to advise their citizens on sustainable practices in terms of waste management and recycling. These changes also need to include legislation accompanied by a community environmental programme designed to improve the understanding and practices of citizens in relation to waste management at all levels within society (Grodzinska-Jurczak 2001). In South Africa the Constitution devolves the function of waste management to local municipalities, as they are the level of government closest to the community. The district municipalities only play the role of overseeing the provision of this service by the local municipalities. Public institutions such as hospitals, schools and universities are generally not provided for in terms of solid waste management. These institutions have to deal with waste management on an individual institutional basis, without guidance from government legislation or policies. According to Malgorzata *et al.* (2003) the environmental knowledge and awareness of a population plays a vital role in the management of waste. Concomitantly, the dissemination of information to the community should be imparted by authorities in charge of waste management. To be effective, a waste management structure that meets the needs of all sections within the population should be implemented. Since the Stockholm Declaration of 1972 there has been a steady development of national and international sustainability declarations relevant to higher education institutions (HEIs) (Wright et at., 2002).

In 1990 leaders of 300 international institutions of higher learning from 40 countries convened in France and undertook a commitment to environmental sustainability by signing the Talloires Declaration (TD) (1990). This declaration has a ten-point action plan to incorporate sustainability and environmental literacy into teaching, research, operations and outreach at colleges and universities (Alshuwaikhat and Abubakar 2008). In South Africa this document was initially signed by six institutions of higher learning, which included the DUT. Universities have the expertise necessary to

develop the intellectual and conceptual framework to achieve the goals stated in this declaration by being actively involved in the education, research, policy development, information exchange and community outreach to help create an equitable and sustainable future. One of the aims of the Talloires Declaration (1990) action plan is a commitment to practice institutional ecology by establishing institutional policies and practices of resource conservation, recycling and waste reduction, in order to achieve sound environmental operations (De Vega, Ojeda-Benitez and Ramirez-Barreto 2003).

The ten-point action plan of the Talloires Declaration (1990) as given in France at the international convention of Principals of Higher Education Institutions are:

1. Increase awareness of environmentally sustainable development.

Use every opportunity to raise public, government, industry, foundation, and university awareness by openly addressing the urgent need to move toward an environmentally sustainable future.

2. Create an institutional culture of sustainability.

Encourage all universities to engage in education, research, policy formation and information exchange on population, environment, and development to move toward global sustainability.

3. Educate for Environmentally Responsible Citizenship.

Establish programmes to produce expertise in environmental management, sustainable economic development, population, and related fields to ensure that all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens.

4. Foster environmental literacy for all.

Create programmes to develop the capability of university faculty to teach environmental literacy to all undergraduate, graduate, and professional students.

5. Practice institutional ecology.

Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations.

6. Involve all stakeholders.

Encourage the involvement of government, foundations and industry in supporting interdisciplinary research, education, policy formation, and information exchange in environmentally sustainable development. Expand work with community and non-governmental organisations to assist in finding solutions to environmental problems.

7. Collaborate for interdisciplinary approaches.

Convene university faculty and administrators with environmental practitioners to develop interdisciplinary approaches to curricula, research initiatives, operations, and outreach activities that support an environmentally sustainable future.

8. Enhance the capacity of primary and secondary schools.

Establish partnerships with primary and secondary schools to help develop the capacity for interdisciplinary teaching about population, environment and sustainable development.

9. Broaden service and outreach nationally and internationally.

Work with national and international organisations to promote a worldwide university effort toward a sustainable future.

10. Maintain the movement.

Establish a secretariat and a steering committee to continue this momentum, and to inform and support each other's efforts in carrying out this declaration.

Shriberg and Tallent (2009) reported that several universities have developed Talloires Declaration implementation plans, including the Australian National University (ANU) and Macalester College. The DUT is a signatory to the Talloires Declaration and has initiated a few projects within the institution to embark on the implementation of the ten points that are tenets of the declaration. The DUT,

however, does not yet have a policy that addresses sustainability and environmental challenges at the institution. To date there is no evidence of rigorous research being conducted to interrogate these issues at the institution.

2.1 Waste Management

Waste management is defined as “the systematic control of the generation, collection, storage, transportation, source separation, recovery, treatment and disposal of solid waste” (South Africa, 2008). The effective management of solid waste in developing countries is constrained by a number of problems, including financial and technological limitations (Mbuligwe 2002). It was suggested by Mbulingwe (2002) that it is advantageous to consider the management of solid waste at institutional level because of the capacity required to be able to effectively sustain and manage the waste. Velazquez *et al.* (2003) affirmed that the lack of financial resources is a constant constraint on most projects. They further stated that the slowing economy has affected HEIs such that they have had to cut budgets by reducing expenditure among university units. Money was reallocated to priority goals, and environmental sustainability was not a first priority for HEIs.

The National Institute of Ecology (INE) (1999) outlined that in Mexico the municipal authorities are in charge of the cleaning services of the cities, which is similar to the situation in South Africa. Although this is the case, De Vega, Benitez and Ramirez-Barreto (2008) indicated that the municipal services for waste collection do not provide this service to universities. De Vega, Benitez and Ramirez-Barreto (2008) further explained that it is the responsibility of individual institutions to contract this service to a private company. In the South African context all public institutions, including hospitals and HEIs, have to make their own arrangements for waste management. Effective solid waste management requires a complete understanding of the composition of a waste stream, together with the activities that determine its generation in the first place. Examining waste by the generation source is particularly important, as the characteristics and composition of solid waste vary according to the source (Smyth, Fredeen and Booth 2010).

2.2 Waste management process

The National Waste Management Strategy (2012) suggested that once waste has been generated it needs to be stored in containers that are suitable for that particular type of waste. Waste such as sharp objects should not be stored in containers that can be torn by such wastes. Ash as a waste should not be stored in a container that is sensitive to heat, e.g. not in plastic bags. The strategy document further stated that the frequency of the collection or transportation of the waste from the generation point should be indirectly influenced by the type of waste that is being generated and stored. The steps of the waste management process are: the generation of waste; the storage of waste; the collection of waste; and the disposal of waste.

2.3 Generation and composition of waste in a university context

According to the National Waste Management Strategy (2012) the most effective approach in dealing with waste is the avoidance of waste generation, which is almost impossible to achieve. All human activities eventually lead to the generation of waste. Nkosi *et al.* (2012) declared that over 42 million cubic metres of general waste is generated in South Africa per year. Nkosi *et al.* (2012) further indicated that in the 42 million cubic metres of waste generated in South Africa, public institutions such as universities etc. contribute quite a sizeable volume.

Desa, Ba'yah Abd Kadir and Yusooff (2011) found that with the increasing number of students in universities the amount of waste generated every day indicates the escalating pattern of waste generation at universities. Desa, Ba'yah Abd Kadir and Yusooff (2011) further stated that the students, staff (both academic and non-academic) and visitors were generators of waste, and that this problem could not be attributed to any single group or department. It was noted, however, that the generation of waste typically originates from the residential colleges, cafeterias, academic blocks and administration blocks.

In a study conducted by Smyth, Fredeen and Booth (2010) at the University of Northern British Columbia (UNBC), the results revealed that during the academic year 2007-2008 approximately 52 081 kg of waste was generated from the core campus, over two fifteen-week semester periods. Overall, the cost of UNBC campus

waste disposal amounted to more than 39 000 CAN$ for the 2007-2008 academic year.

In a study conducted at the Universidad Autonoma Metropolitana (UAM-A) by Espinosa *et al*. (2008), it was concluded that the university community generated a weekly average of 7.74 tons of solid urban and special handling waste. This included 1.72 tons of gardening waste, which was equivalent to 0.110kg per day per person. The study showed that paper and cardboard formed slightly more than 25% of the total waste generated at the university. Gardening waste was slightly less than 20% of the total waste generated at the university. The University Technology Petronas (UTP) showed that paper was the largest component (40%), followed by food waste (30%); plastic (15%); tin/aluminium (4%); cardboard (10%) and glass (1%) (Malakahmad *et al.* 2010). The generation rate variation depended on the population and different activities in each building (Malakahmad *et al.* 2010).

2.4 Storage and collection of waste

The South African National Environmental Management: Waste Act of 2008 (Act No. 59 of 2008) defines storage as “the accumulation of waste in a manner that does not constitute treatment or disposal of that waste”. Once the waste has been generated it needs to be managed; the management must be done in a manner such that it reduces the impact of the waste on the environment and the resultant negative effects on human health (Desa, Ba’yah Abd Kadir and Yusooff 2011). The initial procedure should concentrate on appropriate storage at the premises where the waste was initially generated. This would require that appropriate and suitable containers be provided. The size of the container is also important and should take into consideration the frequency of the emptying of these receptacles. Waste should be contained and not left in the open, thereby resulting in potential health and nuisance issues (Smyth, Fredeen and Booth 2010).

De Vega, Benitez and Ramirez-Barreto (2008) found that almost 65% of the generated solid waste at a university campus to be recyclable. A programme of segregation and recycling is therefore feasible on a university campus (De Vega, Benitez and Ramirez-Barreto 2008). Malakahmad *et al.* (2010) reported that the presence of food waste caused contamination of other waste components including recyclable materials, especially paper and cardboard, and it could reduce their value

for recycling. Biodegradable waste (such as food waste) will almost immediately start to undergo microbiological decomposition as a result of the growth of bacteria and fungi (Tchobanoglous, Theisena and Vigil 1993). This scenario would become worse in humid and high temperature conditions of tropical countries. Additionally, if wastes are allowed to remain in storage containers which have been left open at the university for extended periods of time, flies may start to breed and odorous compounds may develop (Malakahmad *et al*. 2010). Putrescible waste would need to be removed more frequently than other types of wastes.

Typically, the type and capacities of the containers used depends on the characteristics and types of the solid waste to be collected; the type of collection system in use; the collection frequency; and the space available for the placement of containers (Malakahmad *et al.* 2010). The advantage of a medium sized container is that it can also accept bulky waste, while small containers are not large enough to hold bulky waste. On the other hand, as unloading takes place manually on campus, heavy containers could cause a problem for workers (Malakahmad *et al*. 2010). Waste comes in different sizes and the containers used to store the waste should take into consideration the size and type of waste that it is meant to keep. Some wastes are of such a nature that a special type of container is necessary. A plastic bag is not an appropriate receptacle for broken glass as the plastic can easily be torn by sharp objects.

2.5 Disposal of waste

Smyth, Fredeen and Booth (2010) asserted that more than 991kg of waste collected annually at the University of Northern British Columbia could have been diverted from the landfill through composting, recycling and waste reduction activities. The South African National Waste Management Strategy (NWMS) (2012) acknowledged three main methods of waste disposal: landfilling, composting and incineration. Understanding the characteristics of an institution's solid waste stream is the first step towards enhancing the sustainability of a waste management system. Nkosi *et al*. (2012) stated that South Africa has been implementing the 'end of pipe' approach to waste management by only applying the disposal at a landfill site. Landfilling is referred to as the 'end of pipe' approach because there are other means of dealing with waste before landfilling is employed. These other means of dealing with waste

include re-use, recycling, composting and recovery. According to the NWMS (2012) the re-use of materials from the waste stream reduces the waste that eventually goes for disposal by more than 20% of the total waste heap. The NWMS (2012) also encourages the approach of recycling waste because there are many environmental, economic and social benefits of recycling. Composting is regarded as a method of disposal of waste; it is also a method that reduces the volume of waste.

Desa, Ba'yah Abd Kadir and Yusooff (2011) explained that waste disposal was a critical issue for the community, and that the ineffective or irresponsible disposal of solid waste pollutes the environment and poses a health risk to the public. Furthermore, waste management technologies such as land-filling and incineration are not complete solutions to this problem, as nobody wanted a waste management site in his or her neighbourhood.

2.5.1 Landfilling

Malakahmad *et al.* (2010) reported that many countries, such as Malaysia, have found it increasingly difficult to find suitable locations for landfills which are accepted by the population. It is therefore imperative to develop new strategies for waste management. Changes in lifestyle have led to increased waste problems, as posited by Malakahmad et al. (2010). Packaging of convenient household goods is easily available, and a carefree attitude by society to waste management resulted in huge quantities of waste. Plastics which are not degradable constitute a high proportion of modern-day waste. The increasing amount of solid waste being generated has resulted in a reduction in landfill capacity (Malakahmad *et al*. 2010).

2.5.2 Composting

Findings from a study conducted by Mbuligwe (2002) to determine the effectiveness of composting as an optional disposal method showed that besides considerable improvement of the study area in terms of cleanliness, there was also a big reduction of waste needing final disposal. This was so, since the compostable waste component constituted almost 78% of the total waste that was collected.

According to the NWMS (2012) composting is a waste disposal method that is mostly suited to organic waste. This method relies predominantly on the natural decomposition of waste and is most suitable for those waste materials that are

degradable. Composting is a process by which organic wastes are broken down by micro-organisms, generally bacteria and fungi, into simpler forms. The degradation of the nitrogen-containing materials results in the breakdown of the original materials into a much more uniform product, which can be used as a soil amendment (National Waste Management Strategy 2012).

Smyth, Fredeen and Booth (2010) noted that organic matter was subdivided into material that is currently accepted by the University of Northern British Columbia (UNBC) compost programme, and compostable material that is not acceptable by the programme. The small size of the UNBC compost site and its proximity to wildlife limited the kind of organic material that can be composted. Thompson (2005) reported that at three Ontario universities waste audits revealed that compostable organics represented between 17% and 29% of the total campus waste stream. As reported by De Vega, Benitez and Ramirez-Barreto (2008), using institutional organic waste to make compost on the university campus ground or outside has become a common practice within the higher education sector.

Organic waste is typically the heaviest component of a waste stream, thereby costing the most money to dispose of; it also has the highest potential to emit greenhouse gases once buried in a landfill (Diaz *et al*. 1993). The high financial and environmental cost of improperly disposed organic wastes make this component especially important when considering opportunities for increased waste reduction and diversion (Tammemagi 1999). Smyth, Fredeen and Booth (2010) explained that diverting organics from the waste stream has proven to be difficult, not only for institutions of higher learning but also for the municipalities and regions in which they are located.

2.5.3 Incineration

Schmidt *et al.* (2007) concluded that incineration was a better disposal option than landfill, because incinerators provide heat and electricity and save any fuel that would be used to generate heat. The NWMS (2012) described incineration as a method of waste disposal that involves the burning of waste in an environment where the resultant emissions are controlled in an attempt to protect the environment. In South Africa legislation has been promulgated to oversee the protection of the environment from illegal incineration.

2.6 Waste Management legislation

Before the promulgation of the current legislation on waste management in South Africa, the country did not have legislation that specifically addressed waste management issues. Legislation such as the National Environmental Conservation Act: Act no 73 of 1989 only addressed general environmental issues that encompassed waste management. Other environmental issues were addressed with their own specific legislation, with the exclusion of waste management. It was only after 2008 that issues pertaining to waste management were directly addressed with the promulgation of a specific piece of legislation. Previously, waste management was not considered to be a major or serious environmental concern when compared with air and water pollution. The National Environmental Management Act (Act No. 107 of 1998) and the National Environmental Conservation Act (Act No. 73 of 1989) were two of the most significant pieces of legislation dealing with waste management issues (Amutenya, Shakleton and Whittington-Jones 2009).

In South Africa the national Constitution states that the waste management function is the responsibility of local municipalities, as they are the tier of government that is closest to the community. The National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) prescribes the establishment by government of the NWMS. The function of the NWMS is to achieve the objectives of the 'Waste Act'. The Act is not clear about the responsibilities of institutions such as universities with regards to waste management. The DUT, as one of the institutions of higher learning, is not guided by any legislation on such issues. De Vega, Ojeda-Benitez and Ramirez-Barreto (2003) explained that most developed countries had inadequate enacted legislation, and similarly ineffective regulation regimes to cover key waste management issues.

2.7 The National Waste Management Strategy

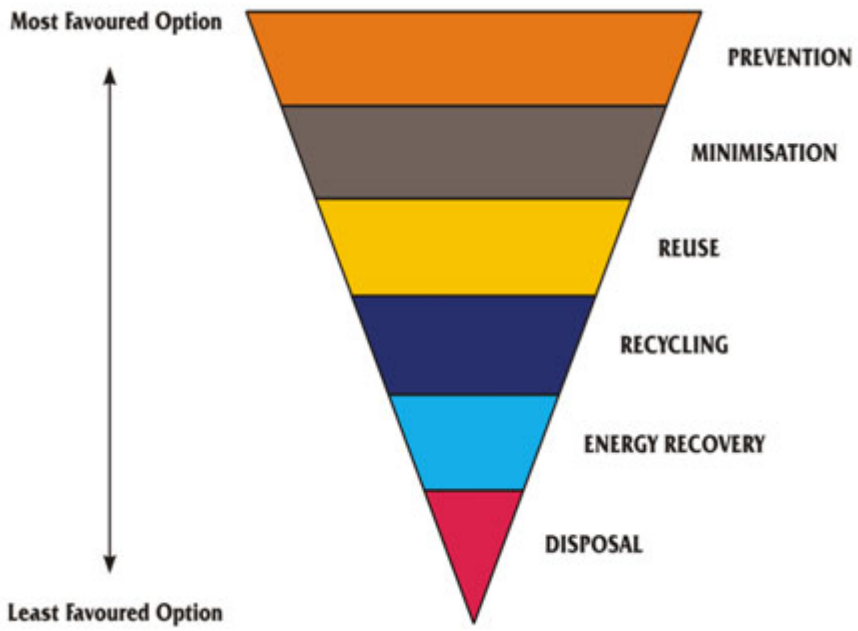

Figure 2.1: Waste management hierarchy (National Waste Management Strategy 2012).

The approach to dealing with waste management in South Africa is governed by the NWMS (2012) document, which recommends that the most preferred approach is to prevent and reduce the generation of waste, as shown in Figure 1 above. Prevention and minimisation are favoured more than disposal. If this fails, the next preferable approach would be to reduce or minimise, re-use and recycle any waste from the heap. This would assist in reducing the volume of waste requiring disposal. The waste that remains after recovery, re-use or recycling should be treated before final disposal. The treatment of the waste serves the purpose of reducing the negative impact of waste disposal on the environment. There are different approaches to the treatment of waste. The most appropriate approach would be the method that is most suitable for that specific type of waste. Materials such as plastics and glass are non-biodegradable; as a result the disposal of such materials at a landfill site would defeat the purpose, and such wastes are best taken for recycling. Organic wastes are best disposed of by composting, as they can be used as manure. Hazardous wastes are best disposed of at landfill sites meant specifically for hazardous wastes (National Waste Management Strategy 2012).

2.7 Waste Management practices and challenges at universities

While numerous waste characterisation studies have been conducted at the household or municipal level, only a small number exist for the institutional sector, namely health care institutions; even fewer studies have assessed the composition of solid waste within institutions of higher learning (Smyth, Fredeen and Booth 2010). In the same way that municipal waste characterisation studies provide decision-makers with a detailed understanding of a waste stream and enable waste management programmes to be tailored to local needs, waste characterisation studies at colleges and universities identify campus specific and regionally relevant opportunities for waste reduction and recycling (Smyth, Fredeen and Booth 2010).

According to De Vega, Ojeda-Benitez and Ramirez-Barreto (2003) there are different models for running sustainable waste management programmes at a university. At the University of Baja California (UABC) an academic was named as the general co-ordinator: the 'solid waste administrator' or the 'recycling co-ordinator'. In this administrative position the individual could dedicate time to managing the recycling programme and also has the authority to direct the cleaning personnel.

Velazquez *et al*. (2003) reported that sustainability initiatives at universities are being fostered by a variety of key players in different settings and with different backgrounds, such as engineers, economists, environmentalists, lawyers and health professionals and others. Alshukwaikhat and Abubakar (2008) explained that over the past years many universities have taken a more responsible approach to managing their environmental performance. They stated that this is not isolated to a single country or region, but has been particularly prominent in Europe, the United States of America, Canada, as well as in Australia, Asia, South America and Africa.

2.7.1 At international universities

De Vega, Benitez and Ramirez-Barreto (2008) argued that colleges and universities have a moral and ethical obligation to act responsibly towards the environment, and are expected to be leaders in the movement for environmental protection. Further, De Vega, Ojeda-Benitez and Ramirez-Barreto (2003) stated that in Mexicali, a capital of the Mexican state of Baja, California, there were no solid waste management plans nor were there programmes to reduce, reuse and recycle solid waste; institutions therefore had to come up with sustainable environmental

programmes. The challenge facing educators was to develop their own criteria in their students' mind-sets and habits towards sustainable living practices (Orr 1992).

As highlighted by Wright *et al.* (2002), the Macalester College in Minnesota, USA, is a unique Talloires Declaration signatory. Over eleven individuals from the college, representing administration, trustees, faculty, staff, alumnae and students, signed the Talloires Declaration, whilst most universities had one representative to sign the declaration. Wright *et al.* (2002) further advised that the college had created its own implementation plan in order for the declaration to be meaningful within its institutional context. De Vega, Benitez and Ramirez-Barreto (2008) concluded that any environmental programme at a university must be rooted in the belief that the process of paying attention to the environment will have the greatest impact if it becomes an integral part of the education mission and vision of the institution. Alshukwaikhat and Abubakar (2008) stated that higher education institutions should not only educate, but should also demonstrate environmental principles and stewardship by taking action to understand and reduce the impact resulting from their activities.

In a university setting, staff and students have a role to play in source reduction to prevent waste from entering the waste stream, and their behaviour is vital to the success of any project which seeks to minimise waste (Tudor, Barr and Gilg 2007). A university that is going to promote sustainability on its campus should have a clear vision and the commitment of management to maintain sustainability. The university should also establish an organisational structure through either a department or a committee, and provide the necessary resources required to achieve a vision of sustainability (Alshukwaikhat and Abubakar 2008). Desa, Ba'yah Abd Kadir and Yusooff (2011) stated that the majority of the findings indicated that management were responsible for resolving their campuses' solid waste problems. The respondents also strongly agreed that discipline on set procedures is needed in order to effectively implement programmes and schemes that deal with the university's solid waste. Dahle and Neumayer (2001) reported that at the University of Wisconsin-Madison, programmes have been established where students work together with academic staff to reduce environmental impacts related to energy use

and solid waste disposal. The majority of interviewees considered the 'campus culture' to be another important barrier to undertaking energy and waste reduction measures (Dahle and Neumayer 2001). It was furthermore claimed that a general lack of interest towards environmental improvement was predominant amongst their higher education communities. Students and staff were described as careless, while the academics were considered to be uninterested and too busy with their own work to participate in a greening process. All members of a campus community are part of creating the environmental impact resulting from an institution's operation; they are all therefore responsible for acting to reduce such impacts. Academics cannot be excluded from participating because they are busy with their research and lecturing, nor can students be exempted because of exams and course work (Dahle and Neumayer 2001).

As expressed by De Vega, Ojeda-Benitez and Ramirez-Barreto (2003), the Autonomous University of Baja California (UABC) experienced problems with their approach to dealing with waste management due to waste management programmes being co-ordinated by two different groupings. This resulted in conflicts when priorities of both parties differed; as a consequence there was no co-ordination between their action plans. In addition, certain administrators had a personal reluctance to implement recycling because it meant a loss of income from scavenging. Zhang *et al.* (2011) reported that historically, most of the United Kingdom's higher education institutions simply hired a contractor to deal with its waste. The waste generated at the Universidad Autonoma Metropolitana (UAM-A) was classified as 'urban solid waste', even though they differ in composition from what other institutions define as 'urban solid wastes'. Practically all the organic waste of the UAM-A is generated by gardening, followed by the cafeteria, and is managed separately (Espinosa *et al.* 2008).

