

**SOLID WASTE MANAGEMENT IN DEVELOPING
URBAN AREAS: CASE STUDY OF LWANDLE
TOWNSHIP**



*Thesis presented in partial fulfilment of the requirements for the degree of Master of Science
at the University of Stellenbosch*

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Declaration

I, the undersigned, hereby declare that the work contained in this thesis is my own original work and that I have not previously in its entirety or in part submitted it at any university for a degree.

Signature:

A handwritten signature in black ink, appearing to read 'J. P. ...', written over a horizontal line.

Date: 23 January 2004

ABSTRACT

The subject of waste management is one that evokes a variety of debates due to the overwhelming implications on the environment and on health that are associated with the management of waste. In developing urban areas associated with informal settlements, environmental problems emanating from household solid waste management predicaments such as illegal dumping, littering and overfilling of skips have become a permanent feature. This is also the case in Lwandle a developing township in Helderberg Municipality, Western Cape.

This study looks into the waste management system in Lwandle with the aim to investigate institutional settings, related socio-economic factors and resultant community perceptions, and avenues for the use of environmental education and community participation. The results show waste collection to be the responsibility of the Helderberg Municipality, but the collection operation is undertaken by a private contractor. The nature of waste collection under these arrangements is mainly determined by the nature of housing and associated accessibility. Consequently, three main methods of waste collection are used: kerbside collection; communal collection where there is use of bins and communal collection where there is use of skips. These have varying efficiency among the nine housing areas.

Socioeconomic conditions, which were marked by a high level of unemployment and low incomes, determine societal attitudes. These underpin finer variations and detailed conditions of waste collection. These, in turn, establish the framework for suitable environmental education and community participation. The latter was found to be minimal.

Thus, a holistic approach to the improvement of waste management that first acknowledges inherent broader societal problems such as housing and unemployment is proposed as part of the recommendations. This approach then concentrates on finer aspects such as contracts for waste collection, aspects of waste collection dependent on waste stream nature of housing areas, appropriate environmental education and community participation.

OPSOMMING

Afvalbestuur is 'n onderwerp wat 'n verskeidenheid van debatte uitlok vanweë die geweldige implikasies vir die omgewing en vir gesondheid wat met afvalbestuur geassosieer word. In ontwikkelende stedelike gebiede wat met informele behuising geassosieer word, het omgewingsprobleme soos omwettige storting, die strooi van rommel en oorvol stortbakke wat verband hou met die hantering van vaste afval uit huise 'n permanente kenmerk geword. Dit is ook die geval by Lwandle, 'n ontwikkelende dorpsgebied te Helderberg, in die Wes-Kaap.

Hierdie studie beskou die afvalbestuursistiem in Lwandle met die doel om institusionele omgewings, verwante sosio-ekonomiese faktore en die persepsies van die gemeenskap wat daaruit ontwikkel, asook moontlikhede vir die gebruik van omgewingsopvoeding en gemeenskapsbetrokkenheid, te ondersoek. Die resultate van die ondersoek toon dat die Helderberg Munisipaliteit verantwoordelik is vir die insameling van afval, maar dat die insameling deur 'n private kontrakteur uitgevoer word. Onder sulke omstandighede word die aard van afvalinsameling hoofsaaklik deur die aard van die behuising en die verwante toeganklikheid bepaal. Daarvolgens is daar drie hoofmetodes van insameling, wat deur verskillende grade van effektiwiteit gekenmerk word, vir die nege behuisingsgebiede: sypaadjie versameling; kommunale versameling in dromme; en kommunale versameling in stortbakke.

Sosio-ekonomiese omstandighede, wat gekenmerk word deur 'n hoë mate van werkloosheid en lae inkomstes, bepaal gemeenskapshoudings wat deur die verskillende maniere van afvalverwydering tot stand kom en ondersteun fyner variasies en gedetailleerde omstandighede van afvalinsameling. Dit bepaal weer die raamwerk vir gepaste omgewingsopvoeding en die deelname van die gemeenskap. Die studie het getoon dat laasgenoemde minimaal is.

'n Holistiese benadering tot die verbetering van afvalbestuur, wat eerstens inherente breër gemeenskapsprobleme soos behuising en werkloosheid erken, word dus as deel van die

aanbevelings voorgestel. Hierdie benadering konsentreer vervolgens op die fynere aspekte, soos kontrakte vir afvalinsameling, aspekte van afvalinsameling, gepaste omgewingsopvoeding en gemeenskapsdeelname.

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CHAPTER ONE: SOLID WASTE MANAGEMENT: CONCERNS, ATTRIBUTES AND RESEARCH IMPLICATIONS

“In an age of mushrooming technology and scientific innovation it is ironic that one of man’s oldest problems is becoming increasingly acute. The collection and disposal of modern waste products is a monumental task.”

(Pavoni, Heeler & Hagerity, 1975:1).

1.1 CONTEXTUAL FRAMEWORK: SOLID WASTE AS AN ENVIRONMENTAL CONCERN

At a time of escalating environmental concern, the problem of waste has come to occupy a central position in many discussions and programmes dealing with environmental problems. Environmental problems reveal facts about human activities, their effects on the environment and their impacts on health, nature and values. More importantly, environmental problems would not exist if human beings did not act the way they do, did not have value standards pertaining to the environment, and if nature could produce or process anything (De Groot & Stevers, 1993: 28). This is particularly true of environmental problems associated with waste. Like most other environmental problems, the problem of waste can be said to be a *necessary evil* emanating from almost all human activities: production, distribution, consumption and even leisure (Conserva, 1997; and Buekenes, 1999). This has become more apparent because, though being an old problem dating back to the advent of communities, it is essentially a problem of modern society (Marsh & Grossa, 1996). It is a direct response to population growth and rising consumerism, industrialisation, and the rapid growth of cities (Kirov, 1975).

Waste as a part of everyday activities, has varying effects on the environment and often leads to pollution, with various constituents and permutations, as indicated in the following definitions. According to the Palmer Development Group (1996:9) waste is “...*an undesirable or superfluous by-product, emission residue or remainder of any activity, gaseous, liquid or solid, or any combination thereof, originating from any residential commercial or industrial area...*”.

Though the environment can assimilate and render the waste harmless, such assimilative capacity may be exceeded and the waste then becomes an environmental nuisance, therefore posing an environmental threat that has adverse health and aesthetic implications (Wilson, 1981). This in turn leads to the deterioration of the environment as a provider of amenities.

To alleviate the negative impacts of waste, and due to the realisation that “...*the whim of individuals can not be depended upon in matters pertaining to the public health, comfort, and aesthetic elements...*” (Ehlers & Steel, 1950: 124), waste management has evolved as an important field of public concern and local government responsibility.

1.1.1 Solid waste management processes

Waste management embodies: avoidance of waste production; reduction of the waste that cannot be avoided; and collection and disposal of waste (residue) in an environmentally acceptable way (Department of Water Affairs and Forestry & CSIR, 1991; Miller, 1996). Formally it can be defined as the purposeful, systematic control and management of waste that involves: generation, on-site storage, collection, transfer and transportation. Then there is processing (recovery) and disposal, all with the aim to minimise costs and impacts (Integrated Waste Management Task Group (IWMTG), 1993). These different functional elements of waste management outlined in the definitions are illustrated in Figure 1.1.

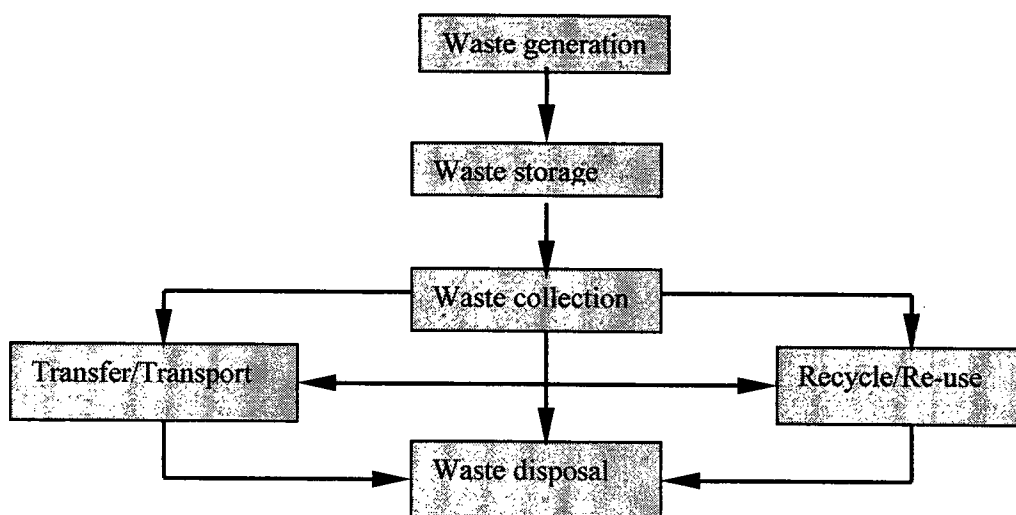


Figure 1.1: Interrelationship between functional elements in a solid waste management system Source: Tchobanoglous, Theisen & Vigil (1993:12)

Waste management is thus a multi-disciplinary process requiring input from a wide field of expertise relating to economic, social, political, biotic and other environmental matters (Lombard, Botha & Rabie, 1992; Wates, & Crosby, 1996). Inevitably waste management necessitates realisation of local conditions because such conditions determine the characteristics of the waste and associated problems in the handling and management thereof (Wilson, 1981). Based on the characteristics of waste, a variety of waste types can be discerned. These types or classes are often primarily a matter of distinguishing between the three states of matter or physical form: hence, there is solid, liquid and gaseous waste (Oditia & Olorunfemi, 1998).

However, classification can also be according to the nature of the receiving medium (air, water or land), according to its detailed composition and properties (e.g. hazardous and non-hazardous waste), or according to source. Thus, there is municipal waste, office waste, industrial waste, agricultural waste, and rural and urban household waste (Cargo, 1978). Approaches to waste management are therefore inherently determined by the nature or type of waste generated.

It is against the foregoing background that this thesis looks into the problem of household solid waste in Third World urban areas, specifically those associated with informal settlements. As such, it is a detailed investigation of the waste management system in the township of Lwandle in the Helderberg Municipality of the Cape Metropolitan Area, and focuses specifically on the collection of household solid waste.

The remainder of this section aims to review literature on waste management further and to contextualise the subject according to conditions in South Africa and in the study area. To this end, the following subsection is a general discussion on environmental and health impacts of non-collection of household solid waste. This is aimed at highlighting the importance and need for waste management. This is then followed by a review of solid waste collection practices in developing communities both worldwide and in South Africa. The study area is then introduced by briefly examining relevant research initiatives on the subject of waste management. Then, a description of the study area is provided. This is followed by a review of study aims and research methodology and, finally, the research agenda is provided.

1.1.2 Environmental and health implications of household solid waste

Proper waste management is a key to upgrading environmental and health quality (Hafen, 1972). This is because the environmental and health impacts emanating from non-collection, improper collection and deficient approaches to waste collection and disposal are serious, contributing to land, air and water pollution (Local Government Management Board, 1994). Non-collection and improper collection impinge directly on communities within developing urban areas.

The most serious health risk associated with improper waste collection is that resulting from blockage of the storm water system. This results in stagnant water that may be contaminated, and encourages the breeding of mosquitoes and flies. This poses the threat of diseases such as malaria and diarrhoea (Palmer Development Group, 1996). In this vein, indirect ramifications associated with waste management include significant infections related to diarrhoea and gastroenteritis in children in South Africa. These affect about 5000 and 1500 children yearly respectively (Ramphela, 1990). Furthermore, worldwide four million children die from diarrhoeal disease because of contaminated water every year (Hardoy, Mitlin, & Satterthwaite, 1992).

Other direct impacts of uncollected waste and improper collection; include physical injury to children, air pollution, general flooding, land damage, and aesthetic problems relating to sight and smell (Palmer Development Group, 1996). In addition, there is the potential health hazard to humans associated with the putrefying contents of bottles and tins, and pathogenic organisms attached to discarded hypodermic needles (Armitage *et.al.*, 1998). Other environmental impacts of non-collection are predominantly linked to the impacts of litter. They include the adverse effect on water quality associated with growth of weeds, decay of litter and reduced availability of oxygen for aquatic organisms due to eutrophication (Palmer Development Group, 1996; Armitage *et.al.*, 1998). The aforementioned environmental and health implications of household solid waste are more pronounced in urban areas and a discussion in this regard follows.

1.1.3 Urban solid waste management systems

The study focuses on waste collection, particularly with reference to urban areas in

developing communities, because the study area may generally be classified as a typical developing urban area, with more than fifty percent of its housing structures being informal. It is also noted that the socio-economic conditions in the study area epitomise conditions in urban areas of developing countries. As such reference to waste management in developing countries serves to provide a framework for a review of the problem. However, in an effort to provide a holistic view, a brief discussion is devoted to waste collection in developed countries.

1.1.3.1 Waste collection in developed countries

In developed countries, collection is more professionalised than in developing countries, and services generally tend to be universal, with hardly any section of a city being left completely unserved. This is because the tax-paying public demands and pays for services ensuring a clean and healthy environment. Most collection is performed by local government, or by firms under contract to the local government or to business and/ or industrial waste producers. Hence, in almost all instances, some form of collection reaches all or most of the population at some level of effectiveness. The use of a "communal collection point" in industrialised countries is predominantly for purposes of waste recovery, whereby these points serve as storage points for recyclable material (UNEP International Environmental Technology Centre, 1996).

1.1.3.2 Waste collection in developing countries

Developing countries, on the other hand, are often characterised by chronic and acute lack of adequate services, particularly in poor and or marginal areas (UNEP International Environmental Technology Centre, 1996). This is because they lack the tax-base to pay for such services. Such areas often result from rapid urbanisation through rural to urban migration and are characterised by poor squatter settlements or neighbourhoods with unpaved or impassable streets (Omara-Ojungu, 1992). As provision of services, including waste collection, to such areas is almost virtually impossible, rampant illegal dumping and littering occur. It is estimated that approximately thirty to fifty percent of the solid waste in many Third World urban centres is uncollected (Hardoy, Mitlin, & Satterthwaite, 1992). This is often associated with fire hazards, bad smells, clogging of drainage channels and subsequent overflowing, pollution and unpleasant health conditions. Moreover, public health, sanitation

and (lack of) waste collection usually have a direct link, because of the presence of relatively large volumes of animal and human faecal matter in the waste. In addition, it is estimated that over 600 million citizens in Latin America, Africa and Asia live in such life-and health-threatening conditions (Hardoy, Mitlin, & Satterthwaite, 1992).

Attempts to deal with these problems often involve employment of community waste collection approaches that make use of communal bins, hence communal waste collection. Consequently, the use of community participation and environmental education is advocated to foster improvement in this regard. In addition, alternative waste management systems that aim at addressing other socio-economic predicaments common in such areas have been developed. The objective of the latter is to look beyond (improved) service provision, to upgrading lives in general.

1.1.4 Communal solid waste collection, participation and environmental education

The process of domestic waste collection has evolved along with the development of modern infrastructure and includes the consideration of collection vehicle systems; manpower; collection routes; public health by-laws and regulations; and aesthetics (Lombard, Botha, & Rabie, 1992). Domestic waste collection in developing urban areas is therefore inherently handicapped because some or all of these considerations are likely to be non-existent. In examining waste management in developing urban areas mechanisms to overcome these inherent limitations, *inter alia* communal solid waste collection, community participation and environmental education, are therefore invariably also examined. Moreover, these are considered a significant part of the practice of waste collection in such areas.