Espinoza *et al*. (2008) declared that initially these programmes focused mainly on the recycling of various types of paper. Later, they started recycling food and beverage containers in the form of steel and aluminium cans, glass bottles and jars, plastic jugs and bottles. Through the presentation of the 'Segregation for a better UAM-A Environment' programme in several cultural events on campus, and through the various awareness campaigns, the community was informed and sensitised

about the importance and the magnitude of solid waste disposal. Solid wastes were separated before they were delivered to the garbage collector trucks and the amounts sent to disposal were thereby reduced (Espinoza *et al.* 2008).

Several private universities had similar programmes, whose results were generally better than those of the UAM-A; this may be explained by the stronger discipline demanded of their communities and a larger dedicated budget (Turpin 2004). The 'separation' programme began years after the programmes of developed countries and therefore results that were achieved were less significant. Nevertheless, on a national level the programme was one of the most advanced in the integral management of solid waste in higher educational institutions.

Wright *et al.* (2002) reported that Ball State University in Muncie, USA, had adopted the Talloires Declaration as its primary environmental policy and was making an attempt to respect its signatory commitment. The University Green Committee was tasked by the university president to examine the implications of the Talloires Declaration for the university. The committee divided itself into nine sub-committees, each being charged with the examination and development of recommendations for the continued management and implementation of the TD tenets (Wright *et al*. 2002).

It is believed that the most important measure for reducing or overcoming any established barriers to greening is to raise environmental awareness within campus communities, i.e. sustainable behaviour cannot be expected to take place unless people understand the benefits and importance of doing so (Dahle and Neumayer 2001). Creighton (1999) proclaimed that in order to promote a university that uses resources efficiently, creates little or no waste, and takes full responsibility for any waste that it does generate, a fundamental change is needed in the thinking behind routine decisions of university administration, staff, faculty and students. Although such a goal might seem overwhelming, universities may find that once a greening process is set in motion it may support and reinforce further actions to take place (Dahle and Neumayer 2001). As Espinoza *et al*. (2008) explained, there are reports of some universities in the United States of America with solid waste management programmes such as those at Michigan University, the University of Pennsylvania and the University of Columbia.

According to Smyth, Fredeen and Booth (2010) the University of Northern British Columbia conducted a study where the location of the interior and exterior waste, recycling and compost receptacles were mapped and distinct flows of waste, such as kitchen and office waste, were documented. The mapping assisted in observations of the distribution of the receptacles within the institution. Carpenter and Meehan (2002) conducted a study at nine universities in Australia and New Zealand and found that all participating universities had an environmental policy that was approved at executive level, and that these policies were established between 1994 and 1998. These policies were developed and then presented to management for approval and implementation within the various universities. Of the nine universities, seven indicated that after the approval of the policy an environmental management plan was developed and was run by an established environmental management committee. While the vice-chancellor remained the officer responsible for the implementation of the principles outlined in the university's environmental policy at the Australian National University, this responsibility was delegated to the pro-vice-chancellor (PVC-Administration) (Carpenter and Meehan 2002)

2.7.2 At local universities

Amutenya, Shakleton and Whittington-Jones (2009) confirmed that Rhodes University, as one of the signatories of the Talloires Declaration, developed an environmental policy that was adopted by the university. Among the aims of the policy was to provide opportunities for the students to study environmental issues. This policy also advocated environmental saving strategies, such as paper saving by printing documents on both sides.

Another aspect that is important to highlight because of its practical consequences on waste management, is teacher education (De Vega, Ojeda-Benitez and Ramirez-Barreto 2003). For teachers to be able to teach environmental education they must first receive the minimal tools. De Vega, Ojeda- Benitez and Ramirez-Barreto (2003) explained that although environmental education was included in some way in most of the basic education curricula, teachers were not qualified to teach it. Bazarra (2001) emphasised that the major bottleneck was teacher training and sensitivity about environmental matters; a lack of education limits recycling and related activities.

Rhodes University has adopted a policy that provides for a reward system to award the department that uses the least volume of paper per capita along with the most recycling. This strategy was hampered, however, due to a lack of resources. At that time, none of the seven computer laboratories had printers capable of printing on both sides, nor could they print multiple pages per sheet. It is likely that most students will choose to print multiple pages per sheet since it saves on costs. This will not only save them money but also reduces the amount of paper used and contributes to environmental management. This might not be a viable option for a small percentage of students who have poor eyesight or learning disabilities, as the smaller print size might be problematic (Amutenya, Shakleton and Whittingon-Jones 2009). Furthermore, paper constituted a large portion of the solid waste generated by universities due to their educational and academic requirements. This waste is therefore recyclable (De Vega et al. 2003).

2.7.3 At the Durban University of Technology

The National Environmental Management: Waste Act (Act No. 59 of 2008) prescribes that industries should prepare an Industry Waste Management plan (IWMP). According to the Waste Act (2008) the contents of such a plan should include, amongst other things, a situational analysis of the institution. This may only be achieved through an understanding of the waste of the institution. To date the DUT has not conducted a waste management situational analysis, which gives impetus for this study. Furthermore, a change of attitudes and practices are essential to effect sustainable change, thus integration of this topic into an orientation programme is crucial.

Anecdotally obtained information shows that the DUT does not have a policy that addresses waste management issues at the institution. Waste is managed on an *ad hoc* basis and no planning around waste matters has been implemented. Personal observation by the researcher from the initial rollout waste management project at DUT's two campuses (Ritson and Steve Biko campuses) have shown that both the staff and the student population at the DUT are reluctant to participate in waste management projects that are initiated at the institution. When projects are initiated that require the support of both staff and students, very few take the time to support and participate in them. It was also observed that participation in such initiatives is

mainly by students from the departments which conduct studies on environmental matters.

Even though e-mail messages circulated between staff members about the unsatisfactory state of the environment at the institution, very few staff members showed interest in participating in projects initiated to address those issues. Anti-litter and clean-up projects were initiated, however the response of the DUT community in terms of participation was poor.

The DUT's management bought into the ten-point action plan of the TD, however no tangible action by the institution has been observed. The student community has made efforts to drive some environmental projects, although unfortunately the general population at the institution has not warmed to these initiatives. Anecdotally obtained information also reveals that some students have arranged competitions that encourage participation in recycling projects within the DUT community. The students have noted a steady increase in the number of people participating in these competitions.

2.8 Recycling and its benefits

The reduction or minimisation of urban solid waste is defined as any technique, process or activity which prevents, eliminates or reduces waste at the source. (Maldonado 2006). Re-use differs from recycling in that re-use takes a product (as it is) and puts it to another use after the first use is complete, whereas recycling is the reprocessing of used material, therefore becoming a raw material for the making of a new product (National Waste Management Strategy 2012). Espinoza *et al.* (2008) explained that the Appalachian University in the USA had approached the problem of solid waste by aiming to reduce the amount of materials consumed; eliminating single use items; encouraging the re-use of materials; and eliminating unnecessary waste.

Amutenya, Shakleton and Whittington-Jones (2008) contend that recycling is one strategy widely advocated to increase efficiencies and to meet the targets of waste reduction. For example, countries such as South Africa have adopted the principles of the 'Waste Management hierarchy' and have set ambitious targets for recycling and for a reduction of the volume of waste requiring disposal in landfills. A lack of

understanding about a recycling programme is one factor that differentiates recyclers from non-recyclers; the former tend to have more information about recyclable materials and where and when to take them, than non-recyclers (Robinson and Read 2005). Demographic factors such as higher level of education, high income, culture and liberal political orientation correlate positively with recycling (Hanyu *et al*. 2000). Bollane (2006) also observed that situational factors such as commitment, interventions, culture, goal setting and social pressure also differentiate recyclers from non-recyclers. Some cultures regard disposal of some material as taboo, e.g. disposal of the hide of a cow that was slaughtered for ritual purposes. Some people regard recycling as too much of a 'hassle' that is not worth worrying about, because the money you get for it is not worth the trouble you go through. In some communities, an individual who works with waste is regarded as an inferior person. These attitudes adversely affect the recycling process.

Solid waste management programmes (such as re-use and recycling) that are structured according to specific issues relating to the reality of the waste generation, are far more successful than those programmes copied from those that have been implemented somewhere else (De Vega, Benitez and Ramirez-Barreto 2008). Carefully planned campus waste characterisation studies are usually successful, they are relatively inexpensive and can generate administrative support, co-operation among students, staff and faculty, and inspire further involvement in campus sustainability issues (Sharp 2002).

2.8.1 The environmental benefits of recycling

There are many environmental and health benefits associated with recycling, as indicated by the National Recycling Coalition. As espoused by Kaseva and Gupta (1996), recycling is beneficial to the environment in that it reduces the amount of waste that eventually goes for disposal. When new products are generated using recycled articles and materials, the amount of energy required is reduced. Significantly, the pollution that would have occurred whilst generating power to make a new product is also reduced. The raw material that are saved when using recycled materials instead of virgin materials is also an environmental benefit of recycling.

This supports the initiative of sustainable development (Amutenya, Shakleton and Whittington-Jones 2009).

Kaseva and Gupta (1996) reiterated that recycling can also conserve soil in that shredded paper wastes have been successfully used as soil mulch, whereby organic matter is spread on top of the soil around plants thus limiting soil erosion, suppressing weed growth and buffering against temperature fluctuations, thus limiting the evaporation of soil moisture. Recycling reduces the need to build landfills and incinerators. As communities resist the siting of landfill sites and incinerators within their areas, it therefore becomes imperative to concentrate on recycling waste as opposed to the development of incinerators and landfill sites. When the volume of waste to be disposed of by landfilling is reduced, the amount of space required for landfilling is consequently reduced. Recycling is beneficial to the environment in that it reduces the amount of waste that eventually reaches landfill sites (Kaseva and Gupta 1996).

When new products are generated, using recycled materials, the amount of energy required is reduced. This reduced energy also decreases pollution levels created by the manufacturing of new products. The natural resource that would have been used as a fuel to generate the energy necessary for the production of the new product is saved. When one ton of steel is recycled, for example, then 2 500 pounds of iron ore; 1 400 pounds of coal; and 120 pounds of limestone are conserved (Kaseva and Gupta 1996). Paper has a direct benefit in the reduction of deforestation and the creation of tree plantations. Without recycling, this material would come from trees. Blog's (2009) study indicated that manufacturing products from recycled materials saves energy. The study discovered that it takes 95% less energy to make aluminium from recycled aluminium than it does to make it from virgin materials. In the steel industry it takes 60% less energy to produce recycled steel, 40% less energy to make recycled newspaper or recycled glass, and 70% less energy to produce recycled plastics. These savings far outweigh the energy created as a by-product of incineration or disposing of the materials in a landfill. Recycling helps to reduce our reliance on foreign oil, coupled with energy savings (Blog 2009).

In the United States of America the processing of minerals contributes almost half of all reported toxic emissions from industry, sending 1.5 million tons of pollution into

the air and water each year. Recycling can significantly reduce these emissions, as recycling results in a net reduction in ten major categories of air pollutants and eight major categories of water pollutants. Recycling helps to reduce greenhouse gas emissions (e.g. carbon dioxide and methane) that may contribute to global climate change, by decreasing the energy needed to make products from virgin materials and thereby reducing the need to burn fossil fuels. The emissions coming from landfills and incinerators, which are major sources of methane gas emissions, are significantly reduced by the employment of recycling. Recycling also helps to reduce the greenhouse gases that may contribute to global climate change by slowing the harvesting of trees, thereby maintaining the carbon dioxide storage benefit provided by trees (Blog 2009).

The findings of a study by Espinoza *et al*. (2008) revealed that the volume and weight of solid waste delivered to the public service was reduced since the recoverable wastes were sent for recycling and the biodegradable yard waste were sent for composting. These wastes were not sent to waste landfills, thus space which would have been used for landfilling has concomitantly been saved.

2.8.2 The economic benefits of recycling

Kaseva and Gupta (1996) stated that while the environmental benefits of recycling are well known, the economic benefit also needs to be considered. Turning waste into valuable raw materials creates employment in the recycling sector and creates competitive manufacturing industries; these factors add significantly to a country's economy. Peti *et al*. (2006) describes that an economic analysis of paper recycling in comparison to wood as a raw material, revealed that paper recycling is an economical alternative to wood as a raw material.

Zhang *et al*. (2008) cited work at Bristol University in the UK, which resulted in a 350% increase in paper recycling by simply providing recycling bins at the student residences. Amutenya, Shakleton and Whittington-Jones (2009) suggested that academic departments at HEIs should increase the availability of recycling bins as a means to increase the recycling rate. Clarke and Maantay (2006) reported that recycling programmes that are poorly communicated have a lower participation rate than those supported by education and awareness efforts. Bollane (2006) added that raising awareness of the need for recycling can be complemented by direct

incentives such as money, or any other forms of incentives targeted at the participants.

The American Recycling Economic Information (REI) study was commissioned by the USA Environmental Protection Agency in partnership with numerous states, in order to determine the economic benefits of recycling for the national economy. The study was completed in 2001. The recycling and re-use industry nationwide in the USA included more than 56 000 establishments. Together, the businesses employed 1.1 million people, generated an annual payroll of $37 billion, and grossed $236 billion in annual sales. The REI studies also indicated that another 1.4 million jobs were indirectly supported by the recycling and re-use industry. Recycling assisted businesses, other organisations and communities to avoid disposal costs associated with landfills and incinerators. Furthermore, local communities demonstrated that recycling and re-use programmes could be cost-competitive in comparison with disposal options. That was particularly true if communities considered the full cost of solid waste disposal and accounted for the environmental and other negative impacts of waste generation.

2.9 Knowledge, attitudes and practices towards waste management in higher education institutions

In this study knowledge, attitudes and practices will be analysed and it is important to understand what these concepts mean. Badenhorst *et al*. (2006) stated that knowledge is an organised body of information that forms the basis for insight or judgement. Encarta (2009) proffered that attitudes are based on a personal view of something, an opinion, or a general feeling about something. Practice is an activity done regularly or often (Hornsby 2010). Jackson (2005) asserted that the knowledge, attitude and practices (KAP) approach explores what people already know and what they need to know about certain issues; it also examines awareness and how this relates to attitudes and behaviour. Additionally, it also compares actual behaviour with ideal behaviour. Ideally, the KAP approach will enable the 'KAP gap' to be identified and also to help with the formulation of strategies to achieve desired behaviours (Jackson 2005).

Summers (2000) found that teachers can play a critically important role in the implementation of environmental education among the students. The attitude of the students towards the environment is significantly influenced by that of the teachers. In order to implement a successful environmental awareness programme among the younger generation, instructors and role models need to fully equip themselves with adequate knowledge, proper attitudes and appropriate consumption patterns and lifestyle (Aini *et al*. 2003).

In a study by Ehrampoush and Moghadam (2005) at Yazd University, the data showed that the knowledge level of male students regarding the methods of waste disposal was 66%, as compared with that of females at 34%. The findings of the same study revealed that 59% of the student population stated that the best way to dispose of solid waste was recycling. The results of the Yazd University study indicated that programmes to improve students' environmental awareness can increase their knowledge. Once the knowledge of the students is increased, their attitudes and practices towards the environment will be based on the knowledge that they have acquired. Malgorzata-Grodzinska *et al*. (2003) conducted a study which showed that the environmental knowledge of the students may improve the environmental knowledge of their parents. Students' practices at their homes would be based on the knowledge they have on environmental issues. Imparting environmental knowledge to the students would equip the students with information to discuss at home with their parents.

Desa, Ba'yah Abd Kadir and Yusooff (2011) conducted a study at the University Kebangsaan Malaysia (UKM) and found that of the 589 first-year students, 376 (63.8%) showed that they had knowledge concerning solid waste management. The results of the same study revealed that 388 (65.9%) of the respondents have a negative attitude towards solid waste management. This shows that students' attitudes were affected by their education, which supports the idea that education plays an important role in developing people's attitudes towards the environment (Al-Rabaani and Al-Mekhlafi 2009).

A further study by Desa, Ba'yah Abd Kadir and Yusooff (2011) examined the knowledge, attitudes, awareness status and behaviour concerning solid waste management among first-year students. The findings of that study revealed that the

respondents' behaviour and practices with respect to waste management was due to the fact that they valued cleanliness and that they wanted to mitigate possible disease occurrence. Desa, Ba'yah Abd Kadir and Yusooff (2011) concluded that there is a necessity for the development of students' attitudes and willingness to reduce problems related to solid waste management.

Behavioural scientists have reported that behaviours, opinions, and attitudes which are rewarded and reinforced are likely to be repeated, and ultimately incorporated into our personal value set and routine behaviour (Curzon 2003). Desa, Ba'yah Abd Kadir and Yusooff (2011) explained that the wise use of rewards and reinforcements increases the chance that the recognised individual will embrace a desirable attitude and may serve also as an incentive for others to adopt the attitude as well.

The results of the study conducted by Desa, Ba'yah Abd Kadir and Yusooff (2011) supported the findings of other studies, in that the level of consistency between environmental attitudes and behaviour is affected by a person's knowledge and awareness, public verbal commitment and his/her sense of responsibility. The transfer from attitudes to behaviour can also be affected by lifestyle; many people, while professing to correct attitudes to the environment, are not ready to change their lifestyle in ways that might mean sacrificing certain forms of comfort for the sake of the environment (Desa, Ba'yah Abd Kadir and Yusooff 2011). More effort must therefore be put into raising students' awareness through awareness campaigns that can bring about considerable changes in the attitude and perception of the students towards solid waste management and recycling.

The results of a study conducted by Esa (2010) indicated that the recycling of paper, plastic, glass and aluminium cans was a common practice among the respondents who were student teachers. When a correlation between environmental awareness, attitude and practices was conducted, the results showed that the respondents had a high mean score for environmental knowledge and attitudes but a very low score for environmental practices. Hakim, Mohsen and Bakr (2011) established that the association of training received on waste management and KAP scores were found to be surprisingly non-significant across all study groups. This result raised important questions about the clarity and practical skills offered in such training programmes. If the training is conducted by a person who is not sufficiently

knowledgeable on the subject of waste management, then the results could be disastrous.

A study at the Yatz University of Medical Sciences revealed that the respondents believed that the best method for the disposal of solid waste was through recycling. This study further revealed that the knowledge level of 66% of the male respondents was good. With respect to the method of segregation, 72.1% respondents believed that the best method of segregation was at the point of generation of the waste. The remaining 27.9% believed that segregation must be done at either the collection point or the disposal point. The results of this study showed that the environmental knowledge of students was not optimal (Ehrampoush and Moghadam 2005).

Similarly, Aini *et al.* (2002) found in their study that the awareness and knowledge of the respondents regarding waste management was very low. Their findings indicated that more than 70% of their respondents did not know the frequency of the waste collection in their area. It also revealed that 40% did not know who was responsible for the collection of waste. There were no guidelines as to where and what type of dustbins should be used, and it was left to the discretion of the owner to purchase a suitable bin. Further, Aini *et al*. (2003) additionally asserted that a guide on the physical structures of the bins ought to be provided by the Municipality in order to facilitate domestic waste management and collection. Newspapers, aluminium cans and carpets were the three items that were recycled. The study also revealed that the respondents felt that they generated very small amounts of waste and as such they were not responsible for cleaning it up. The respondents also felt that recycling was too much of a hassle to bother with, and thus did not see the need to recycle. It would seem that both intrinsic and extrinsic motivation influenced recycling behaviour. They furthermore stated that having sufficient motivation and a positive attitude did not guarantee that an individual would act accordingly. Specific situational variables, such as accessibility to recycling programmes, the amount of effort required, knowledge about the logistics of recycling and environmentally responsible behaviour, were found to affect behaviour towards recycling.

In a study conducted at a tertiary health care institute, Ismail *et al*. (2013) observed that the majority of the study participants considered that it was their responsibility to segregate and discard the generated waste. The majority of the participants also

believed that there should be strict implementation of waste management rules as there was no commitment to ensuring effective implementation. Ismail *et al*. (2013) further proclaimed that proper disposal of waste, following the colour coded system was practiced by less than 33% of the participants and that this was due to a lack of knowledge and the unavailability of colour coded waste collecting bins.

Ramayah and Rahbar (2013) reported that the findings of their study were consistent with the findings of an earlier study conducted by Homer and Kahle (1998). Both studies stated that values regarding waste management and recycling have an impact on specific attitudes towards recycling, such as the convenience of recycling and attitudes about the importance of recycling. Results of the study indicated that the extent of environmentally-related knowledge and awareness was significantly higher when compared with recycling and recycling practices.

Aini *et al*. (2002) reported that there was no significant relationship between age and attitude towards recycling. Research conducted by Ebreo and Vining (2000) found that educational programmes impacted on people's attitude towards solid waste management and their recycling motives. Consequently, the attitude towards recycling was found to have a significant effect on waste recycling. The findings of this study further revealed that more than 70% of the respondents did not know the frequency of waste collection in their area or where the disposed waste was taken. Forty percent of the participants did not know who was responsible for waste collection (Aini *et al*. 2002).

2.10 Conclusion

Due to the educational and academic endeavours together with other activities, a variety of waste materials are generated at HEIs in South Africa. These wastes are dominated by paper and other materials which are common at educational institutions. Unfortunately, in South Africa public institutions have to come up with their own strategies to address the waste problem. This study is an endeavour to deal with that issue at the DUT. The study will look at the current situation with regard to waste management and recycling within the academic departments at the institution. The study will also conduct an analysis of the knowledge, attitudes and practices of the students towards waste management and recycling at the DUT with

the intention of developing a training programme for delivery during first-year orientation.

CHAPTER 3
METHODOLOGY

3.1 Introduction

The previous chapter was concerned with critiquing the relevant literature applicable to the objectives of this study. This chapter details the methodology followed in conducting this study. Research methodology refers to the steps, strategies and procedures used for data gathering and analysis in research (Polit and Beck 2008). This chapter explains all the steps, strategies and procedures utilised in this study.

3.2 Broad Overview of the study

The study analysed the current practices and institutional policies with regards to waste management and recycling within nine academic departments at two DUT campuses situated in Pietermaritzburg. The study consisted of three stages of data collection which formed the basis of the study. These stages are outlined below:

- The first stage consisted of a walk-through survey, whereby direct observation of the types, numbers and positioning of waste receptacles at both campuses was conducted by the researcher.

- The second stage consisted of a questionnaire that was administered by the researcher to the academic and administrative staff members. These were people directly involved in co-ordinating waste management within the departments. The questionnaire assessed the departmental practices regarding waste management and recycling. The person responding to the questionnaire was the head of department, the secretary, the head of programme, or a staff member delegated by the head of department.

- In the third stage a Knowledge, Attitude and Practices (KAP) study was conducted whereby a questionnaire was administered to students by trained assistants together with the researcher. The training undergone by the assistants is elaborated on in section 3.9.1.

Permission to conduct the study was sought and granted by executive management of the DUT (Annexure 1). Fieldwork commenced on the 3rd August 2013 and was completed on the 16th September 2013.

3.3 Study Location/Setting

The South African Department of Education amalgamated the two higher education institutions of M.L. Sultan Technikon and Technikon Natal into a merged institution in 2002. After the merger the name became the Durban Institute of Technology, which was changed to the Durban University of Technology in 2007. The DUT has seven campuses, namely: Indumiso, Riverside, City, Brickfield, M.L. Sultan, Steve Biko and Ritson, which are located in the cities of Durban and Pietermaritzburg. The study was conducted specifically at the Indumiso and the Riverside campuses which are situated in the city of Pietermaritzburg, the capital city of the province of KwaZulu-Natal in South Africa. An awareness campaign was previously conducted at two campuses of the DUT; those campuses were excluded as they would be regarded as 'pre-exposed' for the purposes of this study. The researcher was involved in this initiative which was conducted at the request of the Management of the DUT.