1.1.4.1 The practice of waste collection

Communal solid waste collection facilities are often employed to provide waste services to areas that are not easily accessible to motor vehicles. It entails individuals bringing their household waste directly to the collection point, usually a container or building that can be accessed on foot (UNEP International Environmental Technology Center, 1996). Waste is collected from this communal on-site storage container and transported to be disposed of. However, this approach to household solid waste service provision is often fraught with

disadvantages that may render it undesirable. Disadvantages include the collection of water in the container, thus adding to the weight of the waste, and deposition of dangerous materials, or any other form of waste near or in the container. In addition, the responsible authorities pay little attention to these facilities. Besides these, communal waste facilities are often associated with street and sidewalk dumping and scattering of waste all around the container. The former is due to the reluctance of users to walk to the container, while the latter is because waste is thrown from a distance (Venkateswaran, 1994; Thapa, 1998). Therefore, use of these facilities (communal collection containers) necessitates recognition of the potential for conflict between the physical demands of such containers, public convenience in disposal, and the standards required in maintaining cleanliness. Simultaneously, attention should be paid to the control of waste pickers, odours, disease vectors, and animals. Requisite elements to address these problems include frequent collection, a commitment to cleaning up around the container, and community co-operation to ensure proper use of the container. In essence, there is great dependence on community involvement, and there might be a need for environmental education (Odita & Olorunfemi, 1998).

1.1.4.2 Community participation

The understanding of and acceptance by the majority of the community of a communal collection system inherently is one of the determining factors in the success of such a waste collection system. Hence, community participation during planning and implementation of a communal waste collection system is needed (Doan, 1998). Literature on the subject of community participation in relation to environmental management is extensive (Department of Environmental Affairs, 1992; Sowman, 1994; Ngobese & Cock, 1995; Choguil 1996; Knoll, 1997).

In most cases, the process of participation is underpinned by a number of principles. These include citizen's democratic role (since participation is regarded as an integral part of democracy); public involvement (due to the invaluable component of local knowledge); and decentralising of the decision making process (in order to foster a sense of ownership) (Kent, 1981; Gericke & Sullivan, 1994; Swanepoel, 1997).

A suitable public participation process may thus be adopted to conform to objectives and conditions at hand. The use of public participation in household solid waste management has been widely encouraged because it serves to minimise the gap between waste producers and waste managers (United States Environmental Protection Agency (NEPA), 1989). In securing public participation, NGOs, particularly those knowledgeable about sociopolitical conditions in the area, may be instrumental (Daiz, 1998). Moreover, it encourages waste producers to take responsibility for keeping their neighbourhoods clean and to become part of the waste management process (Hasan, 1998).

1.1.4.3 Environmental education for successful communal collection

Environmental education, on the other hand, serves to elucidate the reasons for maintaining a proper waste collection and storage system, and thus clean surroundings. A number of definitions and aims of environmental education (EE) are given in the literature (Martin, 1993, Sutherland & Ham, 1992, Lotz, 1996). A definition that encompasses and concisely highlights envisaged achievements in waste management in the context of this thesis is that given by O'Donoghue (1993: 29), that *"...environmental education encompasses an ongoing learning process leading to the development of a population that is aware of, and concerned about the total human environment and its associated problems. The population then develops the knowledge, attitudes, motivations, commitment and skills to work both individually and together towards solutions of current problems and the prevention of new ones..."*.

Environmental education thus should invariably involve the implementation of community participation (IMIESA, 1996). It is through environmental education that a desired awareness of waste and the environment may be attained. An increasing number of waste management workshops, seminars and conferences in Southern Africa are concluding that there is a need for education and awareness, and that this should take into account the following (Stevens, 1994: 5):

- the present level of residents' knowledge and understanding of waste procedures upon which education could be based;
- the information which would be important for such campaigns;

- the desired attitude and behavioural change;
- the target population for educational campaigns; and
- the basis on which these campaigns could be launched.

Environmental education and community participation may also be employed in waste minimisation, recycling, composting and in job creation through services rendered by community members (United States Environmental Protection Agency 1998). The latter is looked at in greater detail in the following subsection dealing with the development of alternative approaches to waste management.

1.2 WASTE MANAGEMENT IN DEVELOPING URBAN AREAS OF SOUTH AFRICA

Waste management problems in South African townships are similar to those of many developing countries. Lack of waste collection services rank high among the many issues of the problem (Lombard, 1996). For example, problems of municipal waste management in Bangladesh, identified by Hasan (1998) and found to be similar to those in South African informal settlements, include lack of community involvement and negative attitudes towards taking responsibility in waste management. In an effort to undertake a holistic review of the problems of waste management in urban residential areas, literature on waste management in both formal and informal areas is examined.

1.2.1 Waste management in formal areas

The variation in waste management between formal areas and informal areas in South Africa is similar to the general variation between waste collection in developing and developed countries. In most cases, collection in the formal areas is efficient, primarily due to the nature of housing where there are well-defined streets allowing provision of waste collection services. In most cases the kind of household waste collection used is kerbside or door-to-door collection. There is regular (at least once per week) routine collection, from each waste generator within a given area (Institute of Waste Management (IWM), 1997). This is generally sufficient to maintain a clean and healthy environment. However, this collection

may be incomplete in that, depending on local by-laws, only certain sizes and types of containers or bags may be collected, resulting in other types of refuse such as ash and/ or garden waste being excluded. Such waste may end up in the environment unless removed by another or duplicate system. Another reason that may lead to inefficiency in collection is rent boycotts, as is the case in some townships (IWM, 1997). Apart from these specific problems, there are cases where there are backlogs in provision of basic infrastructure. In this context, waste management is often given a very low priority in the hierarchy of needs perceived by developers, resulting in it being under-resourced (Lombard, 1990).

1.2.2 Waste management in informal areas

In informal settlements, the problem of solid waste is associated with a lack of and rudimentary services and amenities, the prime example being proper housing and roads (Ninham Shand, 1993; Oelofse & Dodson, 1997). For the reader to grasp the concept of waste management in informal settlements, it is deemed necessary to give a brief overview of the nature of informal settlements in the context of South Africa.

1.2.2.1 Informal settlements in South Africa

Informal settlements are defined as dense settlements comprising of communities housed in self constructed shelters under conditions of informal or traditional land tenure, or can broadly be described as housing established unconventionally (Hart, 1992; McCarthy & Hidson, 1994).

Such settlements in most cases are characterised by:

- lack of basic infrastructure and services for collection and safe disposal of solid and liquid waste, leading to the presence of pathogens in the human environment;
- overcrowded and cramped living conditions, increasing the risk of transmission of airborne infections and accidents; and
- insufficient water supply.

Informal settlements can be categorised into the following types (Hart, 1992):

1. Squatting, which entails the illegally occupying of land or dwellings.

2. Spontaneous settlements, where residents are often entitled to the particular land (for example freestanding settlement on tribal land) and which may be subdivided into backyard shacks and freestanding shelters.
3. Site-and-service schemes, which offer formal tenure but are based on processes of informal housing that are meant to be upgraded to more formal dwellings.
4. Outbuildings, which include housing constructed of conventional material but which are used unconventionally and include garages, sheds or backyard rooms.

The establishment of informal settlements in developing countries is a manifestation of inadequate housing resulting from rapid population growth and rural-urban migration (Mathee & Von Schirnding, 1996; Malusi & Maharaj, 1996). However, in South Africa informal settlements have originated due to a number of other factors. These include the abandonment of the provision of rented accommodation to Africans in 1978; the inability of black municipalities to provide housing; and the repeal of the influx control and pass laws in 1986, leading to vastly accelerated urban migration from former homelands (Mashabela, 1990). Moreover, the rapid growth of informal settlements in South Africa has been due to limited finance to afford formal housing even if it could be provided. Therefore, establishment of informal dwelling structures remains the most common (and affordable) means for poor people to acquire shelter (Ballantyne & Oelofse, 1999).

1.2.2.2 Managing waste in informal settlements

In view of this background, informal settlements are heterogeneous and unique and require waste management systems that are unique and appropriate to the particular set-up. A realistic situation, however, is that waste management in informal settlements generally mimics that reiterated in the section on 'Waste Management in Developing Countries'. It is largely determined by the quality of other services (especially roads), and existence and type of on-site storage facilities (Palm & Loots, 1991). Where there is a lack of, or only rudimentary road services, communal collection and on-site waste storage containers (normally skips) are often used. These are placed strategically for easy access and to serve an optimal number of households (Municipal Engineer, 1998).

Other complementary and integral aspects that waste management in such areas depend on are community attitudes and the resultant co-operation which necessitates initiation of public

awareness (Ninham Shand, 1993). Hence Lombard (1996: 293) argued that: “*Ignorance from a lack of communication of waste related information at grassroots level and inadequate environmental education content in the school syllabus is one of the greatest hindrances to effective waste management*”. Consequently, the waste sometimes ends up near the communal collection container and not inside, or on street corners and empty lots. This perpetuates exposure to adverse health and environmental impacts despite the availability of waste collection services (Palm & Loots, 1991; IWMTG, 1993). To alleviate the situation, a number of approaches based on community participation have been tried and implemented successfully in some cases. These are discussed in the following subsections.

1.2.3 Alternative approaches to urban solid waste management

Alternative approaches, sometimes referred to as small and micro enterprises in waste collection, differ from “traditional” approaches in that the former puts less emphasis on technological and financial issues, but rather on innovative methods of delivery. These directly address the issues of local concern. Such issues are often socio-economic, hence labour intensive waste collection methods might be used in areas of high unemployment (Macdonald & Dierwechter, 1996). In terms of service delivery (in waste collection), “alternative” waste collection approaches differ from “traditional” approaches in that there is minimal input from the public in the latter. This is because a local authority, a private sector agency such as a waste removal company, or a combination of both, often undertakes waste collection (Macdonald & Dierwechter, 1996).

The use of alternative approaches to waste collection has been implemented in South Africa and in many cities of other developing countries, including Guatemala, El Salvador, Zimbabwe (Harare), and Senegal (Dakar). In all these cases, the use of alternative approaches has been found to have a number of other advantages besides the one of service delivery. These include cost minimisation; improved quality of service; links with the community; and employment generation (Haan, Coad, & Lardinois, 1998). Despite these advantages, alternative approaches to waste management may fail due to a number of difficulties. These may be in the form of adverse relationships with the municipality or client; limitations in internal management administration arrangements; legislation; and hindrances from the beneficiaries of the service (Haan, Coad, & Lardinois, 1998).

Alternative approaches can be categorised into a number of types depending on contractual arrangement with the authorities. Two broad categories that have been used in South Africa (with varying levels of success) are examined *viz.* (Democritus, 1999; Municipal Engineer, 1995; Palmer Development Group, 1996; Mbande, 1996):

1. One man contract (labour based), which involves the clearing of waste in a designated zone by an unemployed local resident, entering into a contract with the local authority for taking the waste to a communal collection point. This can also be extended to other services such as the maintenance of road surfaces and underground storm water systems.
2. Combined labour/vehicle community-based systems, in which community contractors employ both labour and vehicles. It involves the use of outside consultants in the administration of the system in one of the following ways:
 - consultant contracts with the local authority to collect waste and then involves community based entrepreneurs; and
 - the local authority concludes an agreement with a consultant to administer a contract with local entrepreneurs who then carry out the waste collection process. An example of this is the "Billy Hattingh" approach wherein the contract is tri-partite, with the participants being the local authority, the local entrepreneurs and Billy Hattingh and Associates (Pty) Ltd (a local company).

Billy Hattingh and Associates assists with selecting suitable entrepreneurs, purchasing appropriate equipment, and undertaking the required training and guidance over a period of five years during which the local entrepreneurs carry out the waste removal services.

These approaches have been implemented in South Africa in various forms. In summary it can be stated that the expected end-results for implementing these approaches are improvement of solid household collection, increased understanding of participants and the public regarding waste management, and job creation.

Other endeavours to address the problem of waste in the country have involved enactment of suitable legislation, policies and regulations by the government. These are briefly noted below.

1.2.4 Solid waste management legislation and research initiatives in South Africa

All measures to address the problem of household solid waste are dependent on supporting legislation and policies. South African solid waste legislation is embodied in a number of Acts that address aspects that range from management of waste in protected areas, and waste on roads to management of mine waste. Among these acts, those that have direct effect concerning household solid waste management are the National Water Act (Act 36 of 1998), Environment Conservation Act (Act 73 of 1989) and the National Environmental Management Act (Act 107 of 1998). In addition, the role of legislation in relation to household solid waste management is further reviewed and highlighted in the literature (Botha, 1988; Department of Water Affairs and Forestry & CSIR, 1991; Lombard, Botha, & Rabie, 1992). The publication of the *White Paper on Integrated Pollution and Waste Management for South Africa* (Department of Environmental Affairs and Tourism (DEAT), 2000) and a series of National Waste Management Strategies and Action Plans (DEAT & Department of Water Affairs and Forestry (DWAF) 1999a; 1999b), has meant the realisation of a more concerted effort to address issues related to household solid waste management. As testimony to this, the development of National Waste Management Strategies is underpinned by the overall aim of ensuring that the health of the people and the quality of the environmental resources are no longer affected by uncontrolled and unco-ordinated waste management (DEAT & DWAF, 1999a). Therefore, despite problems being experienced differently by the various tiers of society, there are measures being developed to address waste management problems.

Efforts to improve waste management have not been limited to governmental initiatives through development of regulations, policies and legislation, but have also resulted from interest from civil society and academic institutions. This has been in the form of (academic) research and other related initiatives. The next subsection reviews research on household solid waste management in South Africa.

1.2.5 Research on waste management in South Africa

Extensive research has been undertaken in relation to waste management in developing urban areas in South Africa, some of which are referenced in the various sections of this research. Amongst research initiatives that have had direct influence on this study is that of Kiangi

(1998), which looked into environmental health problems in Kayamandi – a suburb consisting of some informal settlements in Stellenbosch (Western Cape) – and highlights waste management as a major problem. Mbande (1998) proposed alternative approaches to deal with solid waste management problems in developing areas. Smith (1994) examined solid waste management methods in developing urban areas within the Winterveld, Bophuthatswana, through waste stream characterisation, examination of waste disposal practises and resident's attitudes. Lastly, this thesis also draws from work by the United States Environmental Protection Agency (NEPA) (1989) associated with a four day training course, on principles of solid waste management planning, offered by the Fairest Cape Association (Cape Town).

These research works and initiatives, which have influenced this research, address environmental problems associated with lack of housing and informal settlements, particularly problems of household solid waste collection, which are prevalent in the study area. The approach underpinning the study, that of undertaking a situation assessment of the waste management conditions in the study area, has been emphasised by the NEPA (1989) and the Fairest Cape Association. However, the research goes further and modifies stipulated approaches by focusing on key factors characterising waste collection in developing urban areas. These, apart from specific aspects of the waste collection system itself (which are method of collection, frequency of collection and positioning of on-site storage containers) are community attitudes and ascendant socio-economic conditions, and level of community participation and environmental education.

1.3 STUDY AIMS AND OBJECTIVES

It is against the foregoing background that the present study was conceived, with the overarching aim to attempt to contribute to improved waste management in Lwandle, and by extension, to similar townships elsewhere. Within the Helderberg basin informal settlements have already become a major feature of the urban residential landscape (Penderis, 1996). For example, immediately to the West and Southwest of Lwandle are three other townships, which predominantly consist of informal housing; these are known as Nomzamo, Erijavile and Casablanca respectively. Moreover, an estimated 2,57 million people live in such settlements in the entire Western Cape Province (Evans, 1998). Any improvement of waste

management in Lwandle could thus serve as a model or prototype for broader waste management improvement elsewhere.

Apart from the principal aim as stated above, the study also had a number of more specific objectives, which are seen as contributing and fundamental to realising the principal aim. These rest on the proposition that SWMSs essentially need to adapt to the prevailing physical, cultural, and economic circumstances of the communities they serve (Palmer Development Group, 1996). This concerns such aspects as frequency of collection, the (exact) position of waste depots, and level of community participation and environmental education and awareness. This is the ethos that underpins the study, and is thus reflected in the following specific objectives of the study:

- To review and investigate in some detail the *status quo* regarding solid waste management in Lwandle;
- To investigate community perceptions, expectations and viewpoints regarding waste management;
- To ascertain possibilities for the use of environmental education and awareness and community participation programmes; and
- To determine and recommend an improved waste management system for Lwandle.

To achieve these aims, various data collection procedures were employed. These are explained in the next subsection.

1.4 THE STUDY AREA: LWANDLE TOWNSHIP, HELDERBERG MUNICIPALITY

Lwandle township originally was a complex of migrant worker hostels¹ built in 1961 in response to the increasing labour demand in the “Hottentots Holland” basin, now known as the Helderberg basin (Emmett, 1992). The hostels in Lwandle, were built as single-sex institutions to accommodate African migrant workers for the duration of their stay in South

¹ The hostel bungalows had sixteen beds each hence were designed to accommodate sixteen people only but often each bed was occupied by an entire family, and lacked privacy. Privacy could only be secured through partitioning between beds by either curtains, flattened cardboard or wooden planks (Jones, 1993).

Africa's white urban areas (Thurman, 1997). Lwandle was the only area in the basin zoned for blacks until the lifting of the Group Areas Act in 1989 (Emmett, 1992).

Lwandle is situated some forty-five kilometres Southeast of central Cape Town within the Helderberg substructure of Cape metropolitan Area and lies South of the N2 on the eastern outskirts of the Strand as shown in Figure 1.2. In the North, Onverwacht Street forms the boundary between Lwandle and Nomzamo, while in the South the boundary is formed by Broadlands Drive as shown in Figure 1.3.

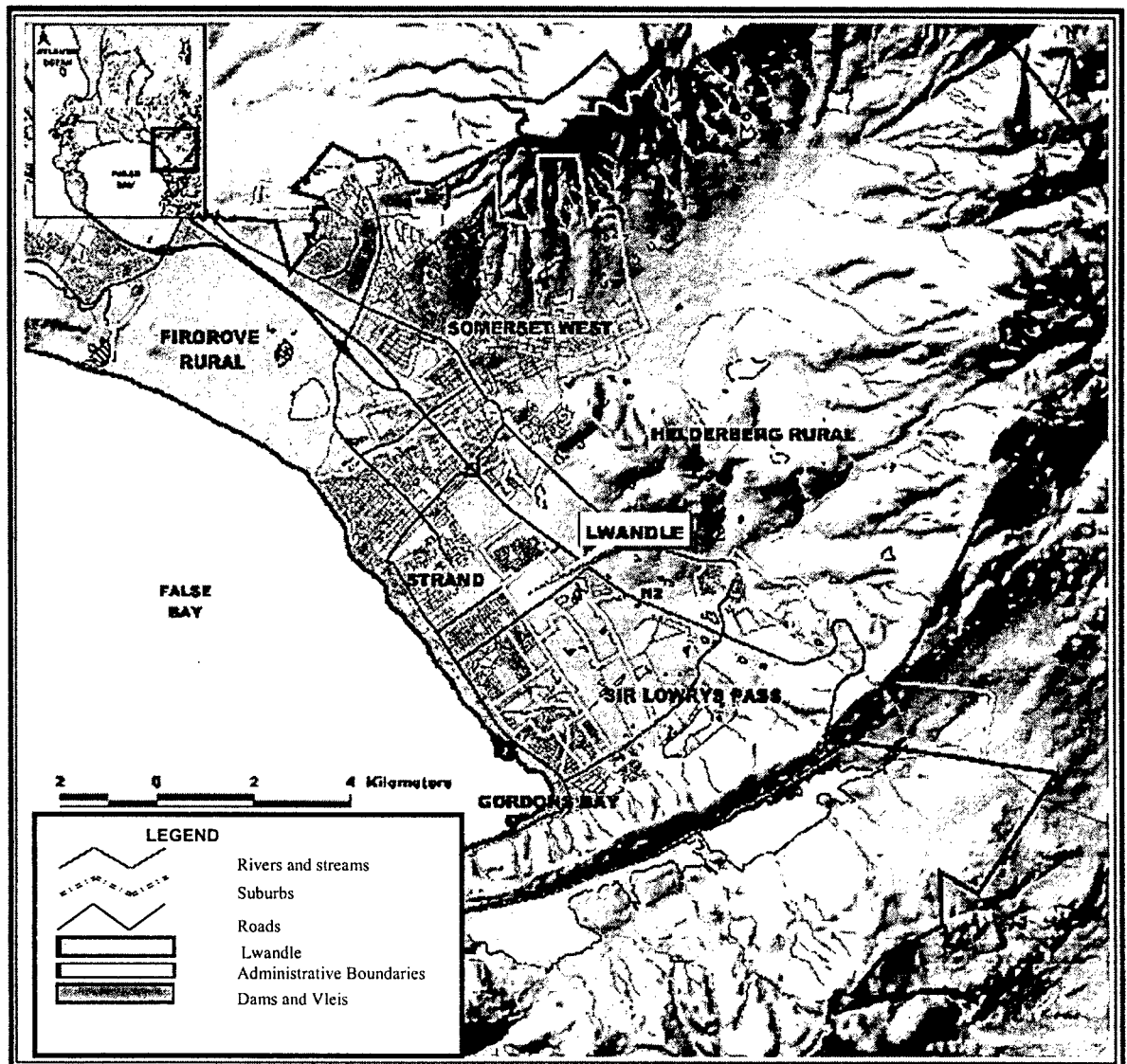


Figure 1.2: The study area: Lwandle township within the Helderberg substructure

It is almost entirely a black township with an estimated population of 10 000 people (Liebenberg & Stander, 1999). The estimated population of 10 000 in the study area is used, instead of an official census figure, because the existing figure represents a combined total population of Nomzamo and Lwandle of 26 000 (Entech 1998).

Within the study area there are six housing segments presented in Table 1.1 and Figure 1.3, these being the Hostel areas (renovated and non-renovated) the “Roll-over” area², the Flats area, the Site-and-service scheme area, the Squatter area (subdivided into Mgababa A, Mgababa B and Ezinkomeni), and the Formal-brick housing area.

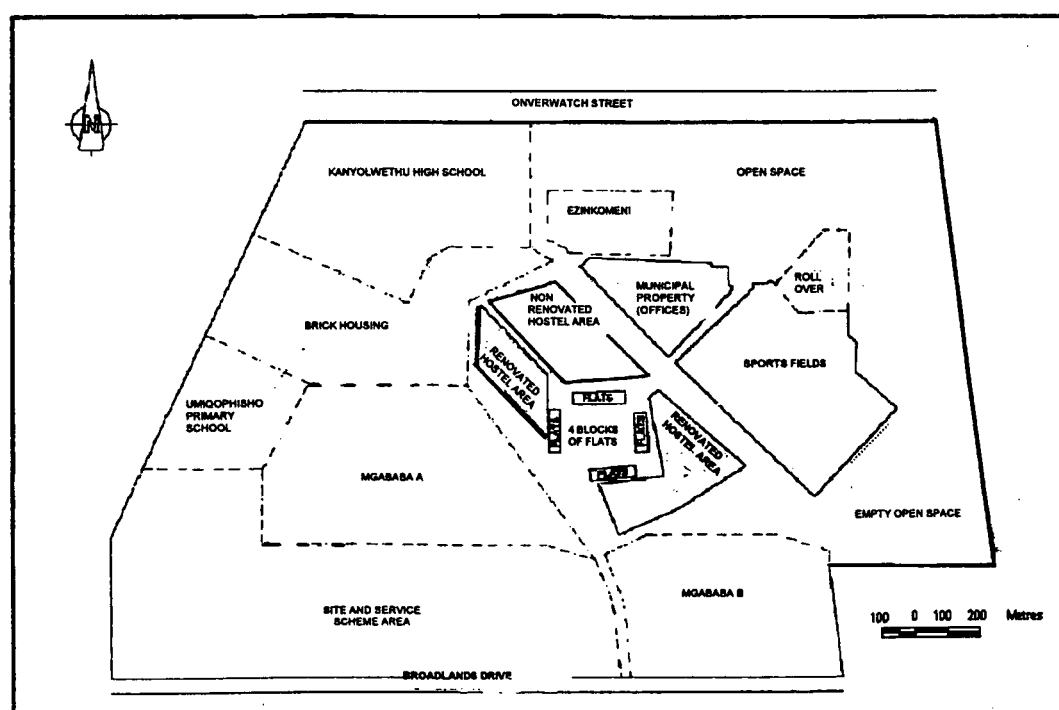


Figure 1.3: Area layout of Lwandle

Lwandle was selected as a suitable study area due to the existence of the variety of housing types represented in it. This presented the opportunity for thorough examination of different solid waste management systems (SWMSs) operating under different conditions pertinent to

² The Roll-over area is a housing area consisting of wooden bungalows used for temporary housing of households that originally come from the hostel area, in order to enable renovation and upgrading of the hostels.

developing urban areas. More importantly, the study area was being plagued by waste management problems.

These problems were illegal dumping and an apparent insufficient and incomplete waste collection system and excessive littering around skips. Therefore, there was a high level of littering. These problems were matched by official initiatives to improve the situation in Lwandle, which further emphasised the relevance of the study and greatly influenced the choice of the study area. Equally relevant was the fact that, by the end of September 1999, a new waste management contract for the Helderberg was being proposed for implementation (Fourie, 1999 *pers.com.*).

1.5 DATA AND METHODS

Data collection procedures were determined by the aims and objectives of the study. These included structured interviews, secondary literature analysis and personal field observations, a questionnaire survey, and waste characterisation.

1.5.1 Structured interviews

Structured interviews were undertaken with major role players in waste management in Lwandle and with staff members of other relevant institutions within Lwandle. These were the Lwandle Municipality (housing clerk) which is part of the Helderberg Municipality, and the Hector Peterson Library in Lwandle (librarian) which had been instrumental in undertaking related education within the community. Members of the Helderberg municipality (Principal technician: solid waste, Civil Engineering department; Environmental Health Officer; and Superintendent: Maintenance) were also involved. The interviews were centred on a number of topics that included waste collection in accordance with housing segments, transportation and disposal, community involvement, administration and institutional monitoring. These interviews consisted of open-ended questions allowing the respondents to provide a thorough description of the areas and the various differences thereof. Interviews were undertaken throughout the data-collection period, allowing enough time for further clarification and confirmation of observed aspects of waste collection.

1.5.2 Questionnaire survey

A questionnaire survey aimed at establishing the residents' experience of the SWMS in Lwandle was undertaken and was presented in Xhosa and English. The framework of the questionnaire was determined by factors that characterise the nature of waste collection and removal service in Lwandle. These were based on observations of the area, information obtained from the interviews with Lwandle and Helderberg Municipality personnel, and information from literature review. Questionnaires were distributed among households in Lwandle, and the household was used as a sampling unit. For the purpose of the survey, the total number of households within Lwandle was determined through interviews with the housing administrator and examination of the study area on the relevant town layout plan dated 1991. The latter was also used as the sampling frame. The total number of households was estimated to be 3466³ (Tubeni, 1999 *pers.com.*), these being distributed over the six housing segments in the percentages indicated in Table 1.1. below. A sample of 100 households was decided upon as a suitable number; this is approximately three percent of the total number of households and every 34th house was systematically selected. The method of sampling was stratified systematic sampling, with the housing segments being used as the strata. In the informal area, which lacks a conventional street pattern, sampling was linear in that sampling was done along a number of regularly spaced dirt roads going through the area, with the sampling interval still being maintained at 34.

Table 1.1: Detailed account of various housing areas and the respective sample size

Housing area	Number of households	% Sample	Sample size
Roll-over	112 (3.2 %)	2.7	3
Flats	139 (4.0 %)	2.9	4
Renovated hostel area	336 (9.7 %)	3.0	10
Non-renovated hostel area	705 (20.3 %)	3.0	21
Mgababa A squatter area	772 (22.3 %)	3.0	23
Ezinkomeni squatter area	235 (6.8 %)	1.7	4
Mgababa B squatter area	604 (17.4 %)	3.0	18
Brick houses (Formerly Regional Service Council (RSC))	23 (0.7 %)	4.3	1
Site and service scheme	540 (15.6 %)	3.0	16
TOTAL	3466 (100%)	2.9	100

³No official statistics for the total number of households in Lwandle were found. Consequently, the relevant figures were obtained through interviews with the housing administrator.

The questionnaire survey was carried out in all the different housing segments of Lwandle with the help of an assistant proficient in Xhosa. Interviews were held with the heads of the selected households. Answers to the various questions were then filled-in in the blank spaces in the questionnaire document by the researcher. The questionnaire (a copy is provided in Addendum A) covered the following aspects: personal information, generation and management of solid waste, nature of on-site waste storage and of the collection service, and resident's attitudes towards solid waste management. Other questions gauged the level of involvement of community members in waste management and waste recycling and views towards environmental education.

Responses from household members served as basis for the review in the analysis. In most cases this data was then processed using Microsoft Excel and compiled into tables presented in this report.

1.5.3 Field observations and secondary literature analysis

This involved personal field observations during which significant aspects conveying the particular nature of the conditions regarding waste management aspects were noted and recorded. There also was analysis of secondary literature such as waste management contracts, and legislative and administrative documents. These documents were perused with the aim to further substantiate information from the interviews, personal observations and the questionnaire survey.

1.5.4 Waste stream assessment

Comparative amounts of generated waste per type were estimated through the waste stream assessment exercise. It entailed voluntary keeping of solid waste by the households and subsequent separation and weighing at two-day intervals by the researcher. Two households were randomly selected from each housing type (a total of eighteen households) for this exercise. However, in total only eight households were ultimately involved in the exercise which lasted for a period of two weeks. This was because of the difficulty in obtaining the waste material from the volunteering households over the extended period of the exercise. Therefore, ultimately the sample was not entirely representative but served to provide information on the composition and quantities of solid waste generated in Lwandle.

1.6 STRUCTURE OF THE THESIS

This thesis is divided into four sections covering various researched aspects of waste management in Lwandle.

Chapter One introduces the study by examining literature on waste management from a broad perspective as a global environmental concern and narrows it down to a problem in Third World Countries, and finally as a local problem in the study area. Various approaches to waste management in developing areas are discussed, and there is a review of alternative waste collection approaches to cater for problematic areas such as informal settlements. Other factors introduced are environmental education and community participation and their impact on waste management. Finally, the study area is introduced, and the existing waste management problems are highlighted. This is followed by the presentation of research aims and methodology.

Chapter Two focuses on the status quo of waste management in Lwandle and is underpinned by the variation in housing areas. The effects of housing on waste management are elucidated through the examination of waste management aspects, namely on-site storage containers, positioning of skips and frequency of waste collection. The results of variant waste collection methods amongst housing areas are also discussed. To provide a holistic overview of the waste management system in Lwandle, other factors examined are the waste profile and institutional arrangement. The concluding subsection highlights most of the examined variables in the context of the resultant extent of waste collection and level of cleanliness.

Chapter Three presents results of the inquiry into social attributes of waste management. There is examination of the socio-economic profile of the area, and this covers the residents' occupation, household income, level of education, residence period, and household size. This is followed by an examination of predominant waste management factors that characterise waste management in developing areas. These include adequacy of waste collection, uncollected waste and open dumping, the role and need of environmental education, community participation and solid waste recycling.

Chapter Four provides a summary of conclusions drawn from the investigations in the

study. It also highlights recommendations for improvement of waste management in Lwandle, and in other developing urban areas that are associated with informal settlements.

CHAPTER TWO: SOLID WASTE MANAGEMENT IN LWANDLE

The purpose of this section is to discuss and provide the reader with an understanding of the nature of waste management in Lwandle while identifying areas and aspects thereof that reveal environmental, health and aesthetic problems that require improvement. The commencing subsection elaborates on various housing divisions and specifically examines the area's accessibility as this greatly impinges on the likely and subsequent nature of household solid waste management approaches employed. The next subsection examines the nature of waste produced in these housing areas through analysis of results of a waste stream characterisation exercise. The waste stream characterisation exercise is a prerequisite for the design of an appropriate SWMS (Smith, 1994). Finally, a detailed account of the waste management approaches adopted in the respective housing areas is given.

2.1 HOUSING AREAS, ACCESSIBILITY AND WASTE COLLECTION APPROACHES

In the quest to understand the nature of municipal solid waste management in a community, it is necessary to understand what and how much waste is generated, how it is currently managed and what problems may be anticipated (NEPA, 1998). It is in this vein that the various housing segments in Lwandle, that are presented in Figure 1.3, were analysed in order to identify variation in the nature of waste management amongst them .