3.3.1 Indumiso Campus

The Indumiso campus of the DUT is situated on the western side of F.J. Sithole Road at Imbali Township. The campus is situated approximately 15km from the city centre of Pietermaritzburg and at a distance of 12 km from the Riverside campus. It is located at the perimeter of Imbali Township and is bordered by F.J. Sithole Road, Sutherland Road and Edendale Road. Imbali Township is a peri-urban area consisting of semi-detached dwellings and a few informal dwellings. It is a township that was established in the 1960s when people migrated from the rural areas to the towns. The Indumiso campus previously operated as a teacher training college and has all facilities, being a large residential area for students with recreational facilities and nine academic units. These nine academic units incorporate lecture venues, the library section, the computer laboratories, the examination venue and the administration section. This study concentrated on the academic units. The academic departments sited at the Indumiso campus are Undergraduate Nursing, Education, and Civil Engineering.

3.3.2 Riverside Campus

The Riverside campus is located in the Scottsville suburb of Pietermaritzburg, at a distance of about 4km from the city centre. Scottsville is predominantly an urban residential area comprising of stand-alone housing units. The campus is comprised of seven building units which are only used for academic and support services purposes. Students commute from Indumiso residences and use private residences in the surrounding areas of Pietermaritzburg. The academic departments sharing this campus are Applied Management, Regional Governance and Development, and Human Resources Management.

3.4 Study Design

A quantitative, descriptive research study was conducted to analyse the current waste management practices of academic departments; to observe the positions and types of refuse receptacles utilised at the two campuses; and also to explore the knowledge, attitude and practices of the students towards waste management and recycling at the DUT.

3.5 Study Population

The study population was comprised of the following categories:

3.5.1 Staff

The staff members who formed part of the study were members of staff based at the two campuses in Pietermaritzburg. The Nursing, Civil Engineering and Education departments are based at the Indumiso campus. The Public Management, Accounting, Tourism, Human Resources, Public Relations, Law & Economics and Applied Management departments are based at the Riverside campus. The selection of staff was based on an individual whose responsibilities were to deal with waste management and recycling in the department or programme. This was restricted to the Head of Department (HOD), Head of Programme (HOP), Programme Co-ordinator or Departmental Secretary/Administrator situated at the two campuses. These staff members were selected as they were considered the most appropriate to answer the questionnaire as they were directly responsible for the handling of waste and recycling operational procedures within their respective departments.

3.5.2 Students

The study included 403 students who were registered within the Faculties of Health Sciences, Applied Sciences, and Engineering & the Built Environment at the Indumiso campus. At the Riverside campus, the selected students were registered within the Faculties of Accounting & Informatics and Management Sciences for 2013. Of the 403 students that took part in this project, 211 were from the Indumiso campus and 192 were from the Riverside campus. The students who formed the study population comprised of both undergraduate and post-graduate students.

3.6 Sampling strategies

For the situational analysis, a staff member was purposively selected to respond to the questionnaire (Annexure 2). The staff member had to be an individual who was familiar with the waste management and recycling activities in his/her department or programme. The two campuses are made up of nine departments and each department was represented by a single staff member for the project. Some departments at the Riverside Campus have a common secretary and Head of Department. It is for this reason that only six questionnaires in total were collected instead of nine. The data was collected to assess the departmental practices with regards to waste management and recycling; this data needed to be collected from a single staff member whose responsibilities were to co-ordinate waste management and recycling within their respective department.

For the KAP study, 403 students were selected using a systematic random sampling method. Out of the sample of 403 students 51.12% were from the Indumiso campus and the remaining students were from the Riverside campus (211 and 192 respectively). The Indumiso and Riverside campuses had a total student population of 4000 in the first semester of 2012. Students from the two campuses were advised about the objectives of this project through the DUT4Life website and posters were displayed in advance (Annexure 3). The DUT4Life online system is the official means by which the university disseminates information to students. Students from each lecture venue were selected as respondents who were to complete the questionnaire by choosing every third person seated in the venue at the time of

selection. Ten lecture venues (five from each of the Indumiso and Riverside campuses) were randomly selected from a list of the DUT venues, using MS Excel. Approval was sought from the Head of Department and the lecturers concerned (Annexure 4), as students were approached during lecture times in these venues. Questionnaires were completed immediately at the end of the lecture. The aim was to try to minimise the disruption of lectures, but to also have readily access to the students whilst they were attending lectures within these venues.

3.6.1 Inclusion and exclusion criteria

3.6.1.1 Inclusion criteria:

- Students had to be currently registered (2013) at DUT at any level of study.
- The lecture venues of the students/respondents had to be at either of the two selected campuses.
- As stated in section 3.5.2 above, the selection of a staff member was restricted to a person who was directly involved with waste management and recycling in that particular department.

3.6.1.2 Exclusion criteria:

- All students whose lecture venues were not based at the Indumiso or Riverside campuses.
- Students who were not registered for the current semester (second semester of 2013).
- All participants who refused to sign the consent form.
- Staff members who were not involved in waste management and recycling in their department.

3.7 Ethical Considerations

3.7.1 Ethics

The study was reviewed by the Research and Higher Degrees Committee (RHDC) of the Faculty of Health Sciences at the DUT. Ethical approval was sought and obtained from the Institutional Research Ethics Committee (IREC) and was allocated the number 059/13. Letters seeking consent from the Heads of Department were sent prior to commencing with the collection of data (Annexure 4). Information

obtained during the study is kept in a secure, lockable area within the Community Health Studies Department at the DUT and will be kept for a period of fifteen years. This data will be shredded and destroyed at the end of this period. Only the study team has access to the information for validation purposes.

3.7.2 Informed Consent and Confidentiality

Informed consent forms were administered to all participants (Annexure 5) prior to them responding to the questionnaire. Confidentiality was maintained at all times throughout the study by maintaining all data collected under storage and making it available only to the research team. Participation was voluntary and withdrawal from the study was possible on request at any point during the process. No financial incentives were provided for participation in the study. The consent form was verbally explained by the researcher prior to the commencement of the data collection phase. The consent form was only available in the English language as the medium of communication at the DUT is English and there was no need for translation of the questionnaire into any other language.

3.8 Data Collection

3.8.1 Data collection instrument

The data was gathered using self-administered survey questionnaires. The preferred method of data collection was to use a self-administered questionnaire in order to save time. The research instrument for the students consisted of 48 items as detailed in Annexure 6, with a level of measurement at a nominal or an ordinal level. In total, 403 questionnaires were despatched and 403 were returned, giving a 100% response rate. The sample size that was suggested by the statistician was 387; the 403 therefore fulfilled the criteria of a minimum of 70% as set out by the statistician. The total number of students that had registered at the two campuses in 2012 had been 4000. The questionnaire was the primary tool distributed to the selected students at the DUT in order to collect the data.

3.8.2 Recruitment and training of assistants/fieldworkers

Two field workers were recruited from the Environmental Health programme for the purpose of collecting data from the students, because they understand waste

management in that it forms part of their curriculum. The two field workers attended a one day training workshop on questionnaire administration, data collection and ethics. The training was administered and conducted by the researcher.

3.8.3 Situational Analysis

An audit of the number, types and placement of bins, skips and other waste receptacles was done by the researcher and information was plotted on a map of the two campuses. The aim was to establish the role played by the institution in handling waste and recycling within the institution, as well as to establish if the types of receptacles provided were appropriate and strategically located or positioned for use. The maps on which the receptacles are plotted are attached as Annexure 6.

A questionnaire (Annexure 2) on waste management activities and recycling was used to collect data from the departments that formed part of the study site. The questionnaire was administered by the researcher. A staff member representing each department that was part of the study site was purposively selected to respond to the questionnaire. Questions were designed to evaluate probable divergent waste management and recycling styles as understood by the various departments. The broad issue of this questionnaire was to establish the practices of the various departments with regards to waste management and recycling.

3.8.4 KAP study

A questionnaire (Annexure 6) was used to collect data from the students about their knowledge, attitude and practices towards waste management and recycling at the DUT. The questionnaire was developed based on the knowledge and experience of the researcher as an Environmental Health Practitioner and as a specialist instructor in the waste management field. The questionnaires were administered by the researcher, together with trained research assistants, after informed consent was obtained from all participants.

3.9 Piloting

The data collection tools were piloted among five students and two staff members prior to the commencement of the study for reliability and validity purposes. The data

obtained during piloting was not used in this analysis. The participants who were involved in the piloting were not part of the main study. The pilot project was conducted by the researcher at the Ritson and Steve Biko campuses of the DUT in Durban. The questionnaire remained unchanged after the piloting exercise.

3.10 Data Analysis

Data collected during the study was captured on a Microsoft Word Excel programme and Predictive Analytical Software version 18.0 (PASW) was used for subsequent data analysis. The data collected from the respondents was analysed using SPSS version 21.0. Data was analysed with the assistance of a statistician and the supervisor. Results were presented as descriptive statistics in the form of tables, graphs and cross tabulations. Bivariate testing included the use of correlations and Chi square test values, which were interpreted using p-values.

3.10.1 Situational analysis

Variables included demographics, waste management and recycling practices and attitudes towards the DUT environment and recycling. Waste management and recycling practices were stratified by faculty and department. Frequency distributions were calculated for demographics such as department and faculty, and waste management and recycling practice. Responses to open-ended questions on the attitudes towards the state of the DUT environment and recycling strategies were presented as a collective narrative per question and compared across faculties. Statistically significant differences were considered at $p \leq 0.05$ and 95% confidence intervals were calculated.

3.10.2 KAP study

Variables included demographics, knowledge on current waste management strategies at the DUT, knowledge on recycling, and attitudes towards littering and recycling practices of waste management. The Chi-squared test was used for bivariate analysis to test for any correlation between gender and KAP; level of study and KAP; and faculty registration and KAP. Responses to open-ended questions on attitudes towards the state of the DUT environment and recycling strategies are included as narratives.

CHAPTER 4

RESULTS

4.1 INTRODUCTION

This chapter presents the results obtained during the data collection stage of this study. The data collection was divided into three phases, the first one being the situational analysis in the form of a walk-through survey and plotting on a map the types and positions of the refuse receptacles on the two campuses. The second stage consisted of collecting data from staff members about current practices within the academic departments or programmes regarding waste management and recycling, through utilising a questionnaire. The third stage involved the use of a questionnaire to conduct a knowledge, attitude and practices survey of students towards waste management and recycling at the DUT.

4.2 SITUATIONAL ANALYSIS ON THE AVAILIBILITY AND POSITIONING OF REFUSE RECEPTACLES ON CAMPUS

4.2.1 Riverside Campus

All of the seven academic blocks at the Riverside campus were found to have sufficient refuse receptacles. Most of the refuse bins and receptacles were located at places that were convenient for the use of the staff and students. Different types of containers were used at different levels. The ground floor levels of all the blocks used concrete bins that were fitted with plastic liners inside. Large containers in the form of skips were only used outside the multi-level buildings. The upper levels and those below ground floor utilised 25 litre black rubber bins. This campus was found to be adequately provided with refuse receptacles. The maps of the campus indicate the positions of the receptacles in relation to each other, as well as the types of receptacles provided at the different levels of the buildings (Annexures 7).

4.2.2 Indumiso campus

The various academic blocks at Indumiso campus did not have formal refuse receptacles. The cleaning employees improvised by providing cardboard boxes to serve as refuse receptacles. The only available receptacles were the four 50 litre

green wheelie bins, which were used by the cleaning staff to push around the academic blocks collecting refuse from the make-shift bins. This refuse was in the form of cardboard boxes and plastic bags which were left outside the lecture venues by the cleaners. The only areas that were found to have some refuse receptacles were the entrance to the main hall and the area around block A. There were a few concrete/cement bins found around this area. The staff parking area was also found to have some refuse receptacles provided, including some skips and concrete/cement bins. One skip was found at the cafeteria and another one was found just outside the entrance to the sports centre. The campus was observed to be relatively clean, and although the cleaning staff complained about the insufficient number of receptacles their efforts in keeping the campus clean was commendable.

4.3 Waste management activities and recycling within academic departments

4.3.1 Study site

The two DUT campuses located in the city of Pietermaritzburg are the Indumiso and Riverside campuses. These two campuses are made up of nine departments. Some of these departments are managed by a common HOD and thus also have a common secretary or administrator. The Indumiso campus has three academic departments, namely Civil Engineering, Undergraduate Nursing and Education; each of these departments had its own individual HOD. The Riverside campus has six departments, namely: Applied Management, Human Resources Management, Finance and Information Management, Accounting, Regional Governance and Development, and Public Management. These six departments are clustered into three pairs, with each pair managed by one HOD; therefore although the Riverside campus has six departments it only had three HODs.

4.3.2 Sampling

In total six questionnaires were despatched and six were returned, which gave a 100% response rate. The method of sampling that was employed was purposive sampling. Individuals representing different departments were identified and approached to respond to the questionnaire.

Table 4.1: Demographic characteristic of the staff from the two campuses (n=6).

Variable		n (%)
Gender	Male	2 (33.33)
	Female	4 (66.66)
Race	African	1 (16.66)
	Coloured	1 (16.66)
	Indian	2 (33.33)
	White	2 (33.30)
Faculty	Health Sciences	1 (16.66)
	Arts and Design	1 (16.66)
	Applied Sciences	1 (16.66)
	Engineering & Built Environment	1 (16.66)
	Management Sciences	1 (16.66)
	Accounting & Informatics	1 (16.66)
Campus	Indumiso Campus	3 (50)
	Riverside Campus	3 (50)
Position in Department	Head of Department	3 (50)
	Head of Programme	1 (16.66)
	Secretary	2 (33.33)
Age	Mean(sd)	49.60(9.66)
Length of Service	≤ 5 yrs	3 (50)
	6 – 15yrs	0
	16 – 20yrs	2 (33.33)
	≥ 21yrs	1 (16.66)

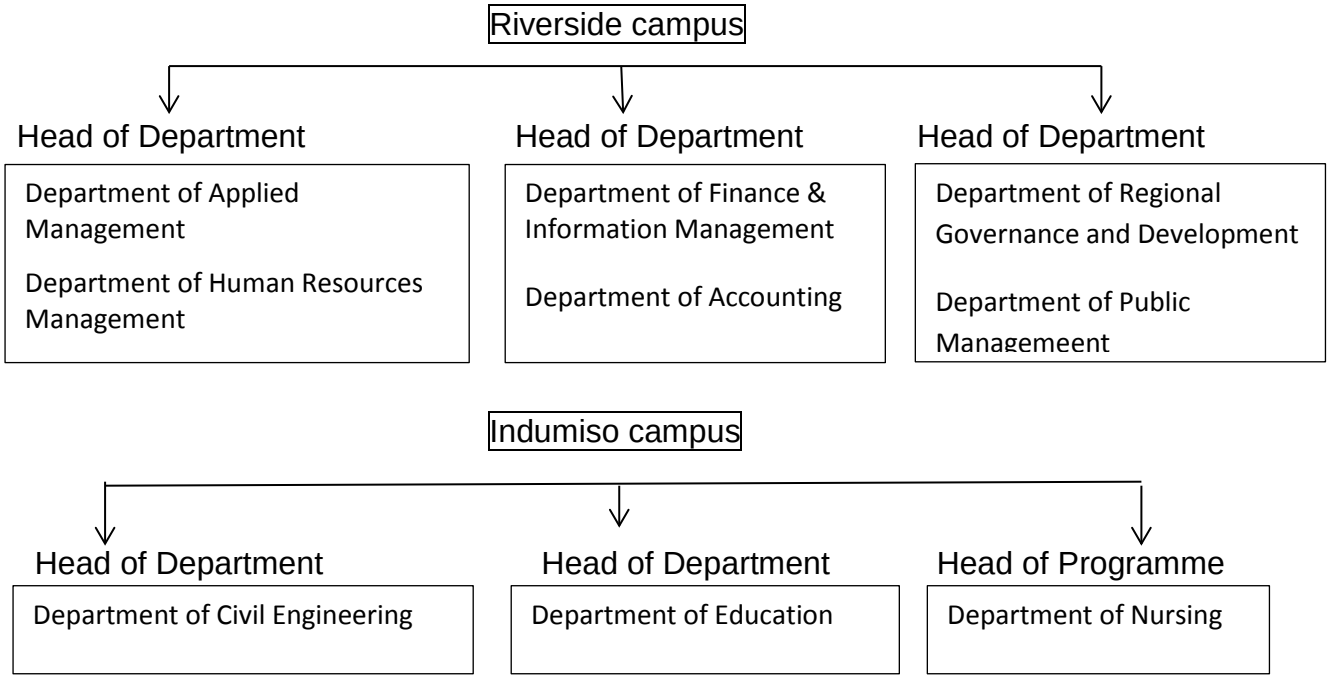

Figure 4.1 Flow diagram of departmental leadership at the Riverside and Indumiso campuses.

When asked about the state of the environment at the DUT, five of the six respondents indicated that the state of the environment at DUT was poor, while one respondent found the state of the environment at the DUT to be fair. None of the respondents indicated that they found the state of the environment at the DUT to be good. A majority of the respondents (n=4, 66.7%) felt that the general cleanliness in the parking areas was satisfactory. Out of a total of six respondents, four felt that the general cleanliness of the offices, lecture venues, and administrative sections was poor, while two respondents (33.3%) indicated that it was satisfactory. Approximately 66.7% of the participants indicated that they felt that the general cleanliness of the food vendors' areas was poor.

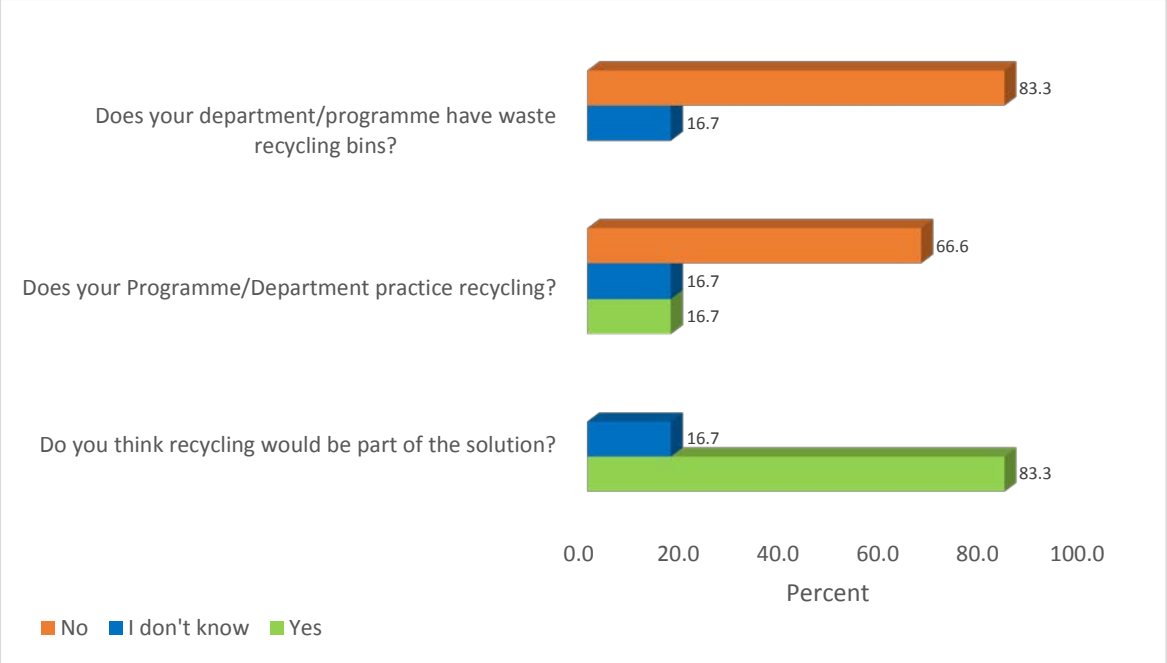

Figure 4.2 Academic programmes/departments recycling practices.

Five out of six respondents (83.3%) indicated that their departments did not have waste recycling bins and did not practice any recycling. Approximately 83.3% of respondents agreed with the idea of recycling being implemented to reduce waste. Only one of the six respondents indicated that they did not know whether recycling would be part of the solution or not. All the participants agreed that all departments at DUT should practice recycling.

More than half of the respondents (n=4, 66.7%) did not respond to the question when they were asked to make comments on the practicing of recycling. A single person commented that she would need training and continuous monitoring and evaluation of waste practices. Surprisingly, four respondents (66.7%) indicated that they did not know how often the bins were emptied. Almost all of the respondents (n=5, 83.3%), did not respond when they were asked who empties the bins for them. Only one respondent indicated that the bins are emptied by the cleaning staff of the DUT. When asked to make suggestions about waste reduction at the DUT, two respondents suggested that the number of bins should be increased to try and reduce waste. One respondent suggested that the reduction of waste at the DUT

should be prioritised, while another indicated that the reduction of waste should be encouraged.

All the respondents indicated that paper formed most of the recyclable waste at DUT. More than half of the respondents (n=4, 66.7%) did not respond to the question about the activities within the institution that produced the most recyclable waste. One person indicated that it was the examinations and tests that led to the generation of recyclable waste, while another indicated that it was printing that led to the generation of recyclable waste.

When asked about income generated from recycling, participants either did not know (66%) or indicated that there was no income generated (34%). Only one of the six departments generated medical waste. Half of the total number of the respondents, (n=3, 50%) indicated that the electronic waste was stored within the department before disposal, while two of the respondents did not respond to this question. Only a single participant indicated that various electronic wastes were handled differently within their department.

Table 4.2 below summarises the positive responses to questions on recycling practices in the various departments. It is interesting to note that all six respondents think that recycling would be a solution to the waste problem at the DUT. The very same departments do not practice recycling and they did not have any recycling bins within their departments.

Table 4.2 Positive responses (Yes) towards recycling practices among departments (n=6).

	Race				***Age group***				***Gender***	
	African	**Indian**	**Coloured**	**White**	**≤ 30**	**31 – 40**	**41 – 50**	**51 ≤**	**Female**	**Male**
I think recycling would be part of the solution.	1	2	1	2	1	1	1	2	4	2
Our programme/department practices recycling.	0	0	0	0	0	0	0	0	0	0
Our department/programme have waste recycling bins.	0	0	0	0	0	0	0	0	0	0
Our department generates any hazardous waste.	0	1	0	0	0	1	0	0	1	0
Our department generates any medical waste.	0	0	0	0	0	0	0	0	0	0

Table 4.2 Positive responses (yes) towards recycling practices among departments (n=6) (cont.).

	Faculty						***Campus***		***Position***		
	Health	***[1]Engin.**	***[2]Applied**	***[3]Account**	***[4]Manag.**	***[5]Arts**	**Indumiso**	**Riverside**	**HOP***	**HOD***	**Secretary**
I think recycling would be part of the solution.	1	1	1	1	1	1	3	3	1	3	2
Our department/programme practices recycling.	0	0	0	0	0	0	0	0	0	0	0
Our department/programme has waste recycling bins.	0	0	0	0	0	0	0	0	0	0	0
Our department generates hazardous waste.	0	0	1	0	0	0	1	0	0	0	1
Does your department generate any medical waste?	0	0	0	0	0	0	0	0	0	0	0

*HOD – Head of Department,HOP - Head of Programme

*[1]Engin – Engineering and Built Environment Sciences *2 Applied – Applied Sciences *[3]Account – Accounting and Informatics *[4]Manag. – Management Sciences *[5]Arts – Arts & Design.