Variation in the nature of each housing area and subdivision necessitates varying waste management approaches (and levels of *cleanliness*). In this regard, the underpinning aspects that were observed to be the determining factors concerning approach to and efficiency of waste collection were accessibility and recognition by the responsible authority. The ensuing discussion is a detailed description of the various housing areas with the main focus on accessibility and the resultant waste collection method used. Moreover, likely suitable waste collection methods in each area are noted.

2.1.1 Flats and Roll-over housing area

The *flats area* consists of four double-storey blocks. Each block houses approximately eleven households, and there are double and single unit housing for each household. It is situated in the central part of Lwandle. Accessibility to this area is by a tarred road going through the four blocks allowing the use of communal collection where communal bins are used often strategically placed at the extreme end and central points of the residential structures, as shown in Figure 2.1, to enable optimal utilisation by residents. There is an average of twelve bins per block, four at the “front” and “back” of households on the ground floor, and four on the first floor.



Figure 2.1: Block of flats allocated with black waste bins

The *roll-over area* mainly consists of well-constructed wooden bungalows arranged in an orderly way, and is situated in the northern part of Lwandle, positioned to the east of the main road entering Lwandle (Vulindlela Street). Entrance by vehicles into the Roll-over area is limited, but each one of the bungalows can easily be reached on foot. Households at the outskirts can be reached by vehicles through a dirt road. The kind of waste collection method used in this area is communal collection. In total there are seven bins in the whole of Roll-over area.

2.1.2 Hostel area

The hostel area houses about 41% of the households in Lwandle, and surrounds the block of flats. It is divided into renovated and non-renovated areas. The housing units in the renovated hostels have been upgraded into family units – either single rooms or double rooms, with a family occupying a single room or a two-roomed unit. Conditions in the non-renovated hostels are such that each unit is occupied by a number of families with partitions made of curtains, cardboard, masoned or other wooden boards. In essence, the non-renovated hostel area has a higher number of occupants or households per block in comparison to the renovated area. Therefore, often after renovation, fewer households are accommodated in the hostel (Tubeni, 1999; Jansen, 1999 pers. com).

The hostel area can be accessed by tarred roads going through the hostel block, hence the use of communal collection is ideal. The use of door to door collection (kerbside) could also be practiced, although, due to the hostel blocks being too close to each other, this would be difficult. The kind of waste collection method used in this area is communal collection wherein there is use of bins. In most cases these kitchen waste bins are mounted on poles, and are in the form of either a 100 litre metal drum, similar to that presented in Figure 2.2, or a typical 85 litre plastic drum.



Figure 2.2: Metal waste bin in the Renovated Hostel area

Eight of these are for general waste, four on each side of the block, while one of these, (often) positioned at the extreme part of the block near the road, is specifically used for kitchen waste. On average, there are nine bins per block.

2.1.3 Squatter area

There are three squatter areas in Lwandle at different locations and having different waste approaches due to the unique nature of each area. The main variations between the three squatter areas in Lwandle (Mgababa A, Mgababa B, and Ezinkomeni) are related to accessibility and the extent to which it is accepted as a residential area by the responsible authority.

Mgababa A is situated on the South-eastern part of Lwandle and is bordered by the site and service scheme area on the south, and the brick housing area on the north. It is traversed by two untarred roads that enable entrance of vehicles. This makes the use of communal waste collection, based on large waste collection containers (skips), favourable for this area. A total of ten skips, similar to the one presented in Figure 2.3, placed at different points within the area along the access roads are used. Furthermore, Mgababa A is bordered by tarred roads, allowing placing of waste along the road, thus also enabling informal kerbside collection.



Figure 2.3: Skip used for waste collection in Mgababa A

Mgababa B is situated on the eastern outskirts of Lwandle with no access for vehicles. Only the periphery of this area can be reached by vehicles. Consequently, communal collection is the only feasible approach to waste collection. The existing waste collection method is favoured by conditions, is communal collection, using a skip (one). Solid waste collection in this area is however limited to the households nearer to the skip, disadvantaging those that are too far, with high possibility of illegal dumping.

Ezinkomeni is situated on the north-western outskirts of Lwandle, and does not have any roads going through to allow entry of vehicles. It is bordered by a road on one side, and waste collection can only take place from here. The area consists mostly of households involved in brewing beer and selling meat, which may have an impact on the kind of waste generated and the subsequent management/ collection approach.

The nature of the area regarding accessibility requires communal waste collection making use of skips. There is no direct waste collection in this area. Residents have to take their waste to skips in Mgababa A, to communal bins in the nearby hostel area, and place it along the road as a form of kerbside collection. Inherently, there is high probability of waste being dumped in the open.

2.1.4 Brick housing and the site and service scheme areas

The *brick housing area* consists entirely of conventional residential buildings, specifically built of bricks, forming the western portion of Lwandle. Access into the area is by tarred and well-defined streets. This area is thus suited for kerbside collection and this is the waste collection approach that is used.

The *site and service scheme area* forms the southern part of Lwandle. It extends to the boundary of Lwandle on the South marked by Broadlands Drive. The area consists mainly of informal structures, though there are several brick houses in this area. It is accessed by tarred and well-defined streets, and consequently is highly suited to kerbside collection. Hence it is provided with kerbside waste collection.

The following subsection looks into the nature of waste generated in Lwandle as a prelude to a detailed analysis of the different waste collection approaches and the associated levels of cleanliness.

2.2 WASTE STREAM ASSESSMENT

For waste to be appropriately managed with regard to collection, transportation and processing, the nature and amount of waste generated by the community needs to be known

(NEPA, 1998). It is important to know the quantities involved, composition by types, physical and chemical characteristics, (present and future) variability with locality and with social strata within localities, seasonal variations and effect of reusing (Kirov, 1975). It is with this in mind that a waste characterisation study was undertaken in Lwandle. However, since municipal solid waste is heterogeneous and of constantly changing nature, it cannot be readily defined by one or two simple parameters. This leads to immense difficulties in trying to obtain truly representative samples in such studies. This is also because there are no standardised techniques for undertaking such surveys (Kirov, 1975; Tchobanoglous, Theisen & Vigil, 1993).

2.2.1 Approaches to waste stream assessment

Two basic approaches are often used in undertaking waste characterisation studies: the output method; and the materials flow method. The materials flow method entails tracing the individual waste item from production to disposal, whilst the output method, which was used in this study, involves collecting, sorting and weighing or measuring the volume and density of the waste (NEPA, 1998). In essence, these are general methodologies that need to be refined according to existing conditions, appropriate sampling techniques, and sorting categories. The sorting categories, for the output method, are assigned on the basis of the aims of the study that could either be to provide:

- general data prior to establishing waste management goals or selecting alternatives; or
- specific data corresponding to a specific waste management option (NEPA, 1998).

One of the aims of this study, which is to review and investigate the *status quo* regarding solid waste management in Lwandle in some detail, falls within the description of the former. Hence, the sorting categories assigned, though highly generalised, but conforming to the underpinning aim of the study, were envisaged to provide data that represented estimates of masses of different waste items. This, in turn, would contribute to undertaking a holistic review of the existing waste management system in Lwandle, and guide planning and fostering of improvement. Improvement could, for instance, be through introduction of alternative waste collection systems, and initiation of waste recovery programmes. Furthermore, this would provide base data for environmental education endeavours. The waste categories assigned for these exercises were: kitchen waste, plastic, paper, glass and

metal. The categories were simplified to enable immediate on-site weighing. The process of sorting was time-consuming and posed health risks. The latter was the case because households in squatter areas have limited toilets and running water and therefore some waste material, which would normally be catered for by these services, was mixed with the rest of the household waste. Other methodological difficulties encountered are elaborated on in the following subsection.

2.2.2 The results of waste stream assessment in Lwandle

Discussions on the results are centred on likely implications for waste collection services, estimates of monthly and yearly amounts of waste generated, and shortcomings of the waste characterisation results. These discussions are based on the outcome of the waste stream assessment presented in Table 2.1 below.

Table 2.1: Waste categories and amounts produced in Lwandle in a two-week period

Housing area	Participating Households	Waste category masses (Kg)							
		Kitchen waste	Plastic	Paper	Glass	Metal	Cloth	Total per area	Total per area fortnightly
Roll over	2	1.209	0.540	1.311	1.255	0.255	0.300	4.871	545.440
Flats	1	3.284	0.734	0.701	0	0.140	0	4.859	675.401
Renovated Hostel	0	-	-	-	-	-	-	-	-
Non-renovated	0	-	-	-	-	-	-	-	-
Mgababa A	1	1.221	2.139	0.989	0.900	0.761	0.337	6.3476	4900.347
Ezinkomeni	0	-	-	-	-	-	-	-	-
Mgababa B	1	1.298	0.960	0.400	0.750	0.210	0.202	3.820	2307.280
Brick houses	1	1.300	1.631	0.043	0.005	0.431	0.300	3.710	85.300
Site-and-service	2	1.171	0.177	1.886	0.325	0.835	0.001	4.395	2373.300
Total	8	9.483	6.181	5.330	3.235	2.632	1.141	28.002	10887.100
Average per household (Kg)		1.185	0.773	0.666	0.404	0.329	0.143	3.500	
Percentages of total		34	22	19	12	9	4	100	

2.2.2.1 Estimates of monthly and yearly amounts of waste generated

The results presented in Table 2.1 indicated that the average amount of waste produced by eight households sampled in Lwandle, in the two-week period of the study, is estimated at 28.002 Kg, amounting to 1.75 Kg per household per week or 0.25 Kg per household per day.

From this, an estimate of the amount of waste produced from each household per month and year may be obtained by multiplying the *0.250 Kg per day* per household value by the total number of days in a month and in a year. This value may also be extended to generating an estimated amount of waste from the area by multiplying this by the number of households in each area.

Comparative appraisal of the waste characterisation results and data from other studies highlighted a variation in quantity of waste generated and quantity of waste collected. The amount of waste collected as reported by Entech (1998) was 3.2 tonnes per week. The amount of waste calculated in this exercise is 6.066 tonnes per week. Based on this comparison it was concluded that the total amount of waste generated from Lwandle is much higher than the amount of waste that is regularly collected. This variation is attributed to two possible factors: firstly, the fact that within Lwandle there are areas such as Mgababa B that have limited regular (weekly) waste collection, therefore indicating that only one half of waste that is generated is collected; and secondly, that the population may have increased since the Entech survey.

In conclusion, the waste stream assessment exercise highlighted a number of factors that reflect the solid waste compositions in Lwandle. These were that the most predominant kind of waste in terms of mass produced is kitchen waste (almost forty percent), followed by plastic and then paper. Informal collection of kitchen waste in Lwandle is confirmed by the vast difference between generated kitchen waste (34% of the total) and collected kitchen waste (13%). This table also highlights the great potential for waste recycling.

2.2.2.2 Implications for waste management

The outlined variations in generated and collected calculations of waste may be used to determine the efficiency of a waste collection system, and possible alternative approaches to utilisation of waste generated (reclamation) to reduce the quantity that is ultimately collected for disposal. Overall in terms of the nature of waste emanating from Lwandle, it can be concluded that the waste is predominantly wet and dense. A suitable waste collection system that caters for this condition is thus necessary.

The ensuing subsections 'On-site storage and collection approaches' indicated that there is limited collection of kitchen waste specifically in the Non-renovated hostel area. This poses problems associated with aesthetics and health due to the putrid nature of this waste material. Therefore, collection of kitchen waste could also be formalised particularly in the Non-renovated hostel area, as it forms the major constituent of the solid waste generated.

Thirdly, the results gave a glimpse of the proportion of various waste items in terms of mass. This could become more useful in initiating waste recovery measures. As indicated there are 22%, 19% and 12% of plastic, paper and glass respectively, which could be recycled. These data may then serve as a guide to determine whether such initiatives may be worth pursuing.

Apart from estimations of quantities of various categories of waste, this exercise furthermore served to elicit impediments that are likely to be associated with initiatives in waste recycling, and the need for education regarding waste recycling. This is due to the fact that some households involved in the waste characterisation exercise did not separate kitchen waste from the rest of the waste to speed up the process of sorting and weighing as was agreed. This shortcoming was concluded to imply that similar problems would also be encountered in recycling initiatives. This is because separation of litter into different types so that recyclable material can be collected is a measure that requires a fair degree of commitment from the public to work successfully (Armitage, Marais, & Pithey, 2000). Though this observation is a digression from the specific aim of this exercise, it is worth noting due to direct implications on waste recycling and waste characterisation investigations.

2.2.2.3 Shortcomings of the waste characterisation exercise

Waste characterisation exercises are fraught with difficulties and shortcomings (Tchobanoglous, Theisen and Vigil, 1993). These range from the fact that analysis of waste composition is expensive and the physical process of hand-sorting waste into categories is an unpleasant task (Parfitt, 1997). In addition, a large sample size is required to minimise errors associated with the highly heterogenous nature of solid waste. Using a large sample in this study was not possible due to the limited time and resources allocated for the study. This brief review of inherent shortcomings associated with waste characterisation exercise serves

to highlight the necessary precaution to be considered in using information from the exercise.

2.3 NATURE OF WASTE COLLECTION IN THE DIFFERENT HOUSING AREAS

Examination of the nature of waste management in the different housing areas was preceded by examination of institutional arrangements with regard to waste management. This was due to the understanding that the nature of subsequent aspects of waste collection services in Lwandle are determined and based on official, responsible institutional arrangements.

2.3.1 Institutional arrangement and collection methods

Waste management in Lwandle is the responsibility of the department of Civil Engineering of the Helderberg Municipality within, but was the responsibility of the Department of Public Health before September 1999 (Fourie 1999 *pers.com*; Gwampi, 1999 *pers.com*). Direct operation of this department in this regard include street sweeping and collection of waste from communal bins in the Hostel, Roll-over and Flats areas. However, it is the onus of a private waste management company, Wasteman, using rear-loading hydraulic-compactor trucks, to undertake general waste removal from Lwandle. Waste collection from the Hostel, Roll-over and Flats areas is undertaken by municipality workers who then place the waste in skips, and along streets to be collected by Wasteman truck which go through the area. The municipality thus facilitates collection of waste in areas where there is use of communal bins. These, in essence, are areas where communal collection is ideal (i.e. informal areas) and kerbside collection would not be feasible. Within the squatter areas there is use of skips from which the waste is also removed by Wasteman.

The following subsection endeavours to examine each housing area in detail in terms of waste collection approach and associated problems.

2.3.2 Waste management in various housing areas

The design of an optimal collection system involves consideration of a number of factors that interact, for example collection frequency and timing (IETC, 1996). Aspects of waste collection explored in this subsection refer to different methods of collection, frequency of collection, and extent of collection in the different housing areas. Analysis of methods of collection concentrated on identifying and differentiating associated effects of various on-site storage containers. Each housing area was examined with respect to the frequency of collection per week. Analysis of the extent of collection involved correlating both methods of collection and frequency to elicit the degree to which each housing area receives waste removal, the distinguishing aspect underpinning this factor being presence or absence of waste removal services.

2.3.2.1 On-site storage and waste collection approaches

Waste collection methods which make use of bins, communal and kerbside, were found to require mandatory use of black plastic bags. These plastic bags are then removed from bins during collection and placed along streets through which the collection truck goes.

Within the *Site-and-service scheme area* and the *Brick houses*, the main kind of waste collection approach is kerbside collection. On-site storage entails use of black plastic waste drums (500 litre bins) often fitted with black plastic refuse bags. Kitchen waste is not necessarily separated but is mixed with the rest of the household waste and is removed as a single load - contrary to what one respondent advised as suitable.

In the Hostel (both Renovated and Non-renovated) areas the predominant method of removal is communal collection, which entails the use of communal bins. An average of four bins is shared per side of the hostel block. On-site storage and collection is similar to that employed in the Brick housing and Site-and-service scheme, with the exception that plastic bags are placed on the streets by the municipal workers.