4.4 RESULTS OF THE KNOWLEDGE, ATTITUDES AND PRACTICES OF THE STUDENTS TOWARDS WASTE MANAGEMENT AND RECYCLING AT THE DUT

Table 4.3: Students demographic characteristics (n = 403)

Variable		**n (%)**
Gender:	Female	229 (56.82)
	Male	168 (41.68)
	Unspecified*	6 (01.48)
Race:	African	391 (97.02)
	Coloured	4 (0.99)
	Indian	5 (1.24)
	White	2 (0.49)
	Unspecified *	1 (0.24)
Level:	1st Year	48 (11.91)
	2nd Year	201 (49.87)
	3rd Year	121 (30.02)
	4th Year	33 (7.93)
Faculty:	Health Sciences	87 (21.58)
	Arts & Design	73 (18.11)
	Eng. & Built Environ.	58 (14.39)
	Management Sciences	127 (31.51)
	Accounting & Informatics	57 (14.14)
	Unspecified*	1 (0.24)
Campus:	Indumiso	218 (54.09)
	Riverside	185 (45.90)
Age:	≤ 20	55 (13.70)
	21 - 30	315 (78.40)
	31 - 40	25 (6.20)
	41 - 50	7 (1.70)
	Mean(SD)	22.86(4.66)

** Information was not provided by the respondent on the questionnaire.*

Table 4.4: Age group stratified by gender

Age group	Gender		Total
	Female(n=229)	Male(n=168)	
≤ 20	42 (77.77%)	12 (22.22%)	54 (13.06%)
21 - 30	171 (54.80%)	141 (45.20%)	312 (78.58%)
31 - 40	13 (54.16%)	11 (45.83%)	24 (6.04%)
41 - 50	3 (42.85%)	4 (57.15%)	7 (1.76%)

Table 4.5 above reflects the age and gender composition of the respondents in the study. The age range of the students surveyed varied between 18 and 50 years. More than 75% were between the ages of 21 and 30 years. The majority of the respondents were female (58%).

Table 4.5: Faculty stratified by gender

Faculty	Gender		Total
	Female(n=228)	Male(n=168)	
Health Sciences	62 (15.65%)	23 (5.80%)	85 (21.46%)
Arts and Design	24 (6.06%)	11 (2.77%)	35 (8.84%)
Engineering	11 (2.77%)	47 (11.87%)	58 (14.65%)
Management	94 (23.74%)	67 (16.92%)	161 (40.66%)
Accounting	37 (9.34%)	20 (5.05%)	57 (14.39%)

Table 4.6 above reflects the faculty distribution stratified by gender. The respondents were from five academic faculties, with the majority from the Faculty of Management Sciences (40.66%). Approximately 58% were female.

Table 4.6: Level of study stratified by gender

Level	Gender		Total
	Female(n=228)	Male(n=168)	
1st Year	38 (9.60%)	9 (2.27%)	47 (11.86%)
2nd Year	117 (29.50%)	80 (20.20%)	197 (49.74%)
3rd Year	60 (15.15%)	60 (15.15%)	120 (30.30%)
4th Year	13 (3.28%)	19 (4.79%)	32 (8.08%)

Table 4.7 above reveals the distribution of study levels stratified by gender of the respondents in the study. The majority of participants were female (58%) as compared with male participants (42%). From the four levels of study, close to half (49.74%) of the respondents were second year students. Only 32 (8.08%) respondents were from the B.Tech level.

Table 4.7: Level of study stratified by Faculty

Faculty	Level of study				Total
	1st(n=48)	2nd(n=201)	3rd(n=121)	4th(n=31)	
Health Sciences	37 (9.20)	50 (12.43%)	0	0	87 (21.64%)
Arts & Design	0	0	35 (8.70%)	1 (0.25%)	36 (8.95%)
Engineering & Built Environ.	0	2 (0.49%)	33 (8.20%)	23 (5.73%)	58 (14.42%)
Man. Sciences	11 (2.73%)	129 (32.08%)	16 (3.98%)	8 (1.99%)	164 (40.79%)
Accounting & Informatics	0	20 (4.97%)	37 (9.20%)	0	57 (14.17%)

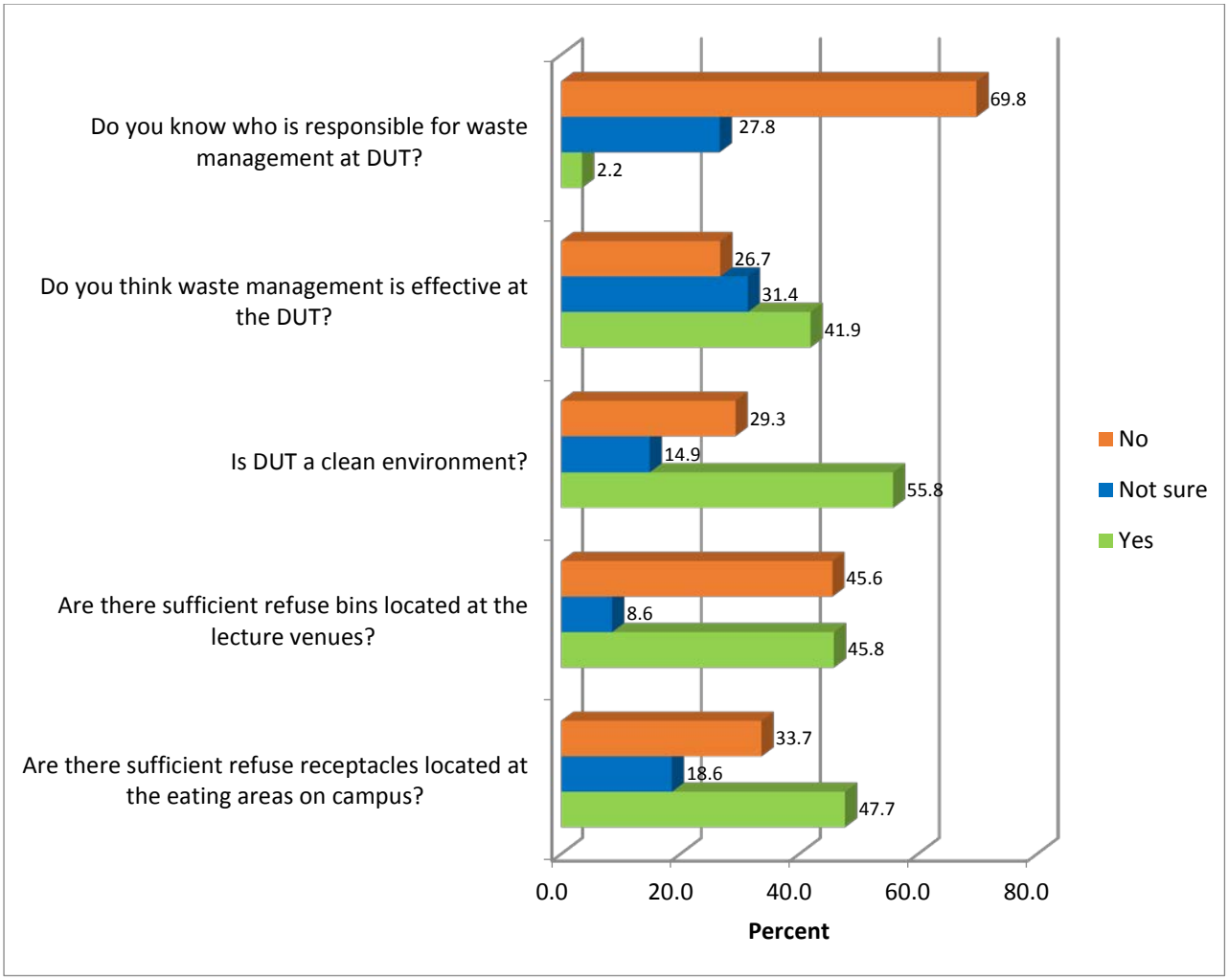

Fig. 4.3 Knowledge and attitudes of waste management at DUT.

A small proportion of the participants (n=9, 2.2%) indicated they knew who was responsible for waste management at the DUT. The remaining 393 participants (98%) were not aware of the authority responsible for waste management. When the respondents who said they knew who was responsible for waste management were requested to specify who it was, seven out of nine (80%) responded correctly by saying it is the DUT and Durban Solid Waste.

With regard to questions relating to perceptions regarding cleanliness and effectiveness of waste management at the DUT, the number of respondents who were in agreement with the statement was higher than those who disagreed. There was an equal number of respondents who agreed and those who disagreed about the sufficiency of refuse bins at the lecture venues (45.6% and 45.8%). A follow-up question was asked where the respondents had to explain their response to the question above. A large proportion (n=171, 42.43%) did not respond to this

question, whilst 125 (31.00%) thought that the DUT is clean because of the number of bins provided and the efforts of the cleaners. There were mixed responses regarding the cleanliness of the lecture venues, the sufficiency of the number of bins provided and the size of the bins provided.

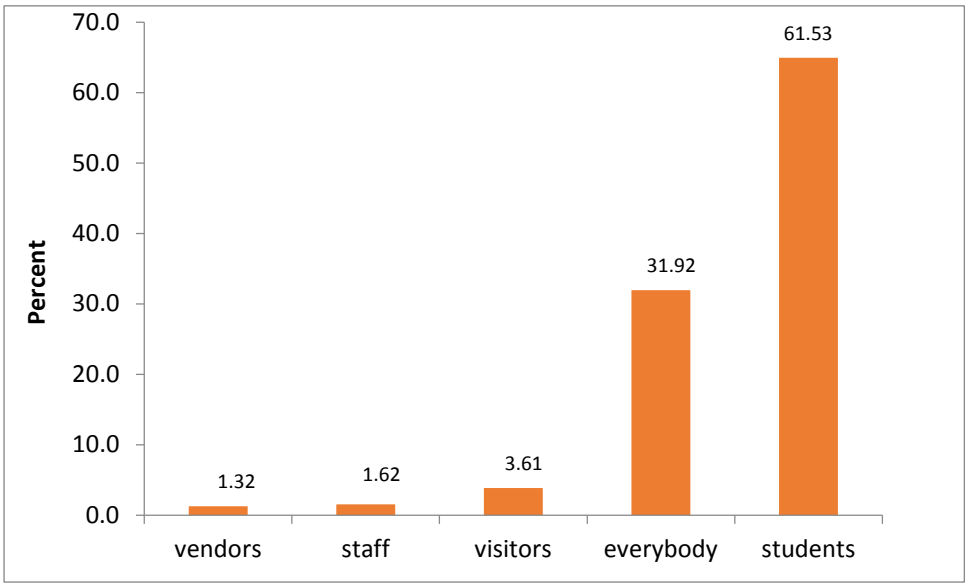

Fig. 4.4 Perceptions regarding responsibility for creating waste.

A large proportion of the respondents (n=248, 61.53%) believed that it is the students who are responsible for creating waste at the DUT. When the respondents were asked to help in identifying the areas where littering is more of a problem, a large proportion (n=149, 36.97%) identified the cafeteria, tuck shop and eating areas as the main areas. Only 27 respondents identified the lecture venues, the library and the corridors as the main areas. Other areas identified included the student parking areas, the sports ground and the rest rooms.

Table 4.8: Knowledge of recycling and its financial and environmental benefits (n=403).

	Yes	No	Not sure
Do you know the purpose for waste separation?	125 (30.90%)	95 (23.60%)	183 (45.50%)
Do you know what recycling is?	313 (77.6%)	36 (8.9%)	54 (13.5%)
Do you know what the financial benefits of recycling are?	87 (21.60%)	314 (78.40%)	2 (0.49%)
Do you know what the environmental benefits of recycling are?	188 (46.70%)	200 (49.60%)	15 (3.70%)
Is recycling practiced at student residences	83 (20.60%)	137 (34%)	183 (45.40%)

A majority of the respondents (45.50%) indicated that they were not sure why waste gets separated. More than 313 (77%) of the respondents indicated that they knew what recycling was. When asked to explain their answer, many respondents (n=153, 38%) confused recycling with re-use; only eighteen respondents understood how recycling differs from the re-use of waste. More than three-quarters of the respondents (n=314, 78.4%) indicated that they did not know what the financial benefits of recycling were. Approximately 188 respondents indicated that the main environmental benefit of recycling was a cleaner environment. Only a fifth of the participants (20.60%) knew whether recycling was practiced at the student residences.

The majority of the respondents (n=229, 56.90%) did not know if the DUT had a recycling programme that involved its student population. Approximately a quarter of the respondents (n=97, 24.10%) stated that the DUT did not have a recycling programme that involved all of its student community.

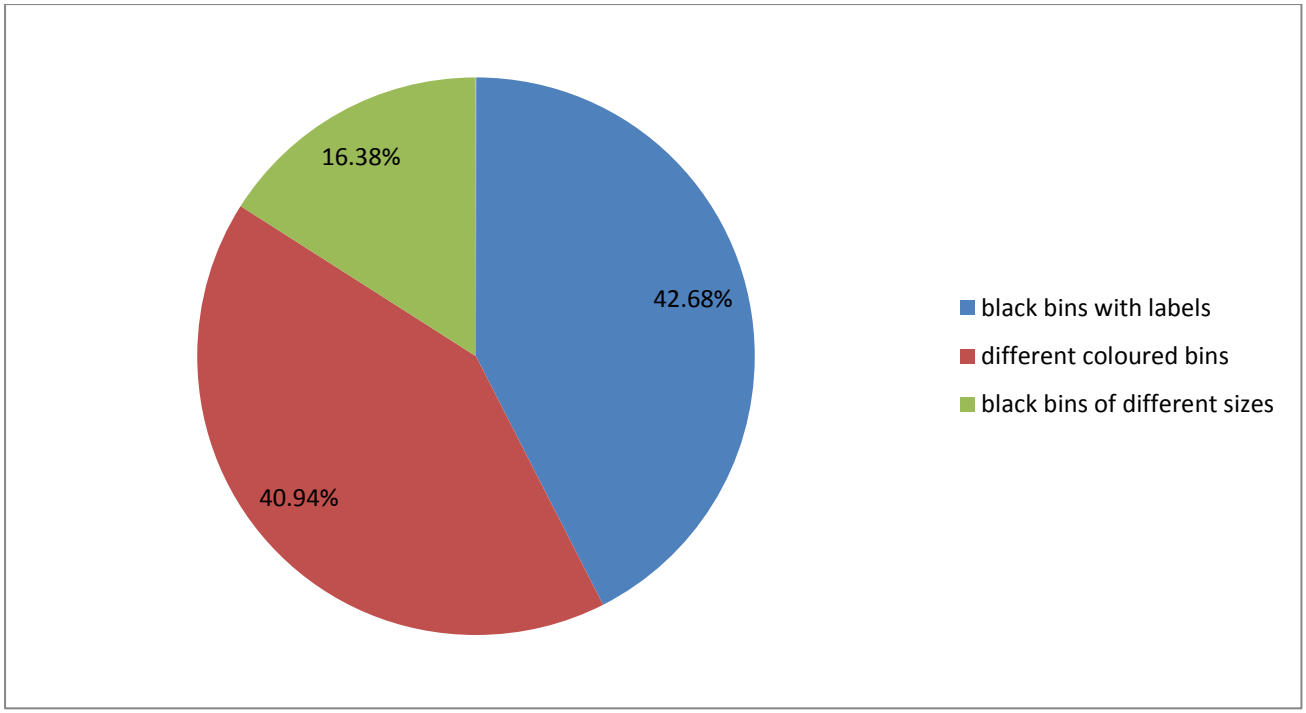

Fig. 4.5: Knowledge of the usage of different recycling bins.

An almost similar number of respondents (n=172, 42.68%) and (n=165, 40.94%) indicated that the black bins with labels were used for recycling purposes, as were different coloured bins respectively. This implied that there is confusion amongst the respondents with regards to the use of bins for recycling purposes. A very small number (n=66, 16.37%) indicated that different sizes of bins were used for recycling.

Fifty-four percent of the respondents indicated that the bins were sufficiently visible. The remainder were not satisfied with the visibility of the bins on campus. A large proportion of the respondents (n=157, 38.95%) indicated that un-recycled waste impacts negatively on the environment. Slightly less than a tenth of the respondents (9.92%) indicated that it is taken away by the responsible authority for disposal. Approximately 343 (85.10%) respondents indicated that they were concerned about littering on campus. About a tenth of the total number of respondents (n=42, 10.50%) indicated that they were undecided about littering on campus. A large number of respondents (n=289, 71.70%) felt that clean-up campaigns were effective. Sixty-seven (16.5%) indicated that they were undecided about whether clean-up campaigns are effective or not, while 47 (11.8%) indicated that they did not think clean-up campaigns were effective.

The maintenance of the campus cleanliness by keeping waste in the refuse receptacles was acknowledged and supported by more than seventy percent (71.40%) of the respondents. More than 80% of the respondents supported recycling to such an extent that they would not have any problems using products manufactured from recycled materials. More than half (57%) of the respondents blamed carelessness, laziness and attitude problems for the problem of littering on campus. A majority of the respondents believed that everyone on campus should take part in bearing responsibility for the cleanliness of the DUT campuses.

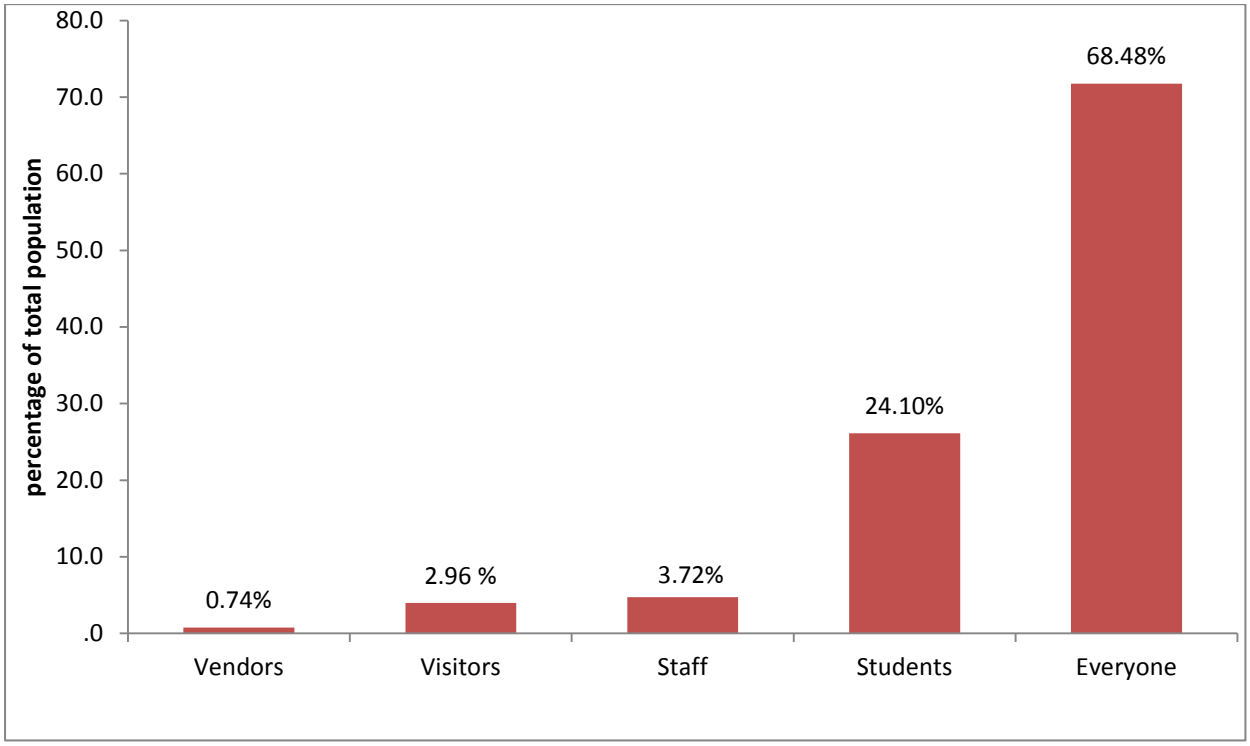

Fig. 4.6: Perceptions regarding participation in recycling activities.

Figure 4.6 above indicates that the majority of the respondents (n=276, 68.48%) believed that it is everybody who should participate in recycling activities on campus. Only three respondents (0.74%) felt that it is the vendors alone who should be involved in recycling activities on campus. Figure 4.7 below shows that the majority of the respondents (32.8%) listed polystyrene as the item of waste that needed to be recycled the most. It is surprising to note that whilst the DUT is an educational institution, only 44 (10.92%) respondents regarded paper as the least recyclable material (10.90%).

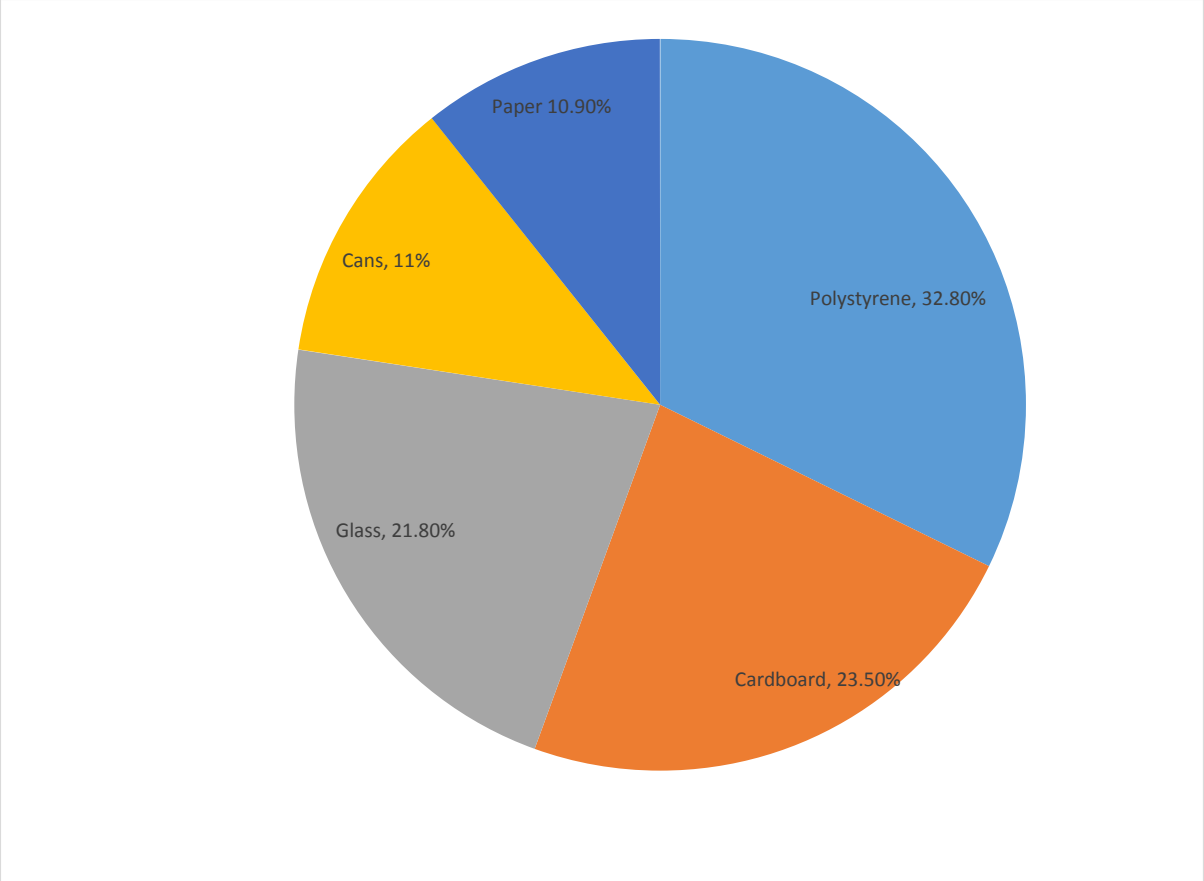

Fig 4.7: Student understanding of recyclable waste items (n=403).

Table 4.9: Positive responses regarding KAP of waste management among students (n=403).