The waste is removed daily by Wasteman personnel which means that only waste that is placed along the streets will eventually be removed. Municipal workers, however, do not

collect waste daily, hence, despite the availability of Wasteman trucks to enable daily collection, removal is invariably irregular, with the chance of overflowing of the bins in some instances. This condition is more pronounced in the Non-renovated hostel area because of the higher number of people per hostel block, with exacerbated adverse impacts. Comparatively, in this area more adverse conditions in terms of aesthetics and potential for health risk were observed.

Kitchen waste in both the hostel areas is allocated special bins and is not mixed with other household solid waste, particularly due to being wet. Independent waste collectors, reported to be pig-farmers, collect this waste through arrangements with the residents. This is specifically because such waste is not recommended for collection by such compactor trucks as used by Wasteman⁴. Inherently, this approach to kitchen waste collection is informal and lacks the necessary commitment to maintain the requirements and expectations of the concerned hostel residents. Moreover, it has been indicated that there is no recognisable pattern or regularity in frequency of collection, meaning that these areas are liable to be without collection of kitchen waste for long enough periods to present unfavourable conditions.

The approach to waste collection in the *Roll-over* and the *Flats areas* is similar to that undertaken in the hostel area. However, there is no special arrangement for collection of kitchen waste per se, hence this waste is disposed with the rest of the household waste. This was reported to be discouraged and in some cases residents dump the kitchen waste in the open.

Within the squatter areas *Mgababa A* and *Mgababa B* waste collection is communal, with the use of skips. There are eight skips within these areas, seven used in *Mgababa A* and one in *Mgababa B*. The skips serve as on-site storage containers in which the waste is kept until there is collection. For in-house storage of the waste "just-any-convenient" container is often used, with rare use of proper conventional waste bins. In these areas households that are near the road that forms the collection route for the Wasteman trucks, also place their waste in plastic bags (not necessarily black plastic bags) and place it along the road for collection.

⁴ One of the factors that result in compactor vehicles working poorly is when there is collection of waste that is very dense or very wet (IETC, 1996).

This in general is a form of kerbside collection, though informal.

From observation and direct interviews with residents, it was found that the skips are used for all kinds of waste, including kitchen waste, wastewater and sometimes faecal material. Therefore, the use of skips is associated with other negative factors in the form of unpleasant smell, flies and rodents (vermin), and health hazards. As a result, further examination of the subject of skip positioning was undertaken.

2.3.2.2 Positioning of skips

In examining the suitability of the position of each skip in the squatter areas, household members were interviewed with reference to distance between skips. The interviewees were expected to give an indication as to whether the distances to the skips were (perceived as) too near, too far, or appropriate. Analysis of these conditions was underscored by examining:

1. Whether the present position is suitable (i.e. was neither too far nor too near).
2. Whether the present position of the particular skip was too near households, hence exposing households to obnoxious odours, vermin, and high risks to physical injury (especially children) and generally unhealthy conditions.
3. Whether the present position resulted in household members having to walk too long distances leading to reluctance to use the particular skip, hence a propensity for dumping the waste in the open.

Results of the questionnaire survey highlighting the perceived conditions influenced by the position of skips are presented in Figure 2.4. In Mgababa A about 44% of the residents regard the distance between the dwelling structures and the skips as being too near, about 4% too far, and about 18% perceive the position of skips as appropriate and not having any adverse impact. These responses were not linked to a particular skip due to the indicated subjectivity associated with distances. Approximately 34% of the residents interviewed were not using skips; they either used communal bins in the hostel area, or placed their waste along the road to be collected.

Mgababa B, has only one skip, therefore there was an inevitably high probability of respondents experiencing adverse conditions related to the positioning of skips. Approximately 50% indicated that the skip is too far, while about 32% indicate that the skip

is too near. None of these interviewees mentioned the position of the skips as being appropriate; and in some parts of this area, the situation was so severe that the dumping of waste in the open was unavoidable. For instance, one respondent residing on the periphery of this area indicated that "...they are well aware of the negative impacts of open dumping on the environment but there was no waste collection service provided for that particular area. Hence, open dumping was the only option for disposal of their waste..."

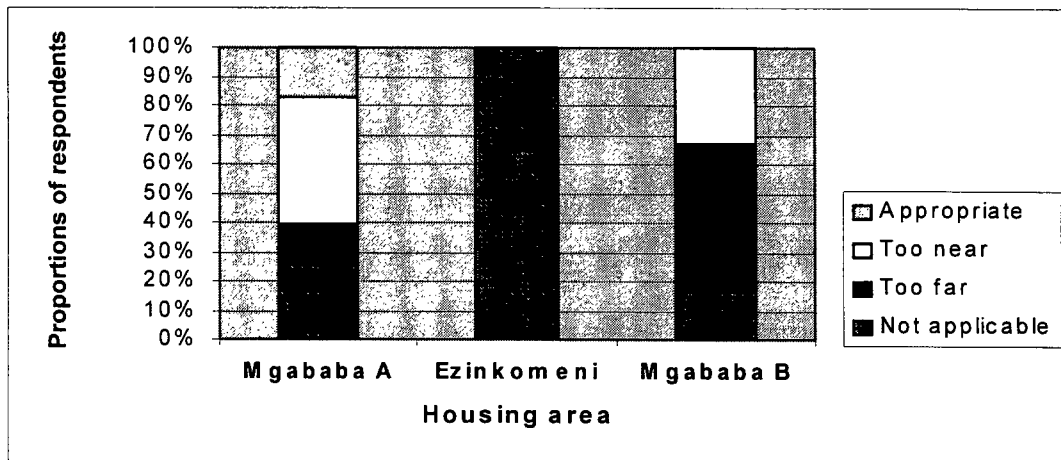


Figure 2.4: Location suitability of skips in Lwandle

In Ezinkomeni, where there are no skips, there was no response in this regard. Under such circumstances the waste was placed along the road to be collected as kerbside collection, or was placed in communal bins in the hostel area, and or it was dumped in the open.

Another aspect that was considered was the involvement of households in waste collection. This was with regard to the direct placing of waste in skips, due to the propensity to put waste near the skip and not inside, leading to the area around the skip becoming a "waste-area". It was generally observed that there often is a mixture of solid waste materials, and wastewater in the vicinity of the skips. This was commented on by one respondent who argued that; "...the main problem lies with the people because they not only put waste (solid waste) in the skips, but also wastewater and other waste material near the skip which leads to bad stagnant wet conditions (see the figure below). These conditions may result in reluctance among the municipality and Wasteman workers to clean and collect the waste on the ground..."

From all of this it was concluded that the use of skips presented a high probability of a number of predicaments, some of which have been identified as invariably dependent on the involved public to address. In addition, the involved waste collection service provider has to be prepared to commit to continued cleaning of the area where the skip is placed. Consequently, when considering frequency of waste removal where skips are used attention should also be given to the frequency with which the adjacent area is cleaned.



Figure 2.5: One of the skips in Mgababa B

In the light of all the aspects raised especially with respect to positioning of skips, there seems to be no particular (national or provincial) set of regulations that serve as “minimum

requirements” for the use of skips. The Institute of Waste Management (IWM) (1997) highlights a number of points for consideration in storage areas for large quantities of waste:

1. Location must be as near as possible to vehicle route but as far as possible from areas where people are.
2. The spot must be easily accessible especially concerning carrying of receptacles.
3. There must be allowance for manoeuvrability of vehicles around the skips.

The above points to a certain extent are too general and vague. This however, may be an allowance to enable appropriate modification in accordance with prevailing conditions. For example, in Lwandle the positioning of skips was undertaken by the contractor (Wasteman) in consultation with the municipal authority and the community (Fourie, 2000 *pers.com.*), and fulfils this requirements set by IWM. Nevertheless, the involvement of the community in this regard was not raised in the questionnaire survey. However, there is a dire need for specificity, particularly concerning the first point, without which adverse conditions like those observed are likely to recur. The positioning of skips might however not be the cause of eventual adverse impacts, but the positioning of dwelling structures. Hence, it might be that even with the presence of some sort of guidelines (and full involvement of the community), the skips might inevitably still be perceived as ‘inappropriately positioned’ because of the nature of development of the squatter settlements.

2.3.2.3 Frequency of solid waste collection

The frequency of collection is determined by public health risks that would arise from infrequent collection, the need for avoidance of odours from the uncollected waste, and the desires of the community in a particular area (IETC, 1996). Alternatively, collection frequency may also be discerned to depend on the demographics of the area, the service demands of the residents (NEPA, 1989) and their willingness to pay for services.

Analysis of the frequency of collection in Lwandle was undertaken with the foregoing background in mind. The expectation was that the nature of each housing area inherently spells out an appropriate waste collection frequency, on the basis of waste collection methods of each housing area. Four categories of collection frequency groups were identified and assigned as being used by Wasteman in Lwandle. These are ‘once in two weeks’ (1/2

weeks), ‘once in a week’ (1/week), ‘twice per week’ (2/week), ‘three and four times per week’ (3-4/week) and ‘five times per week’ (5/week).

From the questionnaire survey, it was found that, within these different waste collection frequency groupings some were used more often than others, as shown in Figure 2.6 below.

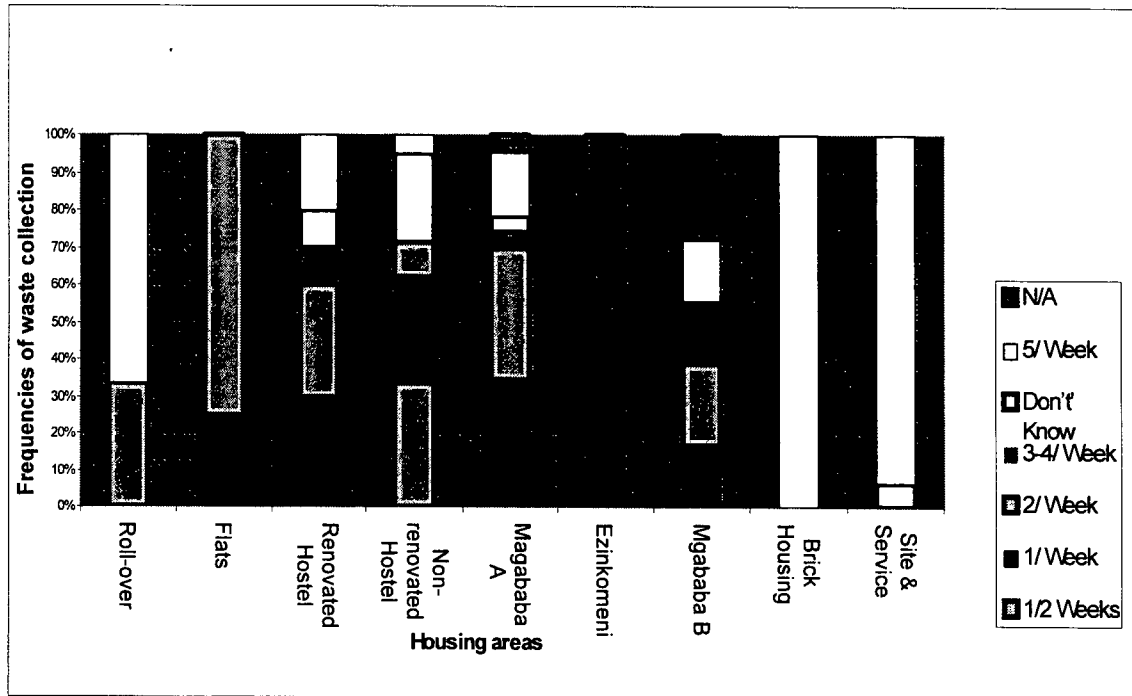


Figure 2.6: Variation per area in the frequency of waste collection in Lwandle

The highest frequency of waste collection was in the Brick housing area, Roll-over and in the Site-and-service scheme area where collection is mostly “five times per week”. The renovated hostel, flats areas and Magababa A and Magababa B squatter areas are mostly serviced “twice per week”. The squatter areas have a number of frequency groups due to limited collection and resultant dependency on waste collection in other areas. Moreover, a considerable number of households in these areas have no collection at all; hence, there was no analysis concerning frequency of collection. The lowest waste collection frequency group of “once per fortnight” was found to be more prevalent in the Non-renovated hostel area. The highest number of people who did not know the frequency of collection was also found to be highest in the Non-renovated area.

Each housing area thus has a predominant waste collection frequency linked to the nature of waste collection and the nature of housing in that particular area, as illustrated in Table 2.3

below. In general, this is a reflection of the housing hierarchy, associated infrastructure and other services and resultant cleanliness and health conditions. Mathee & von Schirnding (1996), indicate that one of the ways of improving people's health is to improve the quality of their housing.

Table 2.2: Predominant waste collection frequencies per housing area

Housing area	Predominant waste collection frequencies	Waste collection method
Roll over	5 times per week	Communal collection (bins)
Flats	2 times per week	Communal collection (bins)
Renovated hostel	2 times per week & Once per week	Communal collection (bins)
Non-renovated hostel	Once in two weeks & once per week ⁵	Communal collection (bins)
Mgababa A	Once per week	Communal collection (skips)
Ezinkomeni	Once per week	No collection ⁶
Mgababa B	2 times per week	Limited communal collection (skip)
Brick houses	5 times per week	Kerbside collection
Site-and-service	5 times per week	Kerbside collection

This is because the health of communities deteriorates when the basic requirements for "healthy housing" are not met. This is with respect to *iter alia*, disposal of waste, positioning and construction of homes, accessibility and safety of a water supply, and the protection of people against in-door pollution, thermal hazards and excessive noise (Mathee & von Schirnding, 1996).

The perception analysis of households in various housing areas regarding the adequacy of the frequency of collection, presented in Figure 2.7, indicates that:

- In areas where there is low frequency of waste collection, namely the Non-renovated hostel area, Renovated hostel area, Ezinkomeni and the other two squatter areas (Mgababa A and Mgababa B) the percentage of perceived inadequacy is high.
- In areas where the frequency has been indicated to be high (around five times per week) there is a perception of complete adequacy.

⁵ A considerably high number of people interviewed indicated that they did not know the number of times for waste collection in the non-renovated hostel area. This could be understood to infer that there is no specific day set for waste collection to conclude on a collection frequency or that the collection frequency is too low for individuals to keep track of.

⁶ The waste from Ezinkomeni is often placed along the road and in the nearby communal bins assigned for the hostel areas. Therefore, though there is no waste collection service for this area, there is an identifiable predominant waste collection frequency of once per week.

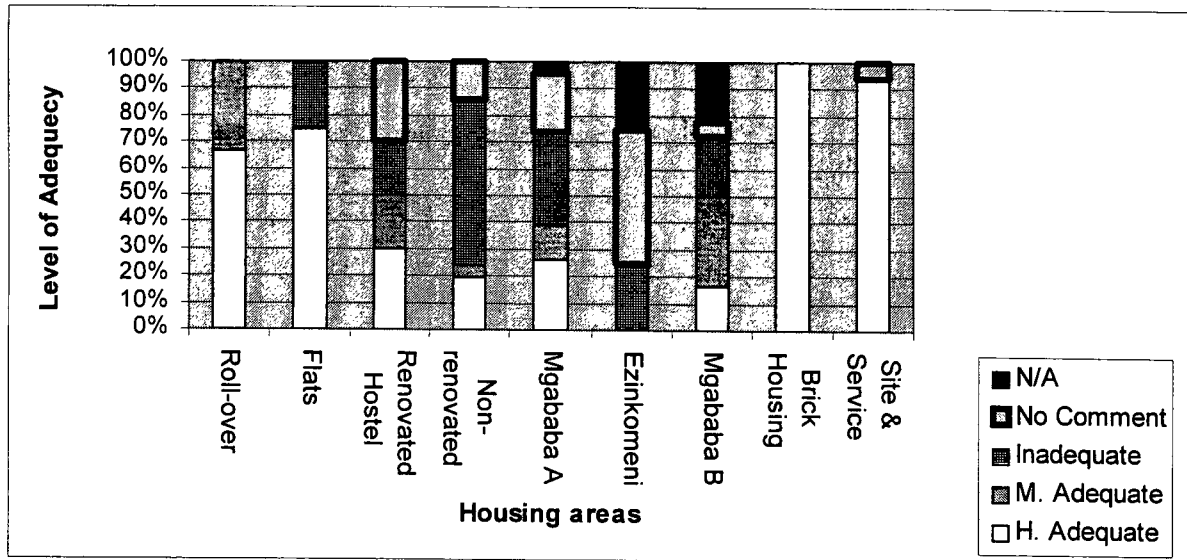


Figure 2.7: Frequency of collection and perceived adequacy

Frequency of waste collection in Lwandle is underpinned by the terms of reference of the contract between the waste contractor Wasteman and the Helderberg Municipality. The contract in this regard stipulates that general solid waste collection and removal should occur daily (Entech, 1998). Though this is the case, the nature of housing inevitably determines the suitability of a waste collection method and resultant frequency of waste collection. This is because each housing area has a particular waste collection method dependent on the nature of housing, and that a particular waste collection method requires a suitable collection frequency. As a point in case, for collection frequency in informal settlements where there is use of communal skips, the contract stipulates that a regular schedule should be identified to prevent overspilling of the bins. The volume and quantity of the bins shall be to the contractor's discretion on condition that the resulting cleanliness of the contributing area shall be to the Engineer's satisfaction (Entech, 1998). In all the squatter areas, except Ezinkomeni, it could be argued that this condition has been met. In the Flats, Hostels and Roll-over areas the collection frequency is overseen by the municipal workers who, after collecting the waste bags from strategic positions, place the waste along the road to be collected by the Wasteman truck. It was also noted that most of the municipal workers are residents of Lwandle, as some were involved in the questionnaire survey.