	Gender	**n (%)**	**p value**	**Age group**	**n (%)**	**p value**	**Race**	**n (%)**	**p value**
I know who is responsible for waste management at the DUT.	Female Male	8 (57.10) 6 (42.90)	0.29	≤ 20 20 - 30 30 - 40	3 (21.4) 10 (71.42) 1 (7.14)	0.57	African Indian Coloured	14 (100) 0 0	0.55
I think waste management is effective at the DUT.	Female Male	78 48.15) 85 (51.85)	0.14	≤ 20 20 - 30 30 - 40 40 - 50	19 (11.65) 130 (79.75) 11 (6.75) 3 (1.85)	0.89	African Indian Coloured White	161 (98.77) 1 (0.61) 0 1 (0.61)	0.30
DUT is a clean environment.	Female Male	127 (57.46) 94 (42.53)	0.93	≤ 20 20 - 30 30 - 40 40 - 50	23 (10.40) 180 (81.44) 12 (5.42) 6 (2.71)	0.05	African Indian Coloured White	217 (98.19) 2 (0.90) 1 (0.45) 1 (0.45)	0.37
There are sufficient refuse bins located at the lecture venues.	Female Male	107 (59.44) 73 (40.55)	0.73	≤ 20 20 - 30 30 - 40 40 - 50	22 (12.22) 143 (79.44) 13 (7.22) 2 (1.11)	0.27	African Indian Coloured White	180 (100) 0 0 0	n/a
There are sufficient refuse receptacles located at the eating areas on campus.	Female Male	119 (63.63) 68 (36.36)	**0.02**	≤ 20 20 - 30 30 - 40 40 - 50	25 (13.37) 151 (80.74) 9 (4.81) 2 (1.06)	**0.03**	African Indian Coloured White	184 (98.40) 2 (1.07) 0 1 (0.53)	0.09

Table 4.9: Positive responses regarding KAP of waste management among students (n=403) (cont.).

	Gender	n(%)	p value	Age group	n(%)	p value	Race	n(%)	p value
I am concerned about littering on campus.	Female Male	81 ((61.36) 51 (38.64)	0.34	≤ 20 20 - 30 30 - 40 40 - 50	18 (13.65) 105 (79.54) 8 (6.06) 1 (0.75)	0.91	African Indian Coloured White	130 (98.48) 2 (1.52) 0 0	0.93
Maintaining campus cleanliness is the responsibility of the students.	Female Male	68 (63.55) 39 (36.45)	0.52	≤ 20 20 - 30 30 - 40 40 - 50	6 (5.60) 95 (88.78) 5 (4.67) 1 (0.93)	0.06	African Indian Coloured White	105 (98.14) 0 1 (0.93) 1 (0.93)	0.94
It is important to keep waste/refuse in the receptacles on campus.	Female Male	54 (63.53) 31 (36.47)	0.57	≤ 20 20 - 30 30 - 40 40 - 50	9 (10.58) 66 (77.64) 9 (10.58) 1 (1.17)	0.88	African Indian Coloured White	82 (96.46) 1 (1.18) 1 (1.18) 1 (1.18)	0.70
There are adequate refuse receptacles on campus.	Female Male	12 (66.67) 6 (33.33)	0.81	≤ 20 20 - 30 30 - 40 40 - 50	2 (11.11) 15 (83.33) 0 1 (5.55)	0.18	African Indian Coloured White	18 (100) 0 0 0	0.45

P ≤ 0.05 was considered statistically significant.

Table 4.10: Positive responses regarding KAP of recycling among students (n=403).

	Gender	n(%)	p value	Age group	n(%)	p value	Race	n(%)	p value
I think recycling has benefits.	Female Male	96 (69.57) 42 (30.43)	**0.00**	≤ 20 20 - 30 30 - 40 40 - 50	14 (10.14) 111 (80.43) 11 (7.97) 2 (1.44)	0.34	African Indian Coloured White	134 (97.810 3 (2.19) 1 (0.73) 0	0.49
I will gladly use recycled items.	Female Male	69 (61.61) 43 (38.39)	0.31	≤ 20 20 - 30 30 - 40 40 - 50	9 (8.04) 91 (81.25) 11 (9.82) 1 (0.89)	0.47	African Indian Coloured White	109 (97.32) 2 (1.79) 1 (0.89) 0	**0.00**
Do you know what recycling is?	Female Male	169(55.40) 136(44.60)	0.36	≤ 20 20 - 30 30 - 40 40 - 50	43 (14.09) 238 (78.03) 19 (6.22) 5 (1.63)	0.52	African Indian Coloured White	295(96.72) 4(1.31) 4(1.31) 2(0.65)	0.39
Does the DUT have a recycling programme that involves all its student?	Female Male	48 (64) 27 (36)	0.39	≤ 20 20 - 30 30 - 40 40 - 50	9 (12) 66 (88) 0 0	0.05	African Indian Coloured White	75(100) 0 0 0	0.34
Do you know what the financial benefits of recycling are?	Female Male	49 (57.64) 36 (42.35)	0.81	≤ 20 20 - 30 30 - 40 40 - 50	7 (8.23) 71 (83.52) 6 (7.05) 1 (1.17)	0.40	African Indian Coloured White	83(97.64) 0 2(2.35) 0	0.28

	Gender	n(%)	p value	Age group	n(%)	p value	Race	n(%)	p value
I know what the environmental benefits of recycling are.	Female Male	111 (59.04) 77 (40.96)	0.44	≤ 20 20 - 30 30 - 40 40 - 50	26 (13.83) 151 (80.32) 8 (4.23) 3 (1.60)	0.48	African Indian Coloured White	183 (97.34) 3 (1.60) 1 (0.53) 1 (0.53)	0.76
The recycling bins are sufficiently visible.	Female Male	104 (60.82) 67 (39.18)	0.19	≤ 20 20 - 30 30 - 40 40 - 50	20 (11.56) 143 (82.66) 8 (4.62) 2 (1.16)	0.40	African Indian Coloured White	171 (98.84) 2 (1.16) 0 0	0.23
I know what purpose is served by the separation of waste.	Female Male	72 (61.54) 45 (38.46)	0.57	≤ 20 20 - 30 30 - 40 40 - 50	16 (13.45) 91 (76.47) 11 (9.40) 1 (0.85)	0.45	African Indian Coloured White	118 (99.16) 1 (0.84) 0 0	0.77
Recycling is practiced at student residences.	Female Male	53 (67.95)) 25 (32.05)	0.44	≤ 20 20 - 30 30 - 40 40 - 50	11 (13.92) 68 (86.08) 0 0	0.07	African Indian Coloured White	79 (100) 0 0 0	0.27

P ≤ 0.05 was considered statistically significant.

Table 4.11: Results of KAP questions on waste management questions.

	Level	n(%)	p value	Faculty	n(%)	p value
I know who is responsible for waste management at the DUT.	1st year 2nd year 3rd year 4th year	3 (21.43) 8 (57.14) 3 (21.43) 0	0.76	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	6 (42.86) 0 0 4 (28.57) 4 (28.57)	**0.01**
I think waste management is effective at the DUT.	1st year 2nd year 3rd year 4th year	13 (7.98) 87 (53.37) 48 (29.45) 15 (8.59)	0.09	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	30 (18.40) 13 (7.98) 22(13.50) 66(40.49) 32(19.63)	0.06
The DUT is a clean environment.	1st year 2nd year 3rd year 4th year	15 (6.79) 118 (53.39) 69 (31.22) 19 (8.14)	0.05	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	37(16.74) 18 (8.14) 29(13.12) 98(44.34) 39 (1.36)	**0.01**
There are sufficient refuse bins located at the lecture venues.	1st year 2nd year 3rd year 4th year	27 (14.84) 88 (48.35) 49 (26.92) 19 (9.34)	0.26	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	37(20.33) 6 (3.30) 35(19.23) 78(42.86) 26(14.29)	**0.02**
There are sufficient refuse receptacles located at the eating areas on campus.	1st year 2nd year 3rd year 4th year	21 (11.23) 102 (54.55) 52 (27.80) 12 (5.88)	0.40	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	34(18.18) 13 (6.95) 21(11.23) 82(43.85) 37(19.79)	**0.00**
I am concerned about littering on campus.	1st year 2nd year 3rd year 4th year	25 (17.60) 57 (40.14) 48 (33.80) 12 (2.11)	0.34	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	127(89.44) 0 2 (1.41) 0 13(9.15)	0.36
Maintaining the campus cleanliness is the responsibility of the students.	1st year 2nd year 3rd year 4th year	17 (15.89) 47 (43.93) 32 (29.91) 11 (9.35)	0.82	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	24 (22.43) 6 (5.61) 11 (10.28) 44 (41.12) 22 (20.56)	0.24
It is important to keep waste/refuse in the receptacles on campus.	1st year 2nd year 3rd year 4th year	12 (14.12) 39 (45.88) 24 (28.24) 10 (11.76)	0.84	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	22 (25.88) 8 (9.41) 9 (10.59) 38 (44.71) 8 (9.41)	0.22
There are adequate refuse receptacles on campus.	1st year 2nd year 3rd year 4th year	3 (16.67) 11 (61.11) 4 (22.22) 0	0.77	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	5 (27.78) 0 1 (5.56) 9 (50) 3 (16.67)	0.13

P ≤ 0.05 was considered statistically significant.

Table 4.10 above indicated that more female than male respondents indicated there were sufficient refuse receptacles located at the eating areas on campus (n=187, p< 0.05). There were more female respondents than males who felt that the refuse receptacles around the eating areas were sufficient (p=0.02). Out of the four age categories, those who were between the ages of 20 and 30 years felt that there were sufficient refuse receptacles at the eating areas on campus ($p < 0.05$).

Table 4.11 shows that out of the 138 respondents who said they think recycling has benefits, 96 were female (p value≤0.05). Of the 112 respondents who said they would gladly use recycled items, 97.32% were African ($p \leq$ was 0.05). Table 4.12 above indicates that out of the fourteen respondents who knew the people responsible for waste management at the DUT, 42.86% were from the Faculty of Health Sciences (p=0.01). Two hundred and twenty-one respondents felt that the DUT was a clean environment. The majority of those respondents (44.34%) came from the Faculty of Management Sciences (p value=0.01). Only 182 respondents felt that there were sufficient refuse receptacles located at the lecture venues. Table 4.12 also indicates that out of the 187 respondents who felt that there were sufficient refuse receptacles at the eating areas on campus, 82 (43.85%) were from the Faculty of Management Sciences whilst only thirteen were from the Arts and Design faculty (p value=0.00).

Table 4.12: Students' attitudes towards recycling at DUT (n=403).

	Level	n(%)	p value	Faculty	n(%)	p value
Do you know what recycling is?	1st year 2nd year 3rd year 4th year	38 (12.46) 151 (49.51) 90 (29.51) 26 (8.52)	0.39	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	72 (23.61) 25 (8.20) 43 (14.10) 123 (40.33) 42 (13.77)	0.43
Does DUT have a recycling programme that involves all its student community?	1st year 2nd year 3rd year 4th year	6 (8.00) 37 (49.33) 27 (36.00) 5 96.67)	**0.01**	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	21 (28.00) 11 (14.67) 7 (9.33) 24 (32.00) 12 916.00)	**0.00**
Do you know what the financial benefits of recycling are?	1st year 2nd year 3rd year 4th year	11 (12.94) 36 (42.35) 27 (31.76) 11 (12.94)	0.23	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	19 (22.35 7 (8.24) 13 (15.29) 29 (34.12) 17 (20.00)	0.49
I know what the environmental benefits of recycling are.	1st year 2nd year 3rd year 4th year	26 (13.83) 81 (43.09) 62 (32.98) 19 (10.11)	0.11	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	49 (26.06) 17 (9.04) 29 (15.43) 59 (31.38) 34 (18.09)	**0.01**
The recycling bins are sufficiently visible.	1st year 2nd year 3rd year 4th year	30 (12.24) 106 (43.27) 64 (26.12) 45 18.37))	0.53	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	46 (18.78) 15 (6.12) 41 (16.73) 109 (44.49) 34 (13.88)	**0.02**
I know what purpose is served by the separation of waste.	1st year 2nd year 3rd year 4th year	20 (16.81) 62 (52.10) 24 (20.17) 13 (10.92)	**0.00**	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	42 (35.29) 6 (5.04) 12 (10.08) 38 (31.93) 21 (17.65)	**0.00**
Recycling is practiced at student's residences.	1st year 2nd year 3rd year 4th year	10 (12.66) 35 (44.30) 30 (37.98) 4 (5.06)	0.48	Health Sciences Arts & Design Engineering & Built. Management Sciences Accounting & Informatics	18 (22.78) 13 (16.46) 5 (6.33) 25 (31.65) 18 (22.78)	**0.00**

P ≤ 0.05 was considered statistically significant.

Table 4.13 Logistic regression of knowledge, attitudes and practices of waste management and recycling at the DUT.

QUESTION	GENDER				FACULTY				LEVEL OF STUDY			
		OR	CI(95%)	p-value		OR	CI (95%)	p-value		OR	CI (95%)	p-value
Do you know what recycling is?	M F	1.00 0.65	0.39; 1.09	0.11	HSC CBE ACC MAN APP	1.00 1.74 2.54 1.60 1.96	0.64; 4.76 1.03; 6.27 0.77; 3.35 0.83; 4.60	0.28 **0.04** 0.21 0.12	1st 2nd 3rd 4th	1.00 1.16 1.31 0.88	0.50; 2.65 0.55; 3.14 0.25; 3.08	0.73 0.54 0.85
Does the DUT have a recycling programme that involves all its student community?	M F	1.00 1.39	0.80; 2.40	0.24	HSC CBE ACC MAN APP	1.00 0.56 1.83 1.41 1.13	0.23; 1.38 0.68; 5.00 0.72; 2.79 0.50; 2.55	0.21 0.23 0.32 0.76	1st 2nd 3rd 4th	1.00 0.48 0.37 0.43	0.19; 1.25 0.14; 1.00 0.11; 1.66	0.13 0.50 0.22
Do you know what the financial benefits of recycling are?	M F	1.00 1.14	0.68; 1.90	0.61	HSC CBE ACC MAN APP	1.00 1.16 1.10 1.37 0.64	0.43; 3.14 0.45; 2.65 0.68; 2.78 0.30; 1.40	0.77 0.84 0.38 0.27	1st 2nd 3rd 4th	1.00 1.26 0.97 0.62	0.56; 2.85 0.42; 2.27 0.21; 1.87	0.57 0.95 0.40

Table 4.13 Logistic regression of knowledge, attitudes and practices of waste management and recycling at DUT (cont.).

QUESTION	GENDER				FACULTY				LEVEL OF STUDY			
		OR	CI (95%)	p-value		OR	CI (95%)	p-value		OR	CI (95%)	p-value
Do you know what the environmental benefits of recycling are?	M F	1.00 1.20	0.78; 1.83	0.41	HSC CBE ACC MAN APP	1.00 1.25 1.22 1.93 0.88	0.56; 2.83 0.59; 2.53 1.09; 3.42 0.44; 1.77	0.59 0.60 **0.02** 0.73	1st 2nd 3rd 4th	1.00 1.67 1.13 0 .78	0.84; 3.31 0.55; 2.32 0.29; 2.10	0.14 0.75 0 .62
Do you know what purpose is served by the separation of waste?	M F	1.00 1.14	0.72; 1.82	0.58	HSC CBE ACC MAN APP	1.00 5.77 4.81 3.83 1.76	2.13; 15.61 2.06; 11.20 2.06; 7.13 0.88; 3.54	**0.00** **0.00** **0.00** 0.11	1st 2nd 3rd 4th	1.00 1.75 3.24 1.40	0.88; 3.49 1.51; 7.00 0.52; 3.78	0.11 **0.00** 0.51
Is the DUT a clean environment?	M F	1.00 1.17	0.76; 1.80	0.47	HSC CBE ACC MAN APP	1.00 0.82 0.88 0.50 0.35	0.37; 1.83 0.43; 1.82 0.28; 0.7 0.17; 0.71	0.63 0.73 **0.02** **0.00**	1st 2nd 3rd 4th	1.00 0.33 0.38 0.45	0.17; 0.68 0.18; 0.81 0.17; 1.22	**0.00** **0.01** 0.12
Are there sufficient refuse bins located at the lecture venues?	M F	1.00 1.15	0.75; 1.74	0.52	HSC CBE ACC MAN APP	1.00 3.44 0.36 0.70 0.76	1.28; 9.26 0.17; 0.76 0.40; 1.22 0.38; 1.52	**0.01** **0.01** 0.21 0.44	1st 2nd 3rd 4th	1.00 1.83 2.05 1.17	0.93; 3.61 1.00; 4.21 0.44; 3.11	0.08 0.50 0.75
Are there sufficient refuse receptacles located at the eating areas on campus?	M F	1.00 1.79	1.17; 2.77	**0.01**	HSC CBE ACC MAN APP	1.00 0.83 0.84 0.48 0.32	0.36; 1.95 0.39; 1.77 0.27; 0.85 0.15; 0.65	0.67 0.64 **0.01** **0.00**	1st 2nd 3rd 4th	1.00 0.64 0.81 1.13	0.32; 1.25 0.39; 1.66 0.41; 3.08	0.19 0.56 0.81

P ≤ 0.05 was considered statistically significant.

Table 4.13 Logistic regression of knowledge, attitudes and practices of waste management and recycling at DUT (cont.).

QUESTION	GENDER				FACULTY				LEVEL OF STUDY			
		OR	CI (95%)	p-value		OR	CI (95%)	p-value		OR	CI (95%)	p-value
Are the recycling bins sufficiently visible?	M F	1.00 1.43	0.92; 2.21	0.11	HSC CBE ACC MAN APP	1.00 0.59 0.44 0.33 0.33	0.25; 1.37 0.20; 0.94 0.18; 0.61 0.16; 0.67	0.22 **0.04** **0.00** **0.00**	1st 2nd 3rd 4th	1.00 0.74 0.63 0.80	0.37; 1.49 0.30; 1.30 0.30;.2.16	0.40 0.21 0.66
I am concerned about littering on campus.	M F	1.00 1.03	0.66;1.62	0.90	HSC CBE ACC MAN APP	1.00 1.02 1.96 1.95 0.99	0.45; 2.33 0.89; 4.33 1.06; 3.56 0.49; 1.99	0.97 0.09 0.03 0.98	1st 2nd 3rd 4th	1.00 1.99 1.22 3.68	1.00; 3.98 0.59; 2,51 1.14; 11.83	0.05 0.59 **0.03**
It is important to keep waste/refuse in the receptacles on campus.	M F	1.00 1.49	0.88; 2.51	0.14	HSC CBE ACC MAN APP	1.00 1.28 1.92 1.05 2.11	0.50; 3.30 0.74; 4.95 0.55; 2.00 0.89 0.86; 5.19 0.10	0.60 0.18	1st 2nd 3rd 4th	1.00 1.25 1.40 0.86	0.58; 2.72 0.61; 3.20 0 .29; 2.59	0.57 0.43 0.79
I think recycling has benefits.	M F	1.00 2.68	1.67; 4.29	**0.00**	HSC CBE ACC MAN APP	1.00 0.89 1.60 1.07 0.73	0.38; 2.00 0.69; 3.72 0.58; 1.98 0.36; 1.48	0.74 0.28 0.82 0.38	1st 2nd 3rd 4th	1.00 2.07 1.21 0.91	1.00; 4.26 0.57; 2.55 0.32; 2.60	0.05 0.62 0.86
Is recycling practiced at student residences?	M F	1.00 1.65	0.96; 2.84	0.07	HSC CBE ACC MAN APP	1.00 0.36 1.86 1.04 0.51	0.14; 0.88 0.61;5.70 0.51; 2.13 0.24; 1.12	0.03 0.28 0.90 0.94	1st 2nd 3rd 4th	1.00 1.02 0.63 1.58	0.45; 2.29 0.27;1.47 0.38; 6.64	0.97 0.28 0.53

F= FEMALE; M = MALE; HSC = Health Sciences; CBE = Civil Engineering and Built Environment; ACC = Accounting and Informatics; MAN = Management Sciences; APP = Applied Sciences OR = Odds ratio; CI = Confidence interval.

P ≤ 0.05 was considered statistically significant.

Using the Health Sciences faculty as a point of reference, in the logistic regression models it was evident that respondents from the Faculty of Accounting understood waste management and recycling better than the other faculties (OR=2.54, CI=1.03 to 6.27, p=0.04); (OR=1.93, CI=1.09 to 3.42, p=0.02). The results were statistically significant since the p-value was 0.02. The odds ratio of the knowledge of the respondents from the faculties of Engineering and Built Environment, Management Sciences and Applied Sciences about the purpose of separating waste was found to be higher than that of the respondents from the Faculty of Health Sciences ($p<0.05$). The knowledge of the third-year respondents about the purpose that is served by the separation of waste was better that of the first-year respondents and the results were significant ($p<0.05$).

The attitudes of the respondents from the Faculties of Management Sciences and Applied Sciences regarding the cleanliness of the DUT were less positive than those of the respondents from the Health Sciences faculty (OR=0.50 and 0.35 respectively), and these results were significant since $p<0.05$ (0.02 and 0.00 respectively). The attitudes of the second-year and third-year respondents about the cleanliness of DUT were less positive than that of the first-year respondents (p-values were 0.00 and 0.01 respectively). The respondents from the CBE faculty were very happy about the sufficiency of the refuse bins located at lecture venues and the results were significant since p=0.01. Attitudes contrasted with those of the ACC faculty and the p-value of the results were significant with a $p<0.05$. The attitude of the respondents from the MAN faculty about the concern for litter on campus was less than that of the HSC respondents, and results were significant in that the p-value was 0.03. The attitude of the female respondents towards the benefits of recycling was far better than that of males, and the results were significant since the p-value was <0.05 (0.00). The attitude of the fourth-year respondents regarding the environmental benefits of recycling was far greater than that of the first-year respondents at 3.68, and the results were significant since p=0.03.

When referring to practices of recycling at student residences, the CBE respondents indicated that they did not participate as much as the respondents from the HSC faculty, and the results were statistically significant with the p-value of 0.03.

CHAPTER 5

DISCUSSION

This quantitative, descriptive research study was conducted to analyse the current waste management practices of academic departments; map the positions and types of refuse receptacles utilised at the two campuses; and to explore the knowledge, attitude and practices of the students towards waste management and recycling at the DUT. To the researcher's knowledge this is the first study to conduct a situational analysis and KAP study of waste management and recycling at the DUT.

The demographic characteristics of the study sample of staff members (n=6) who responded to the questionnaire regarding the current practices of the academic departments regarding waste management and recycling, indicated that all participants were permanently employed staff members of the DUT. The HODs formed the majority of these respondents. Only two of the six respondents were males. Out of the 403 student respondents 97% were Africans. The mean age of the respondents was 22.86 years.

Five out of six respondents (83.3%) indicated that they were not satisfied with the state of the environment at the DUT. Only one respondent found the state of the environment at the DUT to be fair. This concurs with anecdotally collected information referring to the e-mail messages that were circulating amongst staff members of the institution about the state of the environment at the institution. The message expressed dissatisfaction with regards to cleanliness at the institution.

The availability and positioning of the receptacles at the Riverside campus were found to be satisfactory, however it was noted that the same could not be said about the Indumiso campus. The level of littering at the Riverside campus was far less than that at the Indumiso campus. This could be attributed to the availability and positioning of receptacles at the Riverside campus and the lack thereof at the Indumiso campus. The walk-through survey conducted by the researcher at both campuses revealed that the Indumiso campus did not have formal refuse receptacles positioned throughout the campus. Although the two campuses are part of one institution, the practices of providing refuse receptacles are not standardised

between the two campuses. In a study conducted by Smyth, Fredeen and Booth (2010) at the University of Northern British Columbia, the locations of waste, recycling and compost receptacles were mapped out to assist in observing the distribution of the receptacles throughout the institution. The NWMS (2012) suggested that once waste has been generated it needs to be stored in containers that are suitable for the storage of such wastes.