Effectiveness, or inefficiency and discrepancies in terms of collection frequency in the area are therefore the responsibility of both the contractor and the municipal authority. It follows

from this that the observed waste collection frequencies generally fulfil the stipulations of the contract.

The suitability of these frequencies for each housing area, however, is another aspect that is dependent on a number of factors. These include the average number of people using the particular communal container, and the average filling rate of bins and skips. In both cases, the underpinning aspect is the relationship between storage capacity and frequency of collection. This is because storage capacity needs to be sufficient to contain the refuse generated until there is removal, otherwise there is likely to be overfilling of bins (IWM, 1997). Involvement of the communities is also of importance since their attitudes, norms and expectations may elicit the suitable frequency. Inherently, frequency based on these factors would be determined by the dispositional circumstances in each housing area. This would need to be highlighted in the contract. To illustrate this requirement, results of an investigation on the implications of collection frequency in the Site-and-service, Brick houses, Non-renovated and Renovated hostel areas were reviewed and are discussed below.

2.3.2.4 Comparative review of waste collection frequency

Collection frequency of 'five times per week' in the Site-and-service scheme area and the Brick housing areas presents options for each household to take out the waste on any of the stipulated days. As a result, some households do not take out their waste daily, but take it out only when bins are full, which means that the "five-times-per-week" collection frequency is often beyond what is needed. Hence, this frequency could be reduced depending on the factors mentioned in the previous paragraph that include average filling rate of bins.

On the other hand, a relatively high proportion (33%) of households staying in the Non-renovated hostel are provided with a collection frequency of "once per week" and "once in two weeks" as the lowest frequency groups recorded. Comparison made between the two hostel areas *viz.* Renovated and Non-renovated in terms of housing structures (hostel blocks), accessibility and waste collection methods, reveals that there is very little difference between the two hostel areas. In addition, the number of bins per hostel block of the two types of hostels is roughly the same. Therefore, other aspects besides housing conditions, accessibility and waste collection method are instrumental in determining the vast observed variation in waste collection frequencies.

The main difference between the two hostel areas is population numbers since the Non-renovated hostels generally have a higher population than the renovated hostel area. Invariably, more waste is produced from the Non-renovated hostel area. Waste conditions observed in the Non-renovated include overfilling of bins and unsightly littered open spaces. Such conditions are often associated with reluctance to clean the area and one respondent complained that municipal workers seldom clean the area around the bins. Ultimately this may lead to a perfunctory (lower) collection frequency or random collection pattern.

To alleviate this, a higher number of bins or use of bins with greater capacity (for example, 240 litre wheeled bins) would be recommended. Furthermore, increase in frequency of collection (based on the bin's capacity, population per block and community attitudes and expectations) could be another option that may also be recommended.

The indicated limiting aspects of the contract can be interpreted to reflect lack of specificity, with respect to various housing areas in Lwandle that necessitates adoption of distinct waste collection approaches and accommodate varying prevailing conditions. This is particularly in terms of collection frequency for each housing area.

In an effort to further highlight issues raised in this sub-section and to draw a conclusion on the *status quo* of solid waste management in Lwandle, the next subsection examines the characteristics of waste collection in Lwandle.

2.4 EXPLANATION FOR WASTE COLLECTION CONDITIONS IN LWANDLE

This subsection serves to provide a discussion on the aspects impinging on the variation in frequency of waste collection and the associated waste collection methods in the various housing areas. It culminates in explaining the resultant characteristics of waste collection in Lwandle.

2.4.1 Correlation between collection frequency and housing conditions

Having examined the various groups of waste collection frequencies, a direct correlation between frequency of collection and general housing conditions was revealed in that deterioration of housing conditions ostensibly result in deterioration in waste collection. This could be explained in terms of the nature of housing which influences the suitability and applicability of a particular waste collection method because of being constituted of or lacking aspects of urban residential structures. These aspects of urban residential structures are influential in service provision, and include accessibility and recognition of the area by the responsible authorities. The former has been discussed previously in other subsections. The latter is examined in the paragraphs that follow and is aimed at elucidating the situation in the squatter areas, particularly Ezinkomeni.

Squatter areas are by definition illegal, therefore authorities may turn a blind eye on their need for services, including refuse removal. This develops from the understanding that development of a proper waste collection service is dependent on other physical infrastructure associated with proper acquisition of land and housing. These include provision of paving and lighting of streets, drains for wastewater and stormwater, and provision of toilet facilities (Homes, 1984). However, the provision of services in squatter areas or lack thereof, may be translated to indicate the willingness and or ability or lack thereof of communities to pay for services starting with development of proper housing structure. This therefore highlights a condition of interdependence in that provision of services depends on payments for those services. Hence minimal provision of services in squatter areas is a result of a number of factors, one of them being minimal payment for such services.

2.4.2 Lack of legal recognition of squatter areas

Squatter housing areas of Lwandle are associated with lack of roads or rudimentary roads in the form of dirt roads. There is also lack of legal recognition of these areas as residential areas. The need for provision of waste collection, particularly in Ezinkomeni, presents challenges in that, despite continued prohibition of such housing developments, as illustrated by the board presented in Figure 2.8, they have nonetheless proliferated. Presence of these housing developments inherently means that people in this area need to be provided with

amenities necessary to safeguard against unhealthy conditions, which include provision of toilets, potable water, and household waste removal. Provision of these (or one of these) would to some extent seem to contradict the said prohibition (Gwampi, 1999 *pers.com.*).

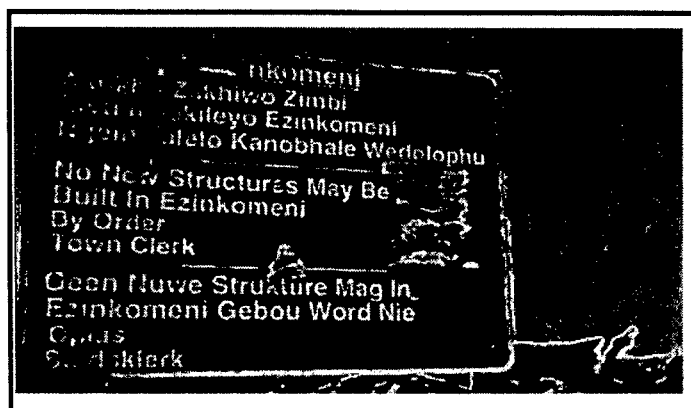


Figure 2.8: A board publicising prohibition of housing development in Ezinkomeni

Based on the above, it was concluded that though the squatter area, and other similar squatter areas in the country, are afforded services, which in some instances are limited and inefficient, there are other factors contributing to such conditions. These include formal acquisition of land for residential development, subsequent legal recognition of these areas as residential areas, and financing of services.

2.5 Relationship between waste collection method and cleanliness

The method of waste collection in the Flats, Hostels and Roll-over areas is communal but makes use of bins instead of skips. Flats and Hostel areas consist of blocks demarcated into housing units, either with double or single rooms, occupied by individual households. Two households make use of one waste bin. The Roll-over area consists of conglomeration of bungalows approximately one to three meters apart. Each bungalow is divided into two rooms and is occupied by one household. One waste bin is used among four households.

In the Non-renovated hostel area, there are no housing units, but each compartment is shared by eight households, making it less practical to assign a single waste bin to a single household. Waste is collected in a communal bin allowing waste from a number of households within one compartment to be stored in one shared container.

Based on the preceding discussions it can be concluded that there is a great variation in the extent of waste collection between the various housing areas of Lwandle, and the resultant cleanliness of each area. It was concluded that variation in levels of cleanliness are influenced by:

1. Legal recognition of the particular area as a residential area by the municipal authority;
2. Nature of each housing area and the resultant waste collection method;
3. Storage capacity of bins, total population of bin users and their involvement with paper waste placement;
4. Collection frequency based on existing conditions of the area; and
5. Stipulation of the waste collection approach in the waste management service contract, especially in the case of communal waste collection where positioning of skips and appropriate area-specific collection frequency needs consideration.

The above points may be used in the analysis of the efficiency of waste collection in Lwandle. Point 3, 4, and 5, (above) were concluded to have a more direct impact on the ultimate cleanliness (in most cases) of the areas making use of communal collection. However, the influence of these points on the ultimate level of cleanliness on each housing area varies. Comparatively the level of cleanliness amongst housing areas was concluded to be as presented in the Table 2.3.

The observed level of cleanliness as indicated in the table correlates with a combination of a number of factors. These factors, apart from being perceived as indicators of level of cleanliness afforded for a particular area by a waste collection service, may also be concluded to be the paramount facets of an operational waste management service. These factors are legal recognition of a residential area or housing area, waste collection method, bin capacity per population ratio, and waste collection frequency. As a point in case, Brick housing area may be considered as depicting highest level of cleanliness that is comparable to any residential area in a high income area. This is largely attributed to the favourable conditions in terms of the legal recognition of a residential area or housing area, waste collection method, bin capacity per population ratio, and waste collection frequency. In contrast, Ezinkomeni squatter area is concluded to be the lowest in terms of level of cleanliness. This condition is on the other hand attributed to the unfavourable conditions with respect to legal

recognition of the residential area, waste collection method, bin capacity per population ratio, and waste collection frequency.

Table 2.3: Comparative level of cleanliness of housing areas in Lwandle

Housing areas	Factors affecting level of cleanliness				Level of cleanliness	Score out of 10
	Legal recognition of housing areas	Waste collection method	Observed bin capacity /population ratio	Collection frequency		
Roll over	Yes	Communal collection (bins)	Adequate	5 times per week	High	7-9
Flats	Yes	Communal collection (bins)	Adequate	2 times per week	High	7-9
Renovated hostel	Yes	Communal collection (bins)	Adequate	2 times per week & Once per week	Medium	5-6
Non-renovated hostel	Yes	Communal collection (bins)	Inadequate	Once in two weeks & once per week	Low	3-4
Mgababa A	No	Communal collection (skips)	Variable ⁸	Once per week	Low	3-4
Ezinkomeni	No	No collection	Inadequate	Once per week	Very low	0-2
Mgababa B	No	Limited communal collection (skip)	Inadequate	2 times per week	Very low	0-2
Brick houses	Yes	Kerbside collection	Adequate	5 times per week	Very high	9-10
Site-and-service	Yes	Kerbside collection	Adequate	5 times per week	High	7-9

The scoring system that was used in assigning levels of cleanliness, as described in Table 2.4 below, was purely based on observed visual impact emanating from the nature of waste collection and waste storage afforded to the various housing areas.

Table 2.4: Description of the levels assigned to scores

Level	Highest	High	Medium	Low	Lowest
Score out of 10	9-10	7-9	5-6	3-4	0-2

⁷ The five levels of cleanliness (lowest, low, medium, high, and highest) assigned to the areas were given different scores out of a total of ten based on observations made by the researcher on the extent of littering and existence or none existence of eyesores associated with waste.

⁸ The total number of people per skip in this area varies from skip to skip and no conclusions were drawn in terms of adequacy or inadequacy.

The degree to which these factors (legal recognition of the residential area, waste collection method, bin capacity per population ratio, and waste collection frequency) have influence on the level of cleanliness is evidently different. It was concluded that in order of highest influence to lowest influence on the level of cleanliness of an area, these factors rank as follows: legal recognition, collection frequency, waste collection method and bin capacity per population ratio.

In an effort to provide a holistic view regarding the *status quo* of waste management in Lwandle, social attributes of solid waste management system were examined and are presented in the following chapter.

CHAPTER THREE: SOCIAL ATTRIBUTES AFFECTING PEOPLE'S PARTICIPATION AND PERCEPTION OF WASTE MANAGEMENT

This section explores some of the social attributes affecting community participation and perception of waste management in Lwandle. Firstly, a socio-economic profile of Lwandle is compiled. This is followed by examination of perceptions, attitudes and expectations with regard to adequacy of waste collection, open dumping, environmental education, and community participation. Much attention is given to this aspect because of the premise that: "In conceptualising the relationships of people to their settings, it is useful to consider the existence of a spectrum of social, political, and economic structures that hold people to places" (Altman & Wandersman, 1987).

3.1 SOCIOECONOMIC CONDITIONS IN LWANDLE

Examination of socioeconomic conditions in Lwandle was undertaken in the knowledge that there is a link between socio-economic conditions, environmental awareness, and environmental behaviour. The objective of this analysis is therefore to elucidate on how socio-economic conditions may influence environmental awareness, and waste-related environmental behaviour. This would enable the contextualisation of a background against which the public's behaviour and perceptions concerning existing waste management system can be reviewed.

The investigation into socio-economic conditions in the study area led to compilation of a rudimentary socio-economic profile of the area covering occupation, monthly total average income, level of education, length of residence, household size per housing area, and home language.

This investigation revealed that, in most cases with regard to the above socio-economic parameters, there is limited variation amongst housing areas. In cases where there is a lack of variation, the outcome of the results is presented in a manner that presents the general situation in Lwandle. It is also worth noting that, as stipulated from the onset, the unit of analysis elsewhere was the household and not individuals. However, in this instance emphasis will be on individuals as respondents in order to correctly depict socio-economic

conditions in Lwandle. The estimated total population of the area of 10,000 as provided by Liebenberg and Stander (1999) is recalled at this stage to enable consideration of the percentages and actual number of people per socio-economic variable examined.

3.1.1 Occupations

Identification and classification of occupations of the interviewed household members was based on the international standard classification of occupations (International Labour Office, 1968). Six occupational categories were identified and the total number of people per category was determined.

In undertaking this analysis, methodology problems that arose were due to lack of distinction in categorising occupations, since some occupations did not appear in the standard guideline used. Essentially, occupational categorising requires precise distinction between activities denoting various occupations. This is difficult to attain, particularly when using the aforementioned approach. This was because some of the activities mentioned by the respondents could be grouped under more than one occupational category. For example street vendors, meat sellers and (home brewed) beer sellers were classified under one generic category of "sales workers". However, given the fact that these do not fall within the formal sector, they might also be categorised under "workers not classifiable by occupation", therefore inferring a condition of being unemployed. Because of this complication, the underpinning approach categorising various occupations was based more on likelihood of obtaining income irrespective of amount. Occupations where there was no likelihood of acquiring income were the only ones categorised under "workers not classifiable by occupation". Other activities not indicated in the international occupational classification guideline book were classified within categories that were closely related or similar to them. Results of this examination are presented in the table below showing individual occupational sub-categories.