All of the participants from academic departments in this study agreed that recycling should be implemented at the DUT, although when it came to implementing it as a practice only one participant was found to be actually practicing it at the time. The practice of recycling within the various departments was found to be inconsistent. One department was found to deal with waste management and recycling in a manner that was inconsistent with the manner employed by the next department. In some instances it was observed that programmes within the same department dealt with waste and recycling in a different manner from one another. This haphazard practice of waste management and recycling in the departments of the same institution may be attributed to a lack of an institutional policy addressing the handling of waste management and recycling in the various departments and programmes. De Vega, Ojeda-Benitez and Ramirez-Barreto (2003) stated that in Mexicali, a capital of Mexican state of Baja, California, there were no solid waste management plans nor were there programmes to reduce, re-use and recycle solid waste, so institutions had to come up with their own sustainable environmental programmes. These institutions were in a similar position to the DUT. The DUT should deal with this challenge in a similar manner to that adopted by these institutions, by firstly drawing up a policy that will guide the various departments on dealing with waste management and recycling issues in a consistent manner. The management of waste will be consistent because the departments will be drawing guidance from the same policy document. A study conducted by de Amutenya, Shakleton and Whittington-Jones (2009) indicated that Rhodes University developed its own policy with regard to environmental issues at the institution. The policy at Rhodes University in South Africa gave guidance on how to deal with issues such as waste management and recycling in the South African context. Carpenter and Meehan (2002) conducted a study at nine universities in Australia and New Zealand;

they found that all participating universities had environmental policies that were approved at executive level. Seven of the nine universities indicated that after the approval of these policies, environmental plans were developed and were implemented by established environmental committees that had the approval and acceptance of the vice-chancellors.

The results of this study indicated that out of the six participants, five expressed dissatisfaction regarding the cleanliness of the area around the vendors. None of the five respondents used the vendors; they were mainly used by the students. At the Indumiso campus the vending area is not provided with refuse receptacles. It is not clear if the reason for the respondents not using the vendors is their dissatisfaction with the lack of cleanliness in the area around which the merchandise is sold. The student respondents concurred with the observations of the staff members, in that approximately 62% of the students believed that it is the students who are responsible for creating waste at the DUT. Roughly 150 (37.2%) respondents believed that it was the area around the cafeteria, tuck shop and eating areas that were mostly dirty, as compared with only 27 respondents who believed that it was the lecture venues that were mostly dirty.

When students were interviewed it was concerning to note that close to 70% of the participants did not know who the responsible body is for waste management at the DUT. The lack of this knowledge indicates that if there was a problem with regard to waste management they would not know whom to approach. Of those participants who indicated that they knew who was responsible for waste management, very few of them provided correct information when asked to do so. An observation made by Dahle and Neumayer (2001) was similar to the findings of our study, and it led to them to concluding that one of the most important measures that need to be taken is raising environmental awareness within campus communities.

The results of this study indicate that close to 43% of the respondents were confused about the recycling scheme on campus. They did not know what was happening to the money that was made through recycling in their departments. They were also not aware that there is money that can be made through recycling. The results also

indicated that close to 50% of the respondents were not satisfied with the visibility of the recycling bins on campus. These results were inconsistent with the findings of a study conducted by Kelly *et al*. (2006) at Massey University in New Zealand, which reflected that 96% of the student population was aware of the recycling scheme employed at the university. Studies conducted at other institutions such as Massey University indicated that the students were not only aware of these recycling programmes, but were also happy with them (Kelly *et al*. 2006).

Approximately 78.4% of the participants indicated that they did not know what the financial benefits of recycling were. Even those participants who thought they knew what the financial benefits of recycling were, could not provide correct information. This is concerning, particularly because tertiary students are close to completing their studies and to entering the working environment. De Vega, Benitez and Ramirez-Barreto (2008) stated that universities and colleges were ethically and morally bound to be leaders in environmental protection. If the student population showed a lack of knowledge regarding matters they were supposed to be leading in, this meant that the institutions that were supposed to impart such knowledge to the students were failing in their duties. Orr (1992) emphasised that the challenge facing educators was to change the mind-sets and habits towards sustainable living practices.

Dahle and Neumayer (2001) made us aware that because all members of a campus community are part of creating the environmental impacts resulting from an institution's operations, they are all responsible for acting to reduce such impacts. Academics cannot be excluded from participating because they were supposedly busy with their research and lecturing, nor can students be exempted because of exams and course work. Approximately 68.5% of the respondents from this study believed that it is everybody who should participate in recycling activities on campus. This concurred with Dahle and Neumayer (2001), when they stated that no member of the institution should be excused from participating in activities that contribute toward reducing the impacts of their activities on the environment. The results of this study indicated that close to 70% of the respondents felt that everybody should be involved in clean up campaigns and other waste reduction initiatives at the

institution. It is interesting to note that close to 72% of the respondents felt that clean-up campaigns were effective, although very few of the respondents have participated in such projects initiated on the campuses. The non-participation of some of the respondents originates from the non-committal attitudes they have towards environmental issues.

In a study conducted by Amutenya, Shakleton and Whittington-Jones (2009) at Rhodes University, it was revealed that students stood to benefit financially from the recycling programmes of the institution. The strategy promoted the printing of multiple pages per sheet of paper. The printing of multiple pages on one sheet saves money for students, in that they pay half the price they would have had to pay if the printing was done on one page per sheet. The results of this study show that the respondents did not understand what the financial benefits of recycling are. The lack of knowledge led to the students losing out on benefits they would otherwise have enjoyed. Bollane (2006) reported that raising awareness of the need for recycling can be complemented by direct incentives such as money. This may encourage people to participate in the recycling projects. De Vega, Benitez and Ramirez-Barreto (2008) felt that a reduction in the quantity of the waste that has to be handled, transported and disposed of in a landfill site could lead to a reduction of institutional expenditure. A reduction in the institutional expenditure could, in the long run, imply a reduction in the rate of the increase of the students' fees. The findings of the REI study in the USA indicated that recycling contributed to the economy of that country by providing employment opportunities to 1.1 million people. Mbuligwe (2001) stated that the effective management of waste in developing countries is constrained by technological and financial constraints. Velazquez *et al.* (2003) reiterated this when they stated that the lack of financial resources is a constant constraint for most projects. If people were aware of the financial benefits of recycling they would contribute effectively to the country's economy by participating in recycling activities within the institution.

De Vega, Benitez and Ramirez-Barreto (2008) commented that the larger proportion of the waste generated by the academic and administration sections at their study institution was paper. The results of this study showed that approximately 33% of the respondents felt that polystyrene is the item of waste that needs to be recycled the

most, as compared with paper that was only at 11%. It is very important to note that the DUT is an academic institution and as such paper would be expected to be the major component of the waste heap generated at the institution. It should also be noted that these results are based on the observations of people who have indicated that they do not understand waste matters very well. One of the objectives of this study was to assist in the formulation of a policy that will guide the manner in which waste is dealt with. Smyth, Fredeen and Booth (2010) affirmed that in the same way that municipal waste characterisation provides decision-makers with a detailed understanding of a waste stream and enables waste management programmes to be tailored for local needs, waste characterisation studies at universities can identify campus-specific opportunities for waste reduction and recycling. Furthermore, De Vega, Benitez and Ramirez-Barreto (2008) asserted that knowing the composition of the waste allows for defining the strategies for separation, collection and the frequency of collection for recycling.

Different authors have observed various environmental benefits of recycling in their studies. Kaseva and Gupta (1996) informed us that recycling is beneficial to the environment, in that it reduces the amount of waste that eventually reaches landfill sites. In South Africa a person running a disposal site business needs to go through vigorous questioning by government departments, and public opinion is sought before permission to run such a business is granted. Recycling reduces the need to build landfill sites. Kaseva and Gupta (1996) further explained that when the volume of waste disposed of by landfilling is reduced, the amount of space required for landfilling is obviously reduced. Blog's (2009) study indicated that it takes 95% less energy to make aluminium from recycled aluminium than it does to make it from virgin materials.

In the steel industry it takes 60% less energy to produce a new product. The energy saved from the use of recycled materials leads to the reduction of pollutants that are generated when energy is utilised. In the results of this study the reflection is that more than 50% of the participants did not know what the environmental benefits are of recycling. This partially explains the reluctance of the respondents to participate in the recycling initiatives within the institution. If the students are not aware of how

they would benefit from participating, then nothing would motivate them to participate; sharing such information with them would motivate them. Kelly *et al*. (2006) conducted a study with the results showing that close to 98% of the respondents thought that recycling was beneficial for the environment.

The results of this study also revealed a very poor commitment to participation by the DUT community in relation to the recycling projects that are initiated within the institution. Clarke and Mantaay (2006) reported that when programmes are poorly communicated, then the participation rates are very low. Dahle and Neumayer (2001) stated that informing potential participants about the value and benefits of recycling has been accepted as critical to sustaining participation in a recycling programme. In their work at the University of Bath in the creation of a guidance handbook, Dahle and Neumayer (2001) further emphasised the importance of understanding the disposal routes of waste materials.

There was a significant difference between the respondents from the CBE faculty and the HSC faculty with regard to participation in recycling activities. The results of the study indicated that the respondents from the HSC faculty participated more than those from the CBE faculty in recycling projects initiated within the institution. This difference might be attributed to the fact that waste management has an impact on the health of the people, and thus students from the faculty of HSC would understand this better. The results of this study furthermore showed that the attitude of the respondents from the Management and Applied Sciences faculties regarding recycling were significantly less positive than those of the respondents from the faculty of HSC ($p<0.05$). The more positive attitude of the respondents from the HSC faculty may also be ascribed to the fact that respondents from this faculty are familiar with the subject of waste management; as a result they tend to participate more. Kaplowitz *et al*. (2009) explained the importance of the general knowledge of recycling as well as recycling programme characteristics, as these are reported to influence attitudes and motivate recycling behaviour. Empirical evidence suggests that an individual's participation in recycling programmes is correlated to their knowledge of how, where and what to recycle, as well as to their knowledge of how recycling benefits the environment (Folz 1999). Kelly *et al*. (2006) concurred with this

when they found that a lack of programme-specific information among staff and students at Massey University was widely cited as a reason for not recycling. Post-graduate student responses tended to be more closely aligned with those of staff than with undergraduate students.

The results further indicated that 229 respondents did not know if the DUT had a recycling programme that involved students. This finding is worrisome because the respondents are the people who should be knowledgeable about such programmes, as they are the people who should be participating in them if there are any in place. A lack of such knowledge gives the impression that there is a lot of work that needs to be done in terms of sharing information about recycling activities taking place within the institution. It might be that it is not the fault of the respondents that they do not know about the recycling projects, but that the information is not properly distributed.

Significantly, the results of this study revealed that there was confusion amongst the respondents when it came to the usage of the various sizes and colours of receptacles for recycling purposes. Some of the respondents had no idea what the different colours are meant for in terms of the types of waste that can be recycled. This lack of knowledge meant that there was an increased possibility that waste could be found mixed in the receptacles provided. This would mean that the purpose of separating waste would be defeated. This is in contrast to the findings of the study conducted by Kelly *et al*. (2006), where they found that the knowledge of the students and staff regarding the four-bin recycling scheme was very high. Kelly *et al*. (2006) established that the institutional community was satisfied with the information they had on the university recycling scheme or recycling in general. Unfortunately that cannot be said about the respondents from the DUT, however this sets the scene for those who would take the challenge of informing the DUT community. Sixty percent of the university community were satisfied with the design and size of the recycling bins (Kelly *et al*. 2006). This meant that they understood how and why they were different, and how they were supposed to be used.

In this study the results indicated that 221 respondents felt that the DUT is a clean environment; close to 45% of those respondents came from the Faculty of Management Sciences, which is located at the Riverside campus. This observation of the Faculty of Management Sciences respondents may be ascribed to the fact that the Riverside campus has sufficient refuse receptacles which are well distributed within the campus. The positioning and number of receptacles plays a major role in keeping premises clean and tidy. The observations of these respondents are attributed to that fact.

More female respondents felt that there were sufficient refuse receptacles located at the eating areas on campus ($p < 0.05$). Similar findings were reported in a study conducted by Kelly *et al.* (2005). This observation may be attributed to the fact that cleanliness is mostly a function associated with the female gender. This finding only applies to the Riverside campus as the Indumiso campus is not provided with appropriate refuse receptacles. The high level of cleanliness of the Indumiso campus that can be observed in the mornings can only be attributed to the efforts of the cleaning staff members. It is interesting to note that the respondents from the CBE faculty were very happy with the sufficiency of the receptacles at the lecture venues ($p = 0.01$). The receptacles were actually make-shift receptacles, in the form of cardboard boxes provided by the cleaning staff. One would have expected that respondents from the Riverside campus would be more satisfied with the sufficiency of receptacles when compared with those of the Indumiso campus respondents.

Further results of this study indicated that the attitudes of the first-year students towards recycling at the DUT were mostly positive. This observation was statistically significant ($p = 0.00$). It goes without saying that when an individual has little information on a particular subject then the individual's attitude will be influenced to a large extent by their experience. Very few of the first-year respondents had anything negative to say about the state of the environment at the institution. Their observations may be influenced by the fact that they compared the state of the DUT to those of the high schools they attended in the previous year. Their observations and comments might have been based on incomplete information as they were still very new at the institution. There was a predominant contrast observed by Kelly *et*

al. (2006) in the study they conducted, when it emerged that undergraduate students recycled 'sometimes' as compared with post-graduate students who recycled more frequently. Given that age has previously been shown to be a significant factor in recycling behaviour, it was suggested that the university community should consider targeting younger and more mature students separately on the issue of recycling (Kelly *et al.* 2006).

Kaplowitz *et al.* (2009) submitted that the campus community appeared to be receptive to information on how to recycle properly, as well as the benefits of recycling. The receptivity of recycling information could be linked to a general positive attitude of the university community towards the recycling programme, as well as a desire to improve their recycling knowledge (Kaplowitz *et al*. 2009). To overcome the respondents' recycling knowledge gap, the design and implementation of a communication strategy that effectively addresses the information needs of the campus population is necessary (Kaplowitz *et al*. 2009). Successful recycling programme communication approaches seem to depend on understanding the perspectives and perceptions of the target groups. It appears that individuals may increase their recycling activities for a variety of reasons when appropriate communication strategies exist (Kaplowitz *et al.* 2009). They further asserted that the design and tailoring of recycling programme educational and communication campaigns remain largely understudied.

The understanding of the respondents from the Faculty of Management Sciences about the environmental benefits of recycling was found to be better than that of the respondents from the Faculty of Health Sciences. This finding was significant ($p = 0.02$). In some instances the respondents from the Faculty of Health Sciences had given an indication that they understand waste management and recycling better than respondents from the other faculties. This indicates that when there are information sharing sessions all faculties should be treated equally, and no assumptions should be made about one faculty having a better understanding of what is being discussed than other faculties.

It is evident form the results reflected in Table 4.14 that there was no statistical significance about the level of study or the faculty at which a respondent is registered, when knowledge about waste management and recycling at the DUT was evaluated. Table 4.14 also revealed that using the Health Sciences faculty as a point of reference in the logistic regression models, respondents from the Faculty of Accounting understood waste management better than the other faculties; this was statistically significant. The understanding of the respondents from the Management Sciences faculty about the environmental benefits of recycling was better than that of the respondents from the Health Science faculty, as reflected (OR = 1.93, CI = 1.09 to 3.42, p = 0.02). One would have expected that the respondents from the Faculty of Health sciences would have a better understanding of the issues relating to waste management and recycling. This gives a clear indication that when trying to address a lack of knowledge from the respondents, students from the various faculties should be treated equally. No assumption should be made that students from a certain faculty have a better understanding; all the students must be treated equally. The knowledge gap should be addressed in a similar manner with all people concerned.

The results in table 4.14 also revealed that the attitude of the female respondents towards the benefits of recycling was far better than that of males, and the results were significant since the p-value was <0.05 (0.00). The results of this study have revealed that there is a huge gap when it comes to the knowledge of students about waste management generally, and also about waste management particularly at the DUT. The gap was not identified with waste management only, but with recycling as well. In order to address this knowledge gap a learning programme will be developed; this will be implemented in the orientation programmes that are used by the various faculties and departments.

The learning programme will include, amongst other things:

- The definition of waste and of waste management.
- The difference between recycling and re-use.
- The effects of poor waste management.
- An explanation of littering.
- Suggested solutions to littering.

CHAPTER 6
CONCLUSION AND RECOMMENDATIONS

To the best knowledge of the researcher, this is the first study conducting a situational analysis of waste management and recycling and studying the knowledge, attitudes and practices of students at the DUT. The findings obtained in this study were utilised to draw conclusions on the *status quo* at the DUT, although they may be extrapolated to other institutions of higher education with similar backgrounds.

The majority of the respondents in the situational analysis of waste management and recycling in the departmental questionnaires were HODs, with and most being female. Only one respondent had been at the DUT for a period of less than five years. The respondents were evenly distributed between the two campuses. Most of the academic departments were not aware of the practices of other departments regarding waste management and recycling within the institution. The findings of the situational analysis revealed that there is no common reference point that is used by the various departments within the institution when it comes to waste management and recycling. The various departments are operating independently from each other. All departments are doing what suits individual departments. Those departments that do practice recycling do not use the same company for their recycled materials, even though this would get them a better rate because the volume of recycled waste would be larger. The recycling receptacles used by those departments practicing recycling were mostly makeshift receptacles. Staff members who practice recycling are aware of what happens to the proceeds made from recycling. Paper was the only waste material recycled by those departments practicing recycling. The findings of this study also revealed that provision of the refuse receptacles needs to be co-ordinated at institutional level, so that all campuses will employ a uniform system. The use of makeshift receptacles should not be taken as a solution to the problem; they should be understood to be a temporary measure which can only be resolved by the adoption of a uniform system at institutional level.

The majority of the respondents from the knowledge, attitudes and practices questionnaire were undergraduate students with most being second-year students.

They were predominantly in the 20 to 30 years age category and were mostly female. The majority were from the Faculty of Management Sciences.

The findings of this study revealed that the majority of the respondents were not aware of the waste management issues faced at the DUT. They did not know who was responsible for waste at the institution and also did not know the frequency of the collection of waste at the institution. They were not aware of the financial and environmental benefits of recycling. The majority did not understand the importance of separating waste when practicing recycling. Considering the lack of knowledge about waste management and recycling, it was not surprising that the attitude towards waste management and recycling was indifferent. The results were, as expected, consistent when trying to establish their participation in environmental initiatives at the institution.

Based on the data gathered during the study and the analysis, it is recommended that:

- The Management of the DUT develops a policy document regarding environmental issues at the institution.
- A waste management plan is developed for implementation and ensuring that refuse receptacles are provided and positioned in a strategic and systemic manner at the various campuses of the institution.
- The various departments (including support departments) within the institution are compelled to co-operate with regard to the implementation of the proposed waste management plan.
- Recycling is adopted by all concerned as a method of reducing the waste that is generated at the institution.
- New students be compelled to attend the orientation programme where they will be informed about the methods of dealing with waste at the DUT (through the developed learning programme), which is not only limited to the authorities but should be understood by the entire DUT community.
- A system of penalising offenders when it comes to littering and pollution on campus should be designed.
- An office be established that will accept and deal with waste management and recycling issues at the institution.

In conclusion, the provision of refuse receptacles at the DUT is inadequate. The practices of the various departments regarding waste management and recycling are not uniform and are not guided by any policy. The knowledge of the respondents regarding waste management and recycling issues at the institution is scanty and inadequate. A lack of knowledge may foster a culture of indifference towards such issues. The DUT as an institution of higher education is well positioned to impart this knowledge, which will not only be useful at the institution but also will develop responsible citizenry so that students practice this at their homes and future places of work. Further work emanating from this study will include a questionnaire administered to students who have been through the learning programme, in order to determine whether there has been any change in knowledge and attitudes. Observations will also be conducted on the practices of the various departments after the design and implementation of an institutional policy on waste management and recycling.

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LIST OF ANNEXURES

Annexure 1

Directorate for Research and Postgraduate Support

Durban University of Technology

Tromso Annexe, Steve Biko Campus

P.O. Box 1334, Durban 4000

Tel.: 031-373257617

Fax: 031-3732946

E-mail: ***moyos@dut.ac.za***

22 May 2013

Mr. G. Mdlozini

c/o Department of Environmental Health

Durban University of Technology

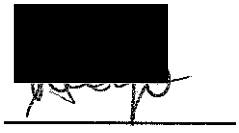
Dear Mr Mdlozini

PERMISSION TO CONDUCT RESEARCH AT THE OUT

Your email correspondence in respect of the above refers. I am pleased to inform you that the Institutional Research Committee (IRC) will grant permission to you to conduct your research at the Durban University of Technology. However, kindly note that the committee requires you to provide proof of ethical clearance prior to you commencing with your research at the OUT.

We would be grateful if a summary of your key research findings can be submitted to the IRC on completion of your studies.

Kindest regards. Yours sincerely



PROF. S. MOYO

DIRECTOR: RESEARCH AND POSTGRADUATE SUPPORT

ANNEXURE 2

QUESTIONNAIRE FOR SITUATIONAL ANALYSIS (DEPARTMENTS AND STAFF MEMBERS)

IMPORTANT NOTICE: Please mark the appropriate box or write an answer in the space provided

Date questionnaire is completed (dd/mm/yyyy) ……./……/……..

Gender: Male ☐ Female ☐

Race: A ☐ C ☐ I ☐ W ☐ Other ☐

If other please specify……..

Faculty……..

Department/Programme……..

Position in Department/Programme……

Age……..yrs. (Optional)

How long have you been in the Department?.....

Campus……

1. What is the state of the environment at DUT?

……
……
……

2. What is your feeling about the general cleanliness of DUT?

a) Parking Areas/Gardens/other

……
……
……

b) Offices / Lecture venues/Admin. Section

……
……
……

c) Food vendors' area

……
……
……

3. Do you think recycling would be part of the solution?

……
……

4. Does your Programme/Department practice recycling?

……
……
……

5. Does your dept/prog. have waste recycling bins? ☐ Y ☐ N ☐ Don't know

6. How often are these bins emptied?

……

7. Who empties these bins for you?

……
……

8. What wastes form the most of the recycled wastes?

……
……
……

9. What are the activities that produce most of the recycled waste?

……
……

10. On average how much money are you making from recycling per month?

……
……

11. What do you do with the money you make from recycling?

……
……

12. Do you think all departments at DUT should practice recycling?

☐ Y ☐ N ☐ Don't know

Comments……
……

13. Does your department generate any hazardous waste?

☐ Y ☐ N ☐ Don't know

13.1 If yes to the question above, how is it dealt with?

……
……
……

14. Does your department generate any medical waste?

☐ Y ☐ N ☐ Don't know

14.1 If yes to the question above, how is it dealt with?

……
…….

15. How does your department deal with electronic waste that is generated within the department?

……
……
……..

16. Do you have any other suggestions about reducing waste at DUT?

……
……
……

Your participation and contribution in this study is appreciated. Thank you.

Annexure 3

NOTICE!!!

A STUDY ON WASTE MANAGEMENT AND RECYCLING AT DUT WILL BE CONDUCTED IN THE SECOND SEMESTER AT THE RIVERSIDE AND INDUMISO CAMPUSES.

SELECTED STUDENTS WILL BE REQUESTED TO FILL IN A QUESTIONNAIRE

WE HOPE TO TRANSFORM DUT INTO A BETTER LEARNING ENVIRONMENT.

YOU ARE KINDLY REQUESTED TO PARTICIPATE IF ASKED TO DO SO.

FOR MORE INFORMATION, PLEASE CONTACT *George Mdlozini 031 373 2844*

Annexure 4

Letter to the Heads of Departments

P. O. Box 100068
Scottsville
3209
13/August/2013

Mrs Dumisile Cynthia Hlengwa
Department of Ecotourism
Durban University of Technology
Riverside Campus

Dear

Permission to collect data from students and staff members

My name is George Mdlozini, and I am conducting a Masters study (Department of Community Health Studies, Faculty of Health Sciences) on waste management and recycling at DUT. We have permission from the DUT management to conduct this study (permission letter attached). I need to collect data from students from your respective programmes and from a single staff member who is knowledgeable of waste management and any recycling activities within your departments. I am planning on approaching each department separately for the staff interview and will access some students from a random list at their lecture venues. This will be done after lecture time with minimum anticipated disruption. The IREC requires that permission be sought from each HOD of departments from targeted campuses.
The aim of the study is to conduct a situational analysis and knowledge, attitudes and practices study of waste management and recycling at the Durban University of Technology (DUT).
The objectives are :

- To conduct a situational analysis of current waste management and recycling practices of the academic departments at the Indumiso and Riverside campuses of DUT.
- To conduct knowledge, attitudes and practices (KAP) survey regarding waste management and recycling among students at Riverside and Indumiso campuses of DUT.
- To design learning material for delivery at orientation of all new DUT students.