There is a relatively high number of "workers not classifiable by occupation" in Lwandle. These include one traditional (healer) doctor, seven students, and fifty-six workers seeking employment. Approximately fifty-six percent of household heads that are potentially economically active in Lwandle do not have regular employment.

Table 3.1: Occupations of respondents

Occupational category	Examples	Total (%)
Professional technical and related	Teachers	3
Administrative and managerial	Secretary, librarian	4
Sales	Retail shop owner, street vendors	16
Service	Post office worker	8
Production and related	Transport, equipment operation and labourers	6
Not classifiable by occupation	Workers seeking employment	63
Total		100

This figure is relatively high in comparison to the Western Cape unemployment or underemployment ratio of at least seventeen percent (Statistics South Africa, 1998). This clearly shows a desperate need for jobs.

The second largest occupational category is that of sales workers mostly in informal business activity. This was composed of (home brewed) beer and meat sellers (seven), retail (shop) owners (three), and street vendors (four), forming sixteen percent of the total. Since this category is largely composed of beer and food sellers, their income is low.

In terms of waste management, activities related to the occupation of sales workers, particularly brewing beer and cooking food for sale, have the potential to generate waste. This is through waste residue from materials used in cooking and brewing and likely congregation of high numbers of people at these households associated with more waste being generated. The surroundings of houses where these activities were practised were mostly observed to be strewn with stumps of trees and wood stacks, and ash mounds. This situation might have arisen because 'waste wood' is seldom tidily packed and is often perceived as having negative visual impact similar to that created by general waste. On the other hand, the ash generated from burning of wood during cooking is not classified as normal household solid waste. Consequently, it is not collected through routine waste collection service, or due to being cumbersome it is not collected regularly.

3.1.2 Individual monthly income

The total monthly income for each household was determined through directly consulting the household heads. Disclosed estimated amounts were then grouped into multiples of seventy-five. Frequency results are presented in the table below.

Table 3.2: Occupations and monthly incomes in Lwandle

OCCUPATION	Head of household income per month										Total	Average
	None	R1- R75	R76- R225	R226- R450	R451- R800	R801- R1250	R1250- R1750	R1751- R2500	R2500 or more	Not specified		
Professional technical and related					1	1	1				3	R 1050
Administrative and managerial				1			1	1	1		4	R 1615
Sales	1	6	3	1	1	1	1			2	16	R 252
Service		1	1	1	2	1	2				8	R 725
Production and related	1				2		2			1	6	R 850
Not classifiable by occupation	19	10		4	6	3	4	2		15	63	R 298
Grand Total	21	17	4	7	12	6	11	3	1	18	100	R798

There was general reluctance among respondents to disclose the (estimated) amount of monthly income. The initial approach was to inquire about total household income instead of individual income. This however was almost impossible because most interviewees were unable to estimate the total household income. Therefore, individual incomes of household heads were used for the analysis. The importance of this information and how it might be used in relation to understanding existing economic conditions and resultant waste management conditions was explained. The researcher also had to reaffirm the anonymity of the information disclosed. Despite these efforts, eighteen of the interviewees did not specify their incomes.

From the results, the highest number of people (21) had no regular monthly income. Monthly incomes were also indicated to be very low. General conclusions drawn from these results were that a high proportion of the population of Lwandle was unemployed. The number of people with occupations that have potential for high income was low. A certain portion of households falling within the second largest occupational category was involved in activities that were meant to enable acquisition of subsistence income. In some cases, this led to production of waste that might not be easily manageable and thus worsened the waste situation in the area. The high level of unemployment in Lwandle constituting a component of the highest occupation category "not classifiable by occupation" implies that regular income that might be there is low. As a result, it can be concluded that the majority cannot afford 'decent' housing and would mostly resort to squatting. This also means that all the

other negative aspects associated with informal housing, which include inherent inefficiency in waste management and illegal dumping are likely to be pronounced and perpetuated.

3.1.3 Level of education

The level of education was determined by investigating the highest education qualifications of the respondents. These were categorised into the five classes presented in Table 3.3.

Table 3.3: Level of education

Highest education qualifications	Total in each level (%)
Diploma and above	4
Standard 8-10	45
Standard 5-7	24
Sub A to Standard 4	18
None	9
Total	100

The results show that only four respondents from the entire sample have studied beyond standard ten. Hence, it can be inferred that the majority of people in the area involved in occupations that do not require high qualifications and therefore corresponding incomes are likely to be low. This outcome corresponds and reflects the situation presented in the two previous sub-sections of low incomes and high unemployment level.

General implications of this situation for waste management and environmental awareness are that there is a likelihood of a high degree of apathy towards environmental and waste management issues. This is because involvement and concerns regarding environmental issues and waste management are relatively high among people who are well educated, hold liberal economic and social philosophies, and have high occupational status (Pressend, 1998). This inherently means that circumstances generally associated with low levels of education such as unfavourable occupations and low-income levels are likely to result in environmental issues being overlooked.

3.1.4 Period of residence in Lwandle

A five-year period was used to categorise the period of residence of households in Lwandle. The results are expressed by housing areas and are presented in the table below.

Table 3.4: Period of residence per housing area

Housing area (Frequencies)	Period of residence (Years)								
	0-5	6-10	11-15	16-20	21-25	26-30	31-35	Total	Average (Years)
Roll-over	2					1		3	20
Flats	4							4	2.5
Renovated hostel area	6	2	2					10	5.7
Non-renovated hostel area	9	7	2	1	1		1	21	8.4
Mgababa A squatter area	17	4	1	1				23	4.5
Mgababa B squatter area	9	6	2	1				18	6.2
Ezinkomeni squatter area	4							4	2.5
Brick houses				1				1	18
Site-and-service scheme	7	4	3			2		16	9.9
Total	58	23	10	4	1	3	1	100	8.6

The table indicates that more than eighty percent of the households have been in Lwandle for a period of less than ten years. In addition, only nine percent of the people in Lwandle have been staying there for longer than fifteen years and the overall average period of residence is eight years. This is the case although the area has been established for over thirty years. In essence, the area is thus relatively “new” since most of the residents are staying in the squatter areas, which are not as “old” as the hostel areas. This situation might be attributable to circular migration, with people not staying in the area for a continuous period. Such a situation has implications on the manner in which people relate to their surroundings concerning environmental issues. This is because the majority of the population might have a low sense of ownership resulting in a lack of appreciation for the surroundings. However, it is clear that this is not the sole reason for adverse solid waste conditions in Lwandle, but it may be part of an array of other factors responsible for the situation.

3.1.5 Household size

The investigation indicated that most households consist of only three people. About three fifths of the surveyed sample households consisted of four or fewer members. The highest number of people per household was twelve, in two households. The housing areas with the

highest number of people (seven and above) were the hostel areas and the squatter areas. The average number of people per household in Lwandle was found to be 4.15. The household size of four members is the second most common in South Africa. A household size of one member per household is the most common in the country (Statistics South Africa, 1998). Therefore, the conditions in Lwandle in terms of household size can be concluded not to be that different from the general conditions in the country.

Table 3.5: Household size by housing area

Housing areas (Frequency)	Total number of people per household											Average
	1	2	3	4	5	6	7	8	11	12	Total	
Roll-over		1	1			1					3	3.6
Flats		3		1							4	2.5
Renovated hostel area	1	2	2	2	2			1			10	3.7
Non-renovated hostel area	3	4	6	3	2		2	1			21	3.4
Mgababa A squatter area		4	6	4	2	2	4			1	23	4.5
Mgababa B squatter area	2	2	4	2	4	1	2		1		18	3.7
Ezinkomeni squatter area		1				2				1	4	6.5
Brick houses						1					1	6
Site and service scheme area	1	3	3		3	4		2			16	4.4
Total	7	20	22	12	13	11	8	4	1	2		4.2

These results largely reflect a condition of high backlog in housing. This is the case since the highest number of people was found in the squatter areas and the hostel areas. Moreover, this was an indication of further growth of the area since informal housing of this nature represents temporary structures.

3.1.6 Home language

Investigation into home language was also undertaken to provide a holistic background regarding socio-economic aspects of the study area and for the sake of completeness. The survey revealed that the predominantly spoken language is IsiXhosa (94%), followed by Afrikaans (4%), then Sesotho (2%).

3.1.7 Conclusion on socio-economic conditions in Lwandle

Conclusions regarding salient socio-economic conditions in Lwandle are summarised in the next table. The information presented here highlights the predominant conditions experienced by more than fifty percent of the population.

Table 3.6: Summary of socio-economic conditions in Lwandle

Socio-economic attributes	Conditions	Percentage
Occupations of household members	Workers not classifiable by occupation (Unemployed)	64%
Total individual monthly income	Low (Below R 800 per month)	60%
Highest education qualifications	Below Standard 10	93%
Residence period	Less than ten years	81%
Household size	4 people and smaller	61%
Home language	IsiXhosa	94%

The general picture is that of abject poverty characterised by low education level, low monthly income and high unemployment. The conclusion that is drawn from these in terms of waste management conditions from the onset is that of a likely apathy towards environmental issues. As Khan (1992: 98) aptly phrased it "...impoverished individuals and communities, whose entire lives are dominated by questions of survival, have demonstrated low levels of interest in conservation, particularly when compared to the responses from more affluent communities...". This is compounded by the lack of formal education and the failure of informal training and awareness campaigns to penetrate low-income communities (Wyn Williams, 1997). The above contention would however need to be fully investigated and further understanding and contextualisation sought in terms of specific conditions unique to Lwandle, in order to sufficiently inform waste management improvement efforts in the area. This is particularly because a number of other socio-demographic variables that include: age; sex; period of residence; home-ownership tenure; marital status; race or ethnic origin) have been indicated to play a role in the description of participants in relation to neighbourhood rehabilitation programmes (Altman & Wandersman, 1987). Furthermore, Ballantyne & Oelofse (1999) report contrasting findings from various studies on environmental priorities from a number of informal settlements in the country.

The examined socio-economic factors in the study are concluded to be some of the basic variables that determine the nature of conduct towards the environment. Results of this

examination presented in Table 3.6 are concluded to present challenges in exhibiting favourable behaviour towards the environment.

3.2 ANALYSIS OF RESIDENTS' PERCEPTIONS OF WASTE MANAGEMENT

Community perceptions were also examined to elicit information about adequacy of waste collection, problems of uncollected waste and resultant potential adverse impacts, and open dumping. The aims of this subsection are therefore to highlight people's perceptions regarding the conditions of waste collection services and secondly, to highlight the role that can be played by the community in waste management.

3.2.1 Perceived adequacy of waste collection

Probing into perceived adequacy of waste collection in Lwandle was initiated by inquiry into constituents of household solid waste and perceived predominant waste items. This served the dual purpose of an introduction to the section of the questionnaire survey in which opinions were sought, and secondly, it was meant to ensure that interviewed members of the community have a clear understanding of the subject being discussed. The ensuing questioning then focused on the perceived adequacy of waste collection with five categories ranking the different levels of adequacy. Results of this inquiry are presented in the figure below.

From the analysis of the level of adequacy of waste collection services in Lwandle, 37% of the interviewed households indicated that the waste collection is "highly adequate". Most of these, are residents of Brick and Site and Services scheme areas. On the other hand, 29% of households perceived waste collection systems as "inadequate". About 44% of this group were from the Non-renovated hostel area, followed by 29% from Mgababa A.

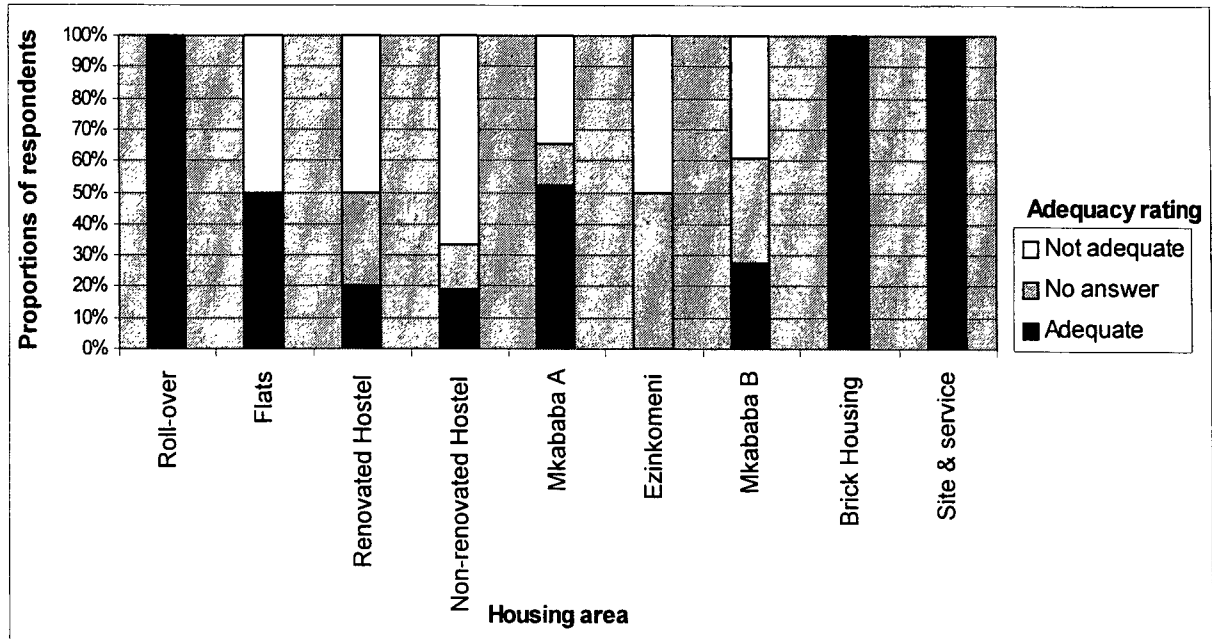


Figure 3.1: Perceived level of waste collection adequacy in Lwandle

A considerable number of households in other squatter areas (Ezinkomeni and Mgababa B) could not respond to this question due to their perceived absence of waste collection in their areas.

Common contentions held with respect to “adequacy or inadequacy” of waste collection services were summarised into the following points:

1. The high frequencies of collection (in all the housing areas) rendered waste removal services adequate.
2. Adequacy of waste collection in the squatter areas, though limited, was associated with the fact that there was collection despite the illegal nature of these settlements (i.e. there were efforts to provide waste removal services and keep the area clean). This perception was irrespective of the level of service provided.

These positive sentiments were conversely juxtaposed by connotations of inadequacy, which were due to the following:

1. Kitchen waste was inadequately catered for, particularly in the hostel areas (i.e. no kitchen waste was to be mixed and collected with the rest of household solid waste, but was collected informally).

2. A period of more than a week sometimes passed without any waste collection, and such instances were particularly common during month-ends (i.e. erratic waste collection of low frequency).
3. There was limited removal of waste around the skips. There was waste within the vicinity of skips due to spillage from overfilling of skips, and placing of waste material near the skips and not inside.
4. The use of skips was associated with adverse conditions related to odours and potential exposure to unhealthy conditions, particularly to children. This was mainly due to disposal of all kinds of waste, including human faecal matter into skips.

3.2.2 Perceptions reflecting waste conditions in the immediate vicinity

The weight carried by the above points varied from housing area to housing area, and was greatly characterised by subjectivity based on immediate local (waste) conditions. Inadequacy of waste collection in relation to the use of skips was expressed strongly by people in the squatter areas and part of the hostel area in the proximity of skips. The general conception related to inadequacy in the squatter areas was underpinned by the insufficient waste removal associated with the use of skips. This was exacerbated by the connection between the use of skips and the limited number of toilet and sanitary systems and stormwater drains. All this affirms the unsuitability of skips as an approach to waste collection, and the dire need for upgrading of other services that have a direct impact on waste management. Exceptions to this was perceptions of adequacy expressed by some households in the squatter areas, situated near streets that serve as waste collection routes and were therefore serviced through informal kerbside collection. In the Non-renovated hostel area inadequacy was related to low frequency of collection and adverse conditions emanating from inadequate collection of kitchen waste.