We require your permission to access your students and staff to fill in a questionnaire. The study will only commence on the week starting on the 19th of August 2013 since full IREC approval has been obtained.

If you need anything further, please let me know. I trust you will yield a positive response.
Yours faithfully
George Mdlozini
Tel: 031 3732844
Email: george@dut.ac.za

Annexure 5

LETTER OF INFORMATION

Title of the Research Study:

A situational analysis and Knowledge, Attitudes and Practices study of waste management and recycling at the Durban University of Technology (DUT).

Principal Investigator/s/researcher: Mr George Mdlozini

Co-Investigator/s/supervisor/s: Dr Poovendhree Reddy and

Mr. Graham J. Barratt

Dear Participant

You are kindly requested to take part in a research study to conduct a situational analysis and attitudes, knowledge and practices study of the waste management and recycling at DUT. The study will contribute towards addressing the waste management problems at DUT.

Brief Introduction and Purpose of the Study:

Outline of the Procedures: This study will be conducted at the Indumiso and Riverside campuses of DUT and it will be conducted amongst both students and staff members. A randomly selected sample of the students will be asked to respond to a questionnaire that has been developed by the researcher. Only those students that are registered at either one of the two campuses will form part of the study. The questionnaire will be administered by trained research assistants and the researcher. Staff members will be asked to respond to a questionnaire that will be administered by the researcher.

Risks or Discomforts to the Participant: There will be no harm to you during the period of data collection.

Benefits: This study will help the subject to identify and address waste management challenges at DUT.

Reason/s why the Participant May Be Withdrawn from the Study: If, for whatever reason, you feel that you cannot continue to answer questions you can stop at any time, there will be no consequences if you refuse to participate.

Remuneration: There will be no payment given for participation in the study.

Costs of the Study: You will not pay to take part in the study.

Confidentiality: The questionnaire used in the interview will be treated confidentially. Your name will not appear in any part of the report. Questionnaires will be kept in a lockable cabinet for the period of fifteen years and will then be destroyed.

Research-related Injury: There will be no compensation or payment because no one will be injured in this study.

Persons to Contact in the Event of Any Problems or Queries:

Mr. Graham Barratt Tel :(w) 031 373 2655

Dr Poovendhree Reddy Tel: (w) 031 373 2808

or the Institutional Research Ethics administrator on 031 373 2900. Complaints can be reported to the DVC: TIP, Prof F. Otieno on 031 373 2382 or dvctip@dut.ac.za.

General:

Potential participants must be assured that participation is voluntary and the approximate number of participants to be included should be disclosed. A copy of the information letter should be issued to participants. The information letter and consent form must be translated and provided in the primary spoken language of the research population e.g. isiZulu.

CONSENT

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, _____ (name of researcher), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: _____,
- I have also received, read and understood the above written information (Participant Letter of Information) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerised system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

_____	_____	_____	_____
Full Name of Participant	**Date**	**Time**	**Signature / Right Thumbprint**

I, _____ (name of researcher) herewith confirm that the above participant has been fully informed about the nature, conduct and risks of the above study.

_____	_____	_____
Full Name of Researcher	**Date**	**Signature**
_____	_____	_____
Full Name of Witness (If applicable)	**Date**	**Signature**
_____	_____	_____
Full Name of Legal Guardian (If applicable)	**Date**	**Signature**

Please note the following:

Research details must be provided in a clear, simple and culturally appropriate manner and prospective participants should be helped to arrive at an informed decision by use of appropriate language (grade 10 level - use Flesch Reading Ease Scores on Microsoft Word), selecting of a non-threatening environment for interaction and the availability of peer counseling (Department of Health, 2004)

If the potential participant is unable to read/illiterate, then a right thumb print is required and an impartial witness, who is literate and knows the participant e.g. parent, sibling, friend, pastor, etc. should verify in writing, duly signed that informed verbal consent was obtained (Department of Health, 2004).

If anyone makes a mistake completing this document e.g. wrong date or spelling mistake a new document has to be completed. The incomplete original document has to be kept in the participant file and not thrown away and copies thereof must be issued to the participant.

References:

Department of Health: 2004. *Ethics in Health Research: Principles, Structures and Processes* http://www.doh.gov.za/docs/factsheets/guidelines/ethnics/

Department of Health. 2006. *South African Good Clinical Practice Guidelines*. 2nd Ed. Available at:

Annexure 6

QUESTIONNAIRE FOR KNOWLEDGE, ATTITUDES AND PRACTICES SURVEY (STUDENTS)

IMPORTANT NOTICE: Please mark the appropriate box or write an answer in the space provided.

DEMOGRAPHIC INFORMATION:

Date of completion of Questionnaire. dd/mm/yy ……/……/…….

Gender

Male	
Female	

Age: _____yrs.

Level of study

1st Year	
2nd Year	
3rd Year	
4th Year	
5th Year	
6th Year	

Race

African	
Colored	
Indian	
White	
Other	

If other, please specify…….

Faculty in which you are registered

Health Sciences	Arts and Design	Applied Sciences	Eng. &Built Env.	Man. Sciences	Acc. & Info.

(Please tick the appropriate box)

1. Do you know who is responsible for waste management at the Durban University of Technology?

YES ☐ NO ☐ NOT SURE ☐

If yes, please explain

……
……

2. Do you think waste management is effective at the DUT?

YES ☐ NO ☐ NOT SURE ☐

Comment:……
…… ……..

3. Is DUT a clean environment?

YES ☐ NO ☐ NOT SURE ☐

Explain……
……

4. Are there sufficient refuse bins located at the lecture venues?

YES ☐ NO ☐ NOT SURE ☐

Explain……
……

5. Are there sufficient refuse receptacles located at the eating areas on campus?

YES ☐ NO ☐ NOT SURE ☐

Explain……
……

6. Who are the main culprits when it comes to littering on campus?

STUDENTS ☐ STAFF ☐ VISITORS ☐ VENDORS ☐ EVERYBODY ☐

Explain

……
……

7. Do you notice that littering is more of a problem in some areas on campus than others?

Please help us by identifying those areas where litter is a problem

……
……

8. Do you know what recycling is?

YES ☐ NO ☐ NOT SURE ☐

If yes, please explain

……
……

9. Does DUT have a recycling programme that involves all its student community?

YES ☐ NO ☐ DON'T KNOW ☐

……
……

10. Do you know what the financial benefits of recycling are?

YES ☐ NO ☐

If yes, please explain

……
……

11. Do you know what the environmental benefits of recycling are?

YES ☐ NO ☐

If yes, please explain

……
……

12. How are the recycling bins used? **(Please select the correct answer/s)**

i) Various black bins with labels for different materials

ii) Different colored bins with labels for different materials i.e. bottles, plastics. Papers etc.

iii) Black bins of different sizes meant for different materials

13. Are the recycling bins sufficiently visible?

☐ YES ☐ NO

14. Do you know what purpose is served by the separation of waste?

YES ☐ NO ☐ NOT SURE ☐

If yes, please explain

……
……

15. Is recycling practiced at student's residences?

YES ☐ NO ☐ NOT SURE ☐

If yes, how often are these bins emptied

……
……

16 What eventually happens to waste if it is not recycled?

……
……

(Please make a circle around the appropriate answer)

17. I am concerned about littering on campus?

Strongly agree Agree Undecided Disagree Strongly Disagree

18. I think clean-up campaigns are effective?

Strongly agree Agree Undecided Disagree Strongly Disagree

19. Maintaining the campus clean is the responsibility of the students?

Strongly agree Agree Undecided Disagree Strongly Disagree

20. It is important to keep waste/refuse in the receptacles on campus.

Strongly agree Agree Undecided Disagree Strongly Disagree

21. There are adequate refuse receptacles on campus?

Strongly agree Agree Undecided Disagree Strongly Disagree

22. I think recycling has benefits.

Strongly agree Agree Undecided Disagree Strongly Disagree

23. I will gladly use recycled items.

Strongly agree Agree Undecided Disagree Strongly Disagree

24. Why do people litter on campus?

……
……

25. What are the benefits of using recycled items?

……
……

26. Who is supposed to participate in recycling activities on campus?

STUDENTS ☐ STAFF ☐ VENDORS ☐ VISITORS ☐ EVERYONE ☐

Please explain

……
……

27. Where do you dispose of your waste?

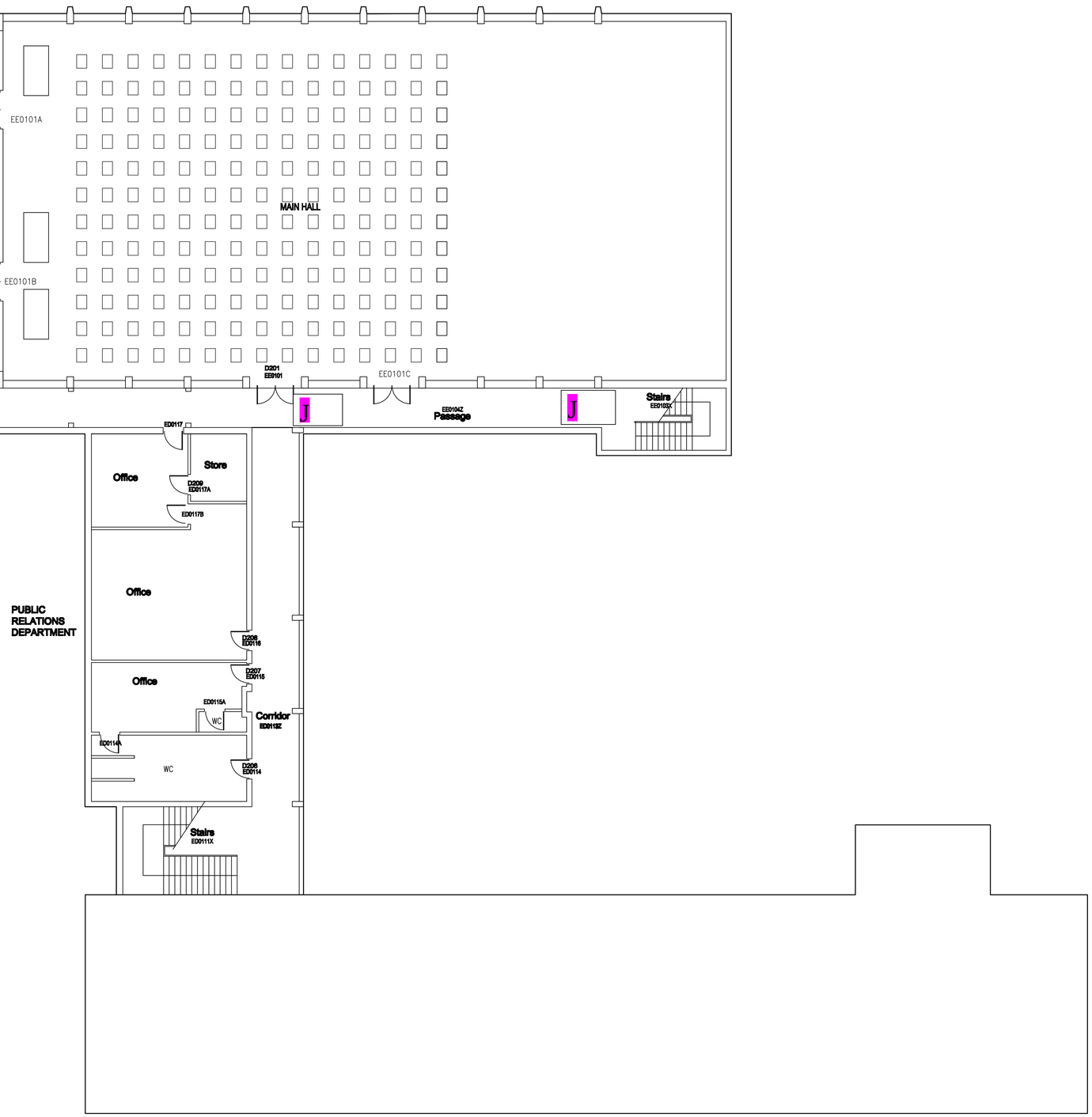
……
……

28. What items of waste may be recycled?

Paper ☐ Cans ☐ Polystyrene ☐ Glass ☐ Cardboard ☐

Other (Please specify)……

Your participation and contribution to this study is appreciated. Thank you.



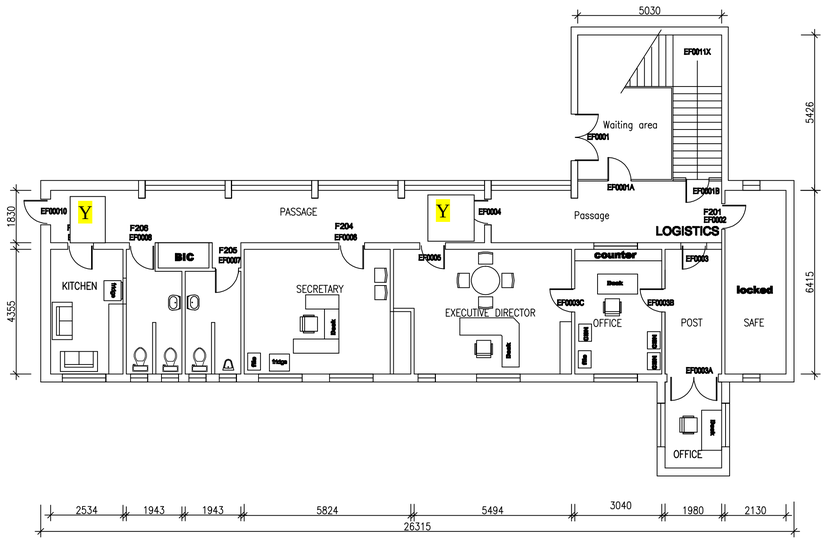
E BLOCK
GROUND FLOOR PLAN 1:100

J - cement bins

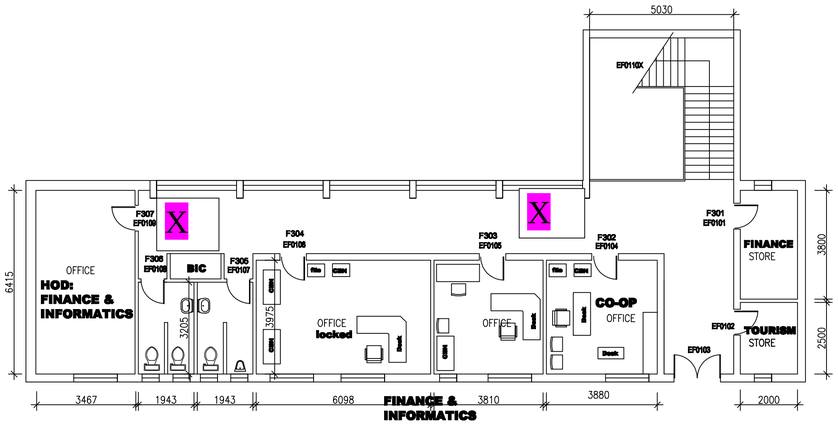
archipod
design and research business unit
of the depart ment of architecture
durban universit y of technology

E–Block Ground floor Plan

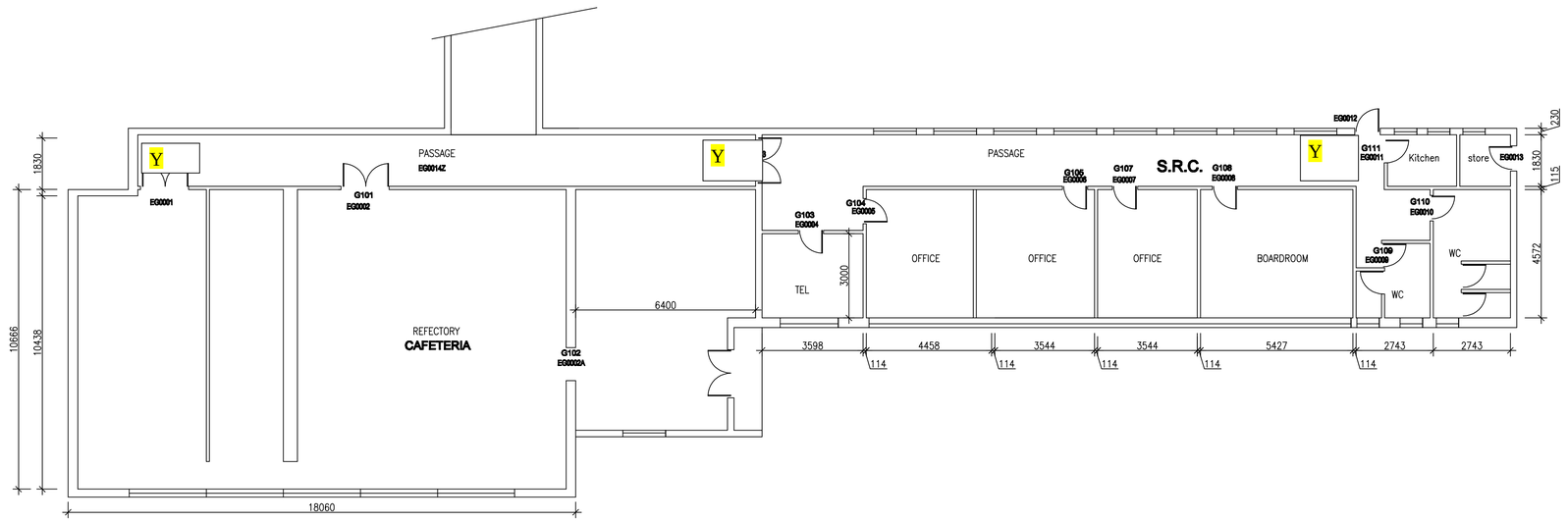
Date:	March 2008
Scale:	1:100
Campus:	Riverside Pmb
Drawn:	S.Majozi



F BLOCK
GROUND FLOOR PLAN 1:100



F BLOCK
FIRST FLOOR PLAN 1:100



G BLOCK
GROUND FLOOR PLAN 1:100

Y = cement bins

X = black rubber bins

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design and research business unit
of the depart ment of architecture
durban universit y of technology

G-F-Block Ground Floor Plan
F-Block First Floor Plan

Date:	May 2009
Scale:	1:100
Campus:	Riverside Pmb
Drawn:	S.Majozi

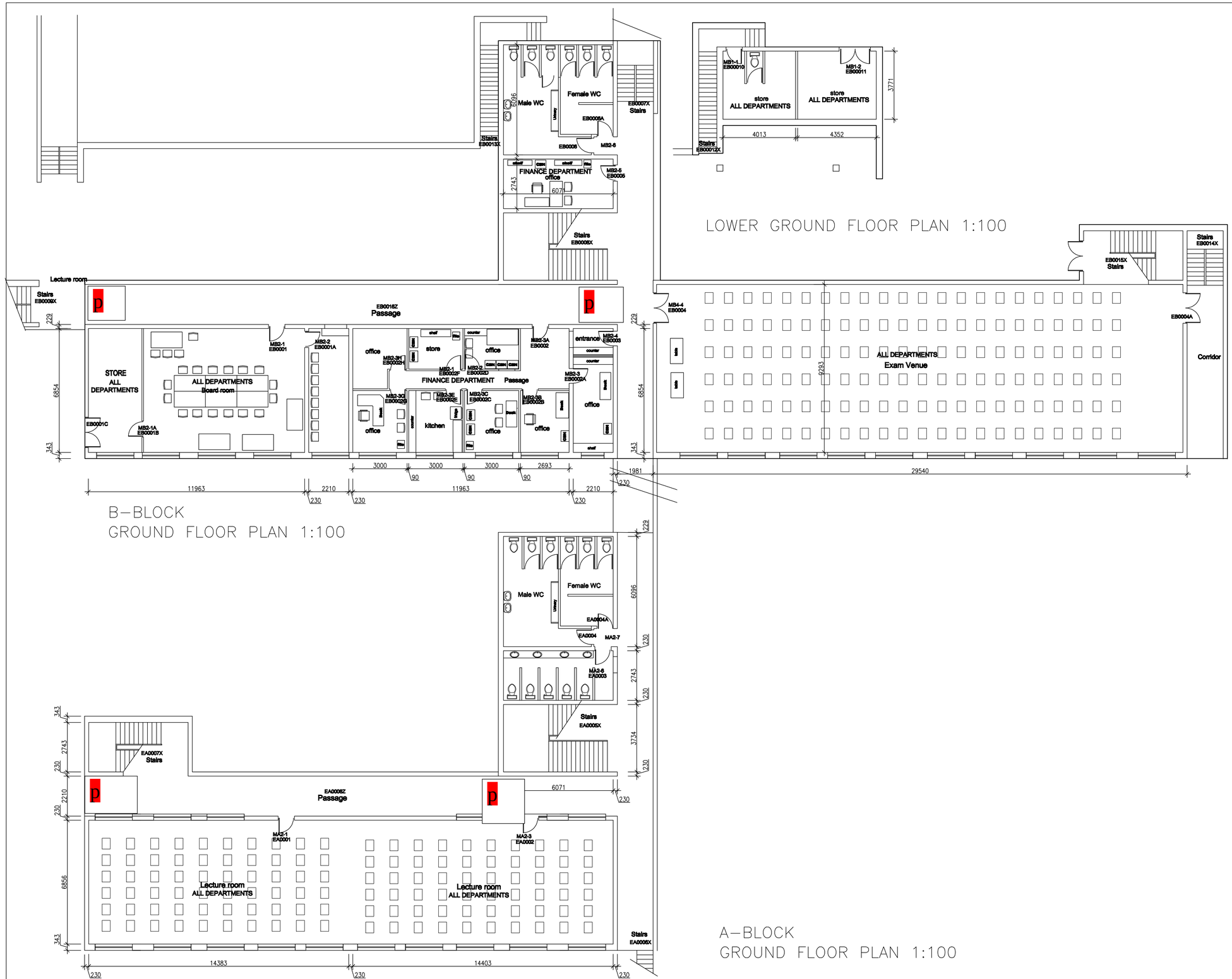
W = black rubber bins

archipod

design and research business unit of the depart ment of architecture durban universit y of technology

C-Block First floor Plan

Date:	May 2009
Scale:	1:100
Campus:	Riverside Pmb
Drawn:	S.Majozi



p = Cement bins

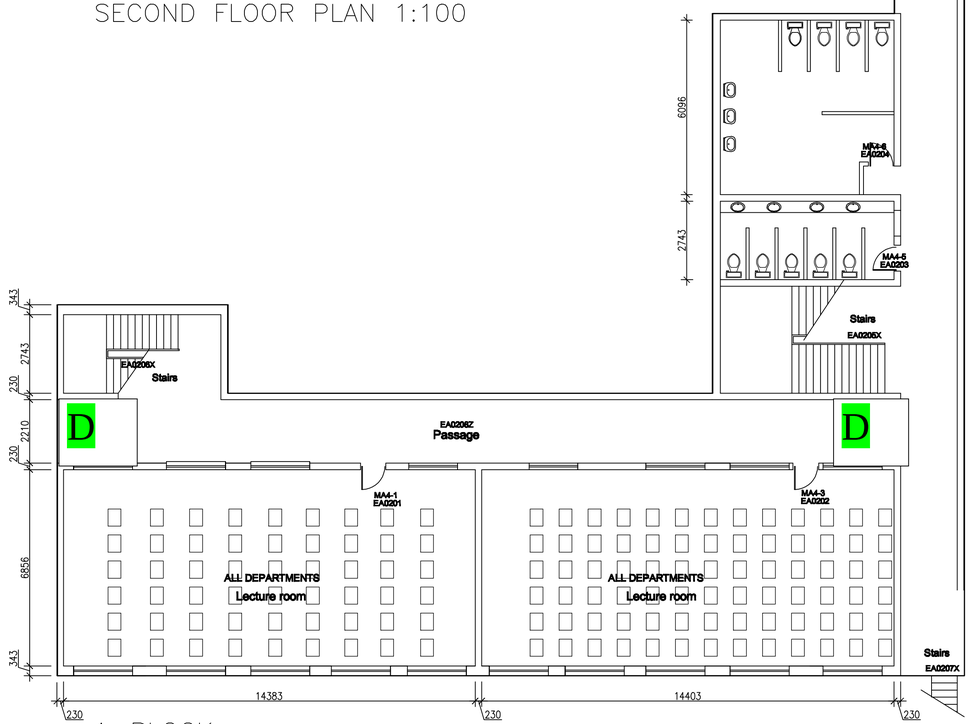
archipod

design and research business unit of the depart ment of architecture durban universit y of technology

A–B Block Ground floor Plan

Date:	May 2009
Scale:	1:100
Campus:	Riverside Pmb
Drawn:	S.Majozi

B–BLOCK
SECOND FLOOR PLAN 1:100



A–BLOCK
SECOND FLOOR PLAN 1:100

D = black rubber bins

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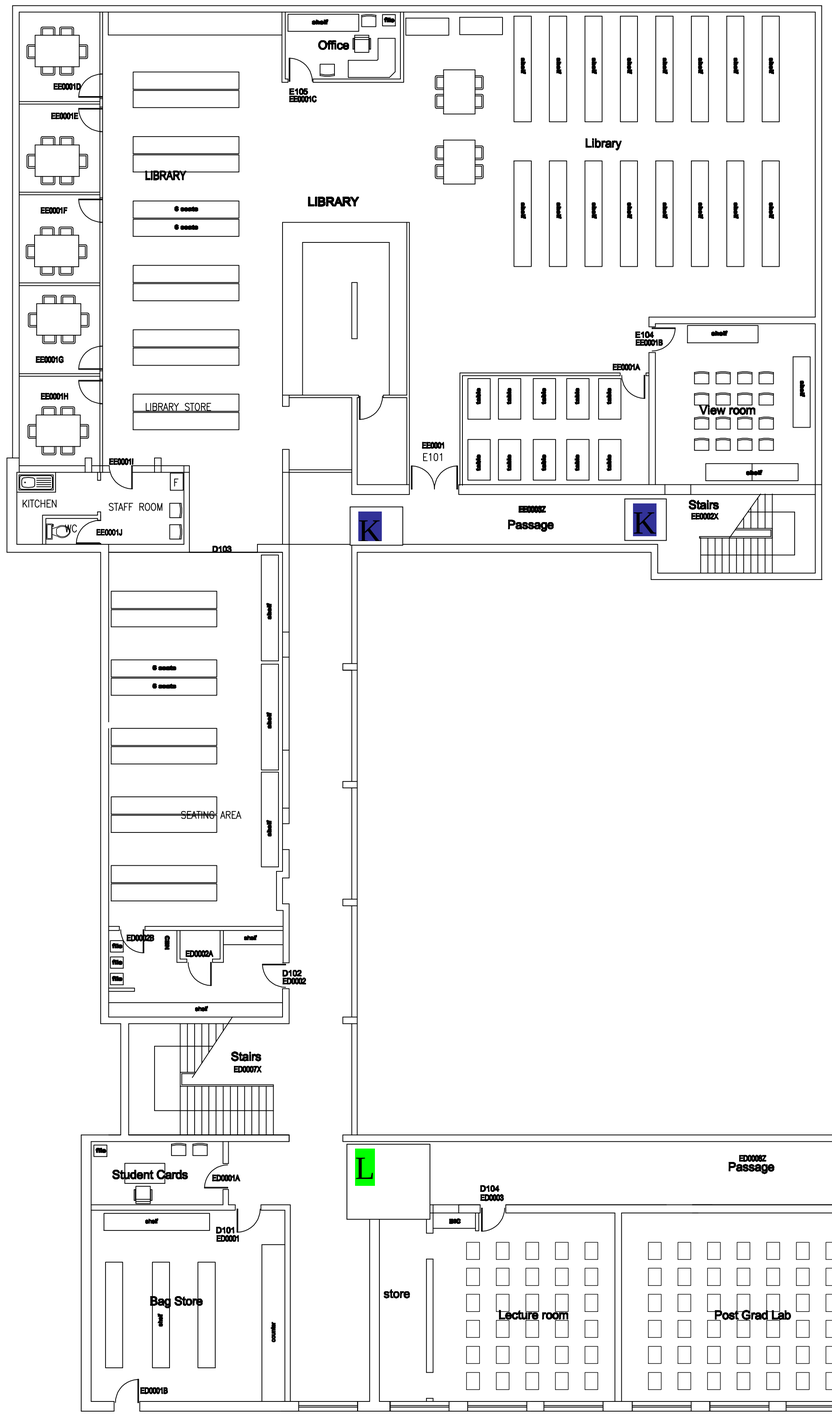
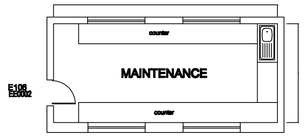
durban universit y of technology

A–B Block Second floor Plan

Date:	May 2009
Scale:	1:100
Campus:	Riverside Pmb
Drawn:	S.Majozi



D & E BLOCK
LOWER GROUND FLOOR PLAN 1:100



D & E BLOCK
FIRST FLOOR PLAN 1:100

L = cement bins

K = rubber black bins

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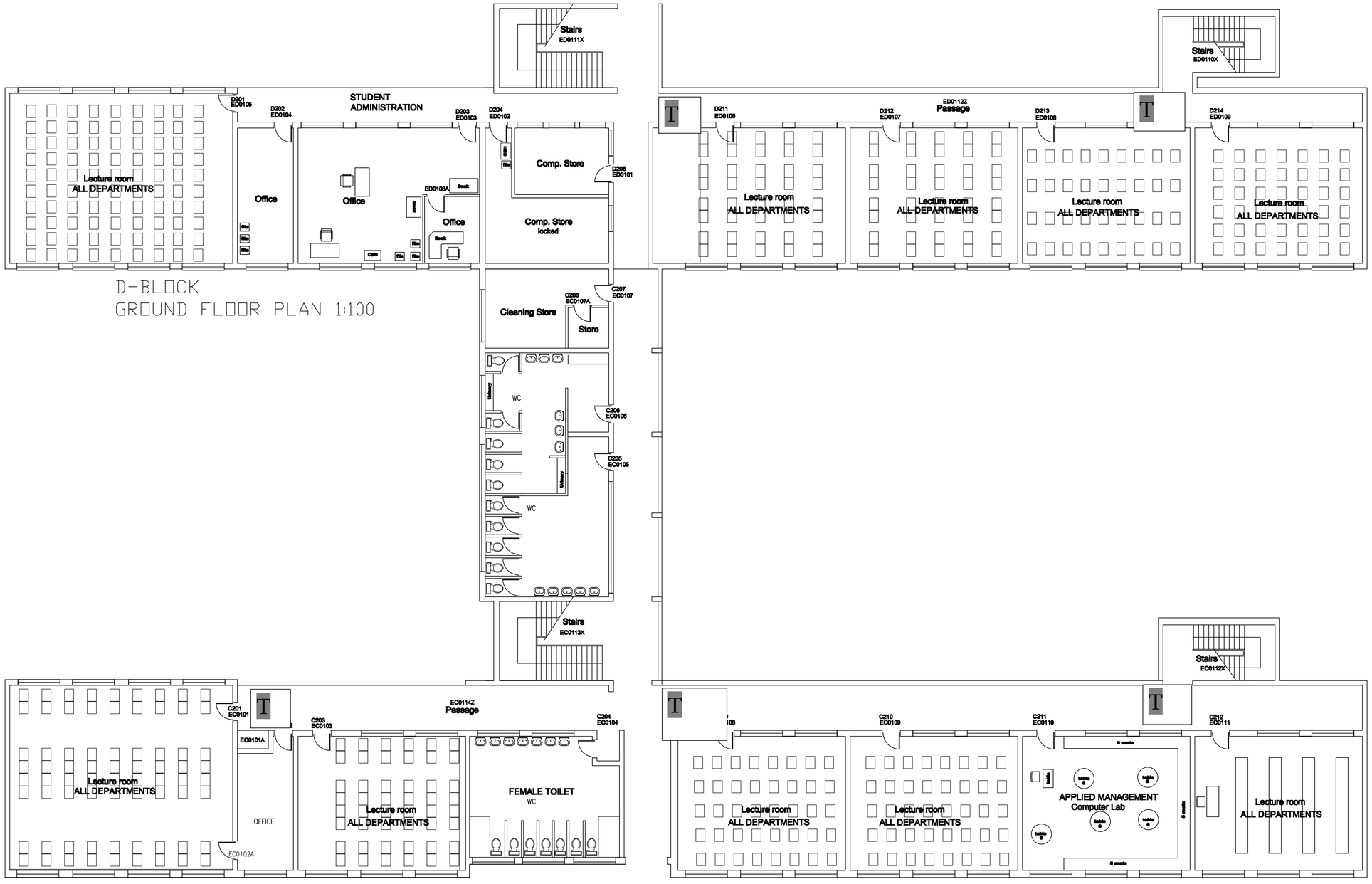
design and research business unit of the depart ment of architecture durban universit y of technology

D & E Block Lower Ground floor Plan

Date:	May 2009
Scale:	1:100
Campus:	Riverside Pmb
Drawn:	S.Majozi



D-BLOCK
GROUND FLOOR PLAN 1:100

C-BLOCK
GROUND FLOOR PLAN 1:100

T = cement bins

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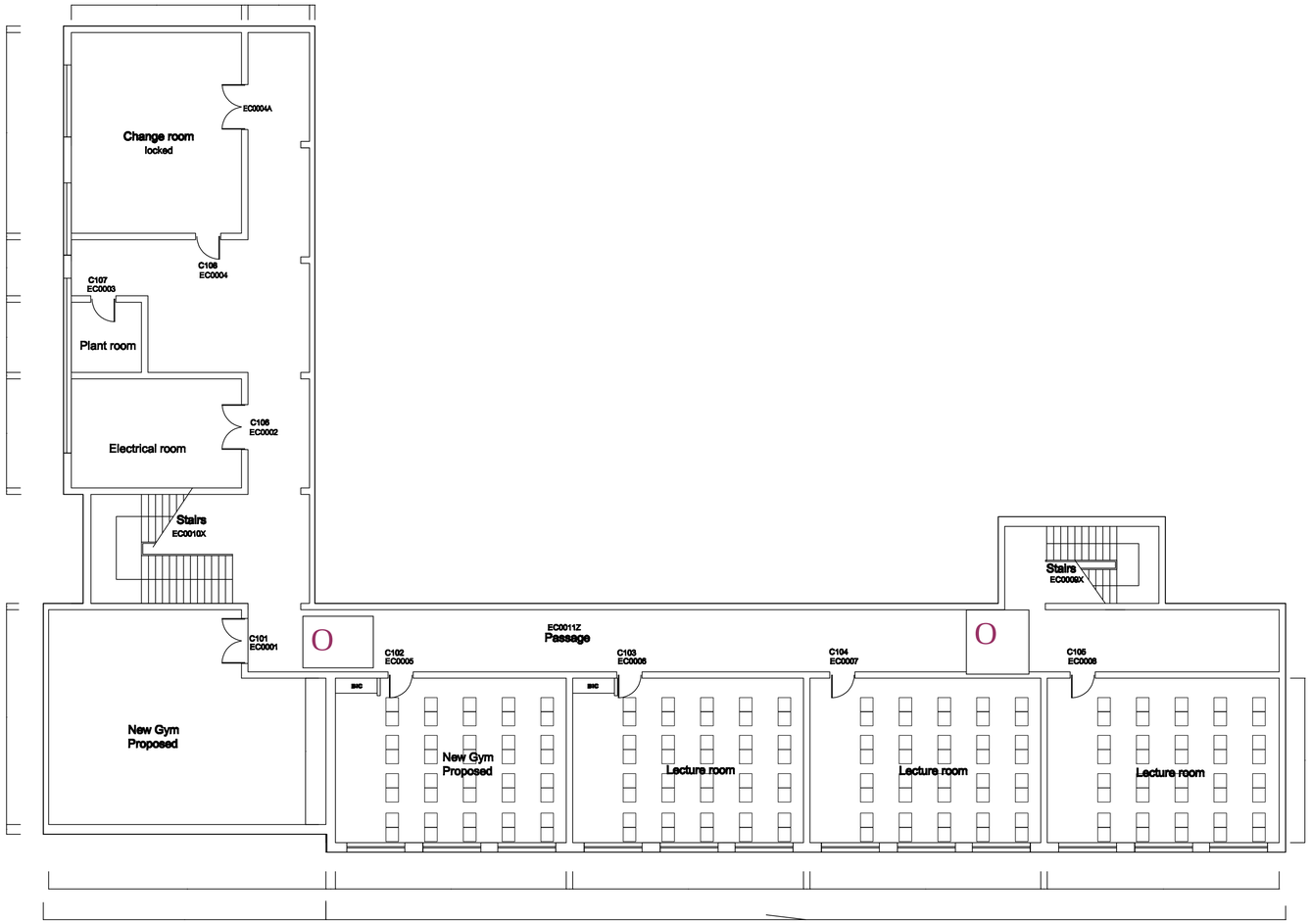
design and research business unit
of the depart ment of architecture
durban universit y of technology

C-Block Ground floor Plan

Date:	May 2009
Scale:	1:100
Campus:	Riverside Pmb
Drawn:	S.Majozi



C-BLOCK
LOWER GROUND FLOOR PLAN 1:100

O = cement bins

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design and research business unit
of the depart ment of architecture
durban universit y of technology

C-Block Lower Ground floor Plan

Date:	May 2009
Scale:	1:100
Campus:	Riverside Pmb
Drawn:	S.Majozi

X = black rubber bin

archipod

design and research business unit of the depart ment of architecture durban universit y of technology

A–B Block First Floor Plan

Date:	May 2009
Scale:	1:100
Campus:	Riverside Pmb
Drawn:	S.Majozi

LEARNING PROGRAMME

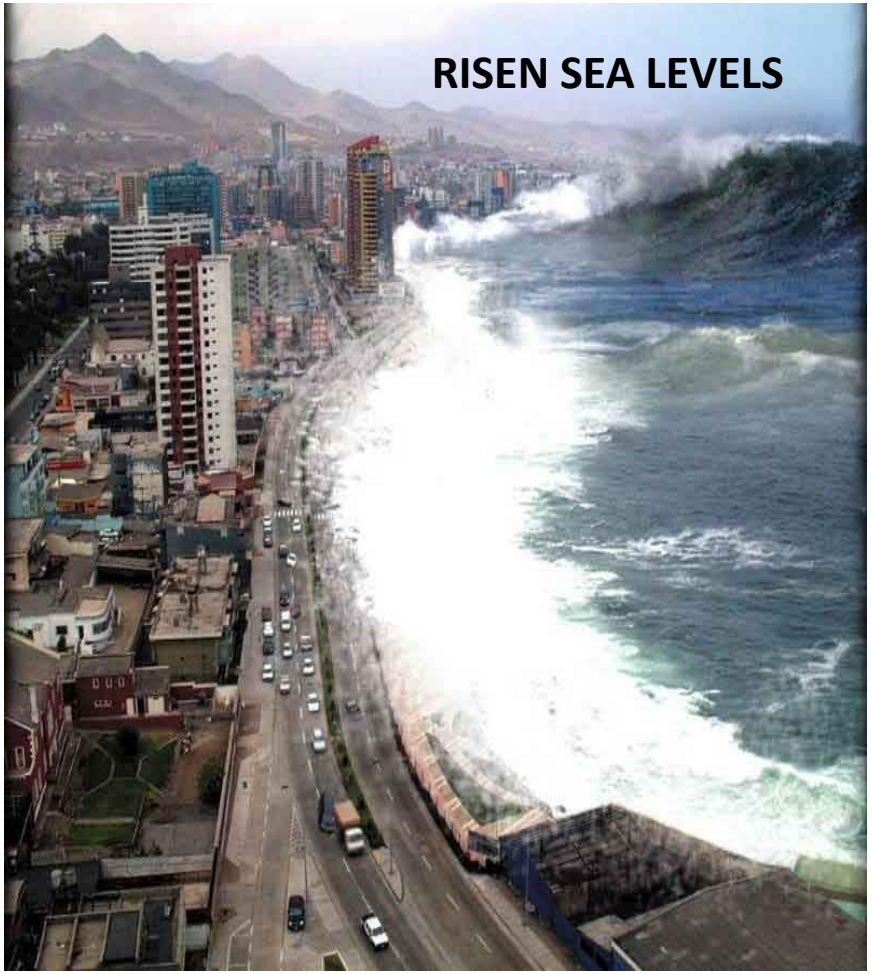
WASTE MANAGEMENT AT DUT

NATURAL DISASTERS

FLOODING

DROUGHT

NATURAL DISASTERS



CAUSES OF NATURAL DISASTERS

- **Human activities** (mainly POLLUTION) play a major role in the severity and frequency of disasters.
- A **natural disaster** (floods, veld fires, global warming etc.) occurs as a result of a disruption in the balance of the environment.
- The **human factor** raises the cost, in both property damage and loss of life.

CO_2 FOOT PRINT MUST FALL

GREENHOUSE GASES

- METHANE
- CO_2
- NITROUS OXIDES
- FLUORINATED GASES
- WATER VAPOUR

POLLUTION – IS IT **DOPE OR DOPEY**

MAKE YOUR CHOICE

WATER POLLUTION

LITTERING

- **All the litter that we see in our environment is there because of somebody's carelessness, laziness or irresponsible attitude.**
- **If everybody was prepared to either put their rubbish in a bin or take it home with them there would be no litter anywhere.**
- **It really is that simple**

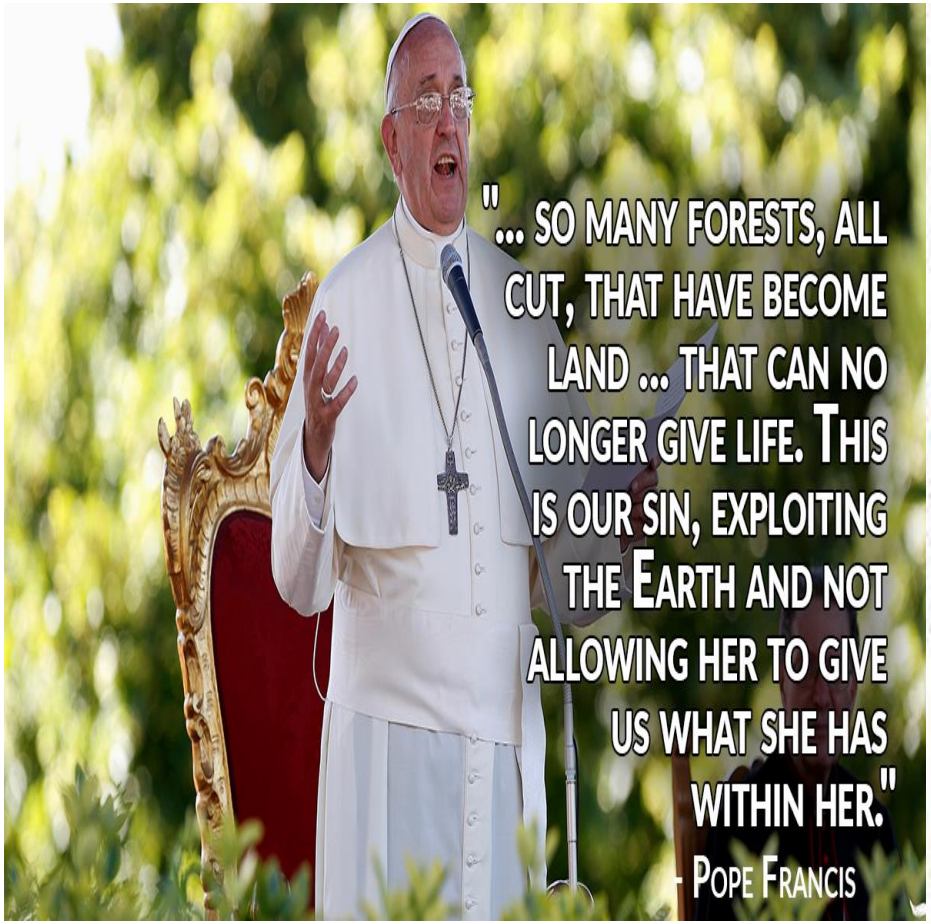

How can we ensure that our beautiful community is not polluted?
eSchooltoday.com

INSTEAD OF LITTERING

OUR PLANET IS OUR RESPONSIBILITY

KEEP IT CLEAN AND SAFE

- **EVERYTIME RECYCLING IS PRACTICESD ENSURE THAT DIFFERENT WASTES ARE KEPT SEPERATELY**


"... SO MANY FORESTS, ALL CUT, THAT HAVE BECOME LAND ... THAT CAN NO LONGER GIVE LIFE. THIS IS OUR SIN, EXPLOITING THE EARTH AND NOT ALLOWING HER TO GIVE US WHAT SHE HAS WITHIN HER."
- POPE FRANCIS


ANIMALS & PLANTS FLEEING CLIMATE CHANGE ARE MIGRATING TOWARD THE POLES AT 20 CM PER HOUR.
Dad, when will we get to Canada?
This is Canada.

REMEMBER THERE'S NO PLANET 'B'

REUSE AND RECYCLING

Reuse

- To reuse is to use an item again after it has been used.
- This includes **conventional reuse** where the item is used again for the same function, and **creative reuse** where it is used for a different function.
- By taking useful products and exchanging them, without reprocessing, reuse help save time, money, energy, and resources.

Recycling

- Recycling is a process to convert waste materials into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution and water pollution by reducing the need for "conventional" waste disposal and lower greenhouse gas emissions as compared to plastic production.
- Recycling is a key component of modern waste reduction

BENEFITS OF RECYCLING

ENVIRONMENTAL

- No matter how safe and efficient our landfills are being billed to be, the possibility of dangerous chemicals coming from the solid waste deposited in these landfills, contaminating underground water supply is always present.
- Combustion or incineration of our solid waste is effective and energy-generating, but we pay the price in increased air pollution.
- Recycling helps conserve limited resources – Throwing away a single aluminium can, versus recycling it, is like pouring out thirteen litres of petrol.
- Recycling just 35 percent of our trash reduces toxic emissions equivalent to taking 36 million cars off the road

FINANCIAL

- There is money in recycling. In the level of the individual, one of the benefits of recycling is financial income. There are a lot of things lying around that we no longer want or need that might just end up in a dumpsite somewhere, that we can recycle and earn money from.
- Cell phones, ink cartridges, etc.
- There is also the financial benefit for the communities who recycle in that there will be reduced costs of waste disposal or recycling.
- Aluminium cans are the most valuable item in your bin. Aluminium can recycling helps fund the entire kerbside collection.
- It's the only packaging material that more than covers the cost of collection and reprocessing for itself.

STRATEGIES TO DEAL WITH WASTE MANAGEMENT ISSUES AT DUT

KEEP IT IN A BIN

KEEP IT TIDY AND CLEAN

STRATEGIES TO DEAL WITH WASTE MANAGEMENT ISSUES AT DUT

STRATEGIES TO DEAL WITH WASTE MANAGEMENT ISSUES AT DUT

Joining environmental clubs

STRATEGIES TO DEAL WITH WASTE MANAGEMENT ISSUES AT DUT

Taking part in greening projects

CHAT TO OTHER STUDENTS ABOUT

ENVIRONMENTAL ISSUES & WASTE MANAGEMENT

IN PARTICULAR