Common factors for the Non-renovated hostel area and squatter areas were that waste collection is communal, and there is erratic and low collection frequency. In the squatter areas what worsened the situation was that other services, which included toilets and wastewater systems, which impinge on waste management, are insufficient. In addition, housing structures in these areas are of relatively low quality.

A sense of adequacy in terms of waste collection, on the other hand, was relayed by households who were mostly serviced with kerbside collection and enjoyed a high frequency of collection. These were mostly the brick housing area, roll-over area and the flats area. Common factors with regard to these were that the housing structures generally are of a relatively higher standard and quality, enabling implementation of kerbside collection. Moreover, because of the higher standards of housing structures, other services are also of higher quality.

The above furthermore implied that the problem of inadequacy of waste collection, particularly in squatter areas, is a manifestation and confirmation of a synergistic phenomenon that characterises lack of other amenities. These include proper roads, sanitary and drainage systems, and (water borne) toilet systems. These are invariably associated with lack of proper housing. Therefore, improvements in waste management systems need to be underscored by an understanding of the context of inter-relatedness of waste management and other services, the chief one being housing. This is because, as indicated in the study, the general trend has been that deterioration in housing conditions is associated with deterioration in other services, including waste management.

3.2.3 Access to services and perceived importance

Inquiry into perceived importance and relative access to various services, namely waste removal, electricity, water services, telephone and sewerage system was also undertaken. Results of this inquiry revealed that 97% of households have access to waste removal, electricity, and water services. These services are nevertheless communal in the flats, hostel, and roll-over areas. Therefore, though there is access, it is limited and is of minimum quality.

The percentages of households having access to telephone and sewerage system services was found to be thirteen and sixty-two, respectively. In the squatter areas there were virtually no water-borne toilets but only a bucket system. The total number of these bucket toilets was less than thirty in the entire squatter settlement areas. Because of the limited number of toilets, some people in the squatter areas made use of the toilets in the hostel areas. The outskirts of Lwandle, where there are "open areas", were reported by interviewees to be used for defecation. There were efforts by the municipality to increase the number of toilets and hence improve this situation (Gwampi, 1999 *pers.com.*).

In terms of perceived importance, all of these, except for telephone services, were perceived as 'very important' by 96% of the households interviewed.

It was concluded that waste management or waste removal services was perceived as basic, being equally important to other services such sanitation and electricity. Moreover, all these services were viewed purely as delivery services, in which the community has little or no input at all. This thus suggests a condition of limited levels of community involvement with regard to waste management.

3.2.4 Uncollected waste and open dumping

In an effort to elaborate on the subject of community perceptions with respect to waste management conditions in Lwandle, common waste management problems experienced by households were examined. This examination entailed determining the number of households associating these problems with lack or inadequacy of waste collection services and open dumping as presented in the table below.

Table 3.7: Perceived problems associated with open dumping

Problems	Proportions of respondents (%)
Littering	24
Creates bad smell	32
Danger to children	14
Visually unattractive	19
Leads to blockage of drains	4
Health risk/ Attracts disease vectors	81

The majority of people interviewed associate problems of inadequacy of waste collection and open dumping with potential health risks. Such perceptions were closely associated with recognisable unpleasant waste conditions related to overflowing of skips, kitchen waste in the hostel areas, and unsightly stagnant water near and around skips.

Cases of gastro-intestinal infections among children had been reported, and two incidents of illnesses directly related to waste were also cited. These could be attributed to wastewater and food waste (Gwampu, 1999 *pers.com.*). Despite this, no epidemiological studies are

known to have been undertaken with respect to waste management in Lwandle in order to serve as conclusive proof of health risks presented by the situation.

Although adverse environmental and waste management conditions were generally realised to lead to health risks to the community, mismanagement of waste from the community through open dumping and misuse of skips continued. The implication was that there was a certain level of awareness with regard to waste management. This awareness was however rendered sterile, apparently due to an attitude of ineffectuality and dependence on authorities.

3.2.5 Open dumping and environmental awareness

In an effort to further highlight this inherent environmental awareness and associated perceptions amongst the residents of Lwandle, the subject of illegal dumping was investigated and is discussed below. This inquiry was considered to be important because open clandestine dumping was one of the major problems in Lwandle. Analysis in this respect was also underscored by the aim to provide rudimentary data that may serve as a basis for environmental education efforts.

Results of this inquiry indicated that in almost all cases open dumping was generally regarded as a problem, leading to negative conditions highlighted in Table 3.7. The majority of these negative implications were related to littering. Other reasons given for perceiving open dumping as a problem were that it is illegal, and it negatively affects the image of the area, particularly from the point view of visitors and tourists.

On this basis it was concluded that most members of the community were to a certain extent aware of environmental issues related to waste. These conclusions on level of awareness in Lwandle bear testimony to awareness campaigns that were undertaken in 1998 by the Helderberg Public Health Department. These campaigns entailed informing people about health implications of mismanagement of waste and highlighted risks posed by open dumping of (solid) waste and waste-water. It was also shown that their success could have been enhanced if there had been 'follow-up' initiatives (IMIESA, 1998; Gwampi, 1999 *pers.com.*).

Positive behaviour related to waste management was concluded to be low due to lack of voluntary and steadfast efforts to maintain clean surroundings. This is because awareness on its own is not an end but means to an end. However, it is also worth noting that, such efforts

would need to be supported by appropriate and consistent municipal interventions to improve the waste collection services. This is because most of the open dumping occurs in the squatter areas where there is limited waste collection. These conclusions and suggestions were further reiterated in an outcome of the inquiry into the need for environmental education in Lwandle.

3.3 WASTE MANAGEMENT AND ENVIRONMENTAL EDUCATION IN LWANDLE

Involving the people in the 'hows' and 'whys' of waste management requires a certain level of environmental awareness that may be brought about through environmental education (EE). EE in this instance is understood to embody a process of recognising values and clarifying concepts. This is in order to develop skills and attitudes necessary to understand and appreciate the inter-relatedness of man, culture and biophysical surroundings (Winter, 1998). This process should be aimed towards explaining environmental concerns in terms of local needs and to help people to critically reflect and act on their environmental well-being (Pressend, 1998; Huckle, 1995). This is because public education based on waste management stimulates interest in how waste management decisions are made (United States Environmental Protection Agency, 1998). Against this background, results of an inquiry undertaken on perceptions regarding EE related to waste management issues in Lwandle are presented and discussed below.

Results of the inquiry into the perceived role of EE in Lwandle revealed that the vast majority of people (82%) supported the use of EE in sensitising people about waste management issues. Numerous reasons associated with this were given and are summarised into the following points.

1. It would help the community at large to formulate an approach to handling their waste and to sensitise them about the related health impacts.
2. Without it there will always be litter, hence it might be used as preventive measure to improve waste conditions of the surroundings.
3. It is the responsibility of each member of the community to keep the area clean, this would be a way of ensuring that this responsibility is fulfilled, as some people expect their surroundings to be cleaned by the authorities.

4. It would result in maintenance of clean surroundings; hence in the end save money because there would be reduction in measures aimed at removing litter from the area.
5. Through it, forums for the community to air their views would be created, and these might be incorporated into the waste management system of the area.

Acknowledgement of the need for EE in relation to waste management and reaffirmation of the above reasons was provided by the office of Public Health, Helderberg Municipality. To this end, a community educator proficient in Xhosa would be assigned to educate the public about proper management of household waste (Fourie, 1999 *pers.com.*). Detailed information on this proposal was not obtained due to this effort still being in the conception phase.

Recommendations drawn from the above discussion relating to EE are primarily that implementation of EE in Lwandle needs to be focused on action-based learning. In addition, EE implementation needs to aim towards community involvement in the management of waste. The EE approach adopted should reflect existing conditions in each housing area and unique problems thereof. The already mentioned reasons, from members of the community, for undertaking EE may be used as basis for such efforts, and to initiate community participation. The overall effort concerning undertaking EE in the area would need to be underpinned by the understanding that there is inter-relatedness and interdependence between EE and community participation. The latter is explored and discussed in the next subsection. As a final note to emphasise the need for EE in Lwandle and other developing urban areas, Wyn Williams (1997: 20) highlights that: ...“if low income households and communities are not empowered to improve their capacity to manage the environment, the future of cities will be one of drastic environmental decline that will also affect the economies of cities and the nation alike”.

3.4 COMMUNITY PARTICIPATION

Community participation and EE are intricately dependent on each other because the success of education relies on the willingness of the community to participate and full comprehension of the principles underscoring such activities. Efforts to acquire an overview of public participation in the area were mainly due to the realisation that community participation plays

a major role in waste management and co-responsibility in maintaining a clean environment (Ninham Shand, 1993). This is important also because it elicits and addresses environmental concerns and includes capacity building in enabling communities to handle their own environmental problems (Pressend, 1998). Moreover, much of the literature emphasises the use of community participation in household solid waste management during all stages of the planning process (Ninham Shand, 1993; Dierwechter & Macdonald, 1996; Daiz, 1988.)

Community participation in waste management entails community involvement in activities such as litter/waste clean-up campaigns, recycling projects, involvement in formation of community based organisations, and implementation of schemes aimed at maintaining clean surroundings. Attitudes and perceptions concerning participation through recycling of household waste (e.g. metal, paper, and glass) for possible sale and waste reduction were investigated.

3.4.1 Community involvement in waste management in Lwandle

This inquiry revealed that 95% of the interviewed households indicated no involvement in waste management in the area. The only form of community participation in waste management in Lwandle was through clean-up campaigns. These were organised by staff members of the Helderberg Municipality from the Hector Peterson Memorial Library in Lwandle and the Public Health Department. These campaigns served the dual purpose of educating the people while also cleaning the area. Education in this context was focused on highlighting the level of resources associated with managing litter and related health implications (Fourie, 1991 *pers.com*; Tubeni, 1999 *pers.com*).

The results listed in Table 3.8 also indicated that future possibilities of community involvement in various activities associated with waste management were limited due to a number of reasons. This was correlated with the level of education in order to elicit the existence of relationship between level of education and propensity for involvement in environmental issues. A high proportion of respondents (about two thirds) showed little interest in being involved in waste management, while less than one third indicated that they could be involved.

Table 3.8: Education level and involvement in waste management

Involvement and Non-involvement in Waste Management	Highest education qualifications					Total Percentage
	None	Sub A to Std 4	Std 5-7	Std 8-10	Diploma & above	
Involved due to appreciation of clean surroundings and avoidance of associated adverse health implications	2	6	3	18	1	30
Non-involved because it is mainly the responsibility of the authorities	7	9	16	12	1	45
Non-involved because of being too busy		2	4	11	2	19
Do not know		1	1	4		6
Total Percentage	9	18	24	45	4	100

The main reason involved the perception that waste management is the responsibility of authorities. Secondly, employment commitments and the process of searching for employment generally keep people busy with insufficient (free) time to be involved in waste related activities.

Based on examination of the above table, somewhat the influence of level education qualifications on involvement in waste management was suggested to be indirect and being both negative and positive. The majority of respondents that indicated likelihood to be involved in waste management initiatives are relatively well educated (standard eight and above). On the other hand, the majority of respondents who mentioned employment commitments being a limiting factor in involvement in waste management are also relatively well educated. Overall, because of the small sample used, no definite conclusion was reached on the distinct relationship between level of education and involvement in waste management.

3.4.2 Solid waste recycling

Lack of community involvement in waste recycling was evident amongst households in Lwandle. Recycling only occurred at the high school (Khanyolwethu High School) where paper is recycled through sale to a recycling company.

Lack of awareness regarding recycling in the area was apparent to some extent and has been noted previously in Section 2.2.2 which emphasises the need to sensitise the community about this subject. In consideration of recycling, other factors (Seik, 1997) to focus on are:

- operational aspects, for example placing of bins at convenient and visible locations, simple and convenient methods of separating and sorting recyclable waste, and proper labelling of bins;
- marketing publicity aspects, for example effective dissemination of information and running of publicity campaigns; and
- financial aspects, for example making the financial benefits of recycling (such as the donation of proceeds to charity) more transparent and visible to residents, and testing the economic viability of collection.

In addition to the above points, before any effort is made to implement waste recycling initiatives, the following should be examined: availability of markets; methods of collecting and sorting (to optimise material recovery rates); public and environmental safety; and community (and authority) support (Coleman, 1998).

3.5 SUMMARY AND CONCLUSIONS

A number of conclusions were reached on community perceptions, community participation in various aspects of waste management and waste management problems and EE. Generally, there is a high level of awareness in relation to the concept of waste management, and associated adverse environmental and health impacts. This however was juxtaposed by low levels of awareness regarding waste recycling (and the possibility of earning subsistence income from waste management).

3.5.1 Community participation in waste management

There is very low level of community participation related to waste management, with very limited involvement of community in initiatives for co-responsibility in management of waste in the form of appropriate organisations and or recycling projects. However, this was expected, given the prevalent socio-economic conditions of low education level, low average individual income, and high unemployment. From the study it is concluded that problems

emanating from waste management might be regarded as trivial in comparison to other socio-economic predicaments, and not warranting much attention. This could be the case, because such aspects as job commitments and the process of searching for employment were mentioned as a priority in most cases and led to limited involvement in waste management related issues. However, paramount to this is the fact that waste management is viewed by the community and the authorities as a technologically based service delivery commodity that is far removed from 'pressing' socio-economic needs of the community. Therefore, the community will have very limited reasons to be involved in waste management initiatives such as clean-up campaigns, and municipality-organised participation and EE programmes.

Problems associated with waste management were distinguished as manifestation of other "bigger" problems, the primary one being unemployment and resultant inability to afford basic housing (i.e. lack of housing) hence the development of squatter settlements. As a recommendation to addressing this problem, alternative waste collection methods may be used. In that vein, Dedehouanou (1998) argues that various types of municipal waste collection contracts could be encouraged and the choice of the scheme should conform to the complex characteristics of urban settlements, including low incomes, unemployment, and poverty. This is re-emphasised by Halla & Majani's (1999) argument that participatory and partnership arrangements that involve co-ordination of stake-holder contributions and commitments lay the basis for employment creation and income generation through waste collection, disposal and recycling. However, great caution should be taken not to create false expectations in terms of job creation (for all) and solving all waste management problems. This is of particular importance in areas with high levels of unemployment, as in Lwandle (Pithey, 2001 *pers.com.*).

The use of alternative waste collection methods invariably requires and promotes community participation that would greatly benefit the area. Aspects of community participation that need to be noted are the following (Macdonald & Dierwechter, 1996):

- *Type of participation* in waste management research and evaluation, decision-making, implementation and or / benefits;

- *Who participates* - individuals representing themselves or as members of one or several community-constituted organisation (representing an interest or coalition of interests); government representatives (officials or councillors); and/ or consultants; and
- *The basis, form, extent and effects* (anticipated and real), of participation.

It is recommended that community participation in relation to waste management needs to be thoroughly understood and customised in terms of these aspects in order to conform to and reflect existing conditions and realistic goals.

3.5.2 Environmental education

Further education, supported by appropriate community involvement aimed at changing attitudes on responsibilities towards waste related issues, is a necessity. These EE efforts need to encourage people to be involved in waste management in order to:

- instil a sense of ownership with regard to the surrounding neighbourhood and environment;
- develop mechanisms to ensure that there is efficiency in the waste collection system and other related services;
- generate locally based and suitable waste management approaches that reflect socio-economic conditions; and
- ensure that efforts to improve waste management systems for the area serve as a point of departure to address other socio-economic needs, for example unemployment.

Such efforts should be underscored by understanding existing conditions in the community and explicit insight into the goals to be achieved by EE. Pertinent aspects that characterise the conditions in the area elucidated in the study could be used as a starting point to formulate aims, rationale, and methodology for undertaking EE programmes. These aspects include:

- high level of unemployment and generally low education level reached;
- acute awareness of negative aspects of waste management like littering, health risks, creation of negative image of the area, e.t.c.;

- lack of awareness of positive aspects of waste management such as possible generation of minimum income through recycling, and involvement in waste collection;
- general perceptions of inadequacy in waste collection in squatter areas and Non-renovated hostel areas;
- general perception of inadequacy associated with the use of skips; and
- the perception that waste collection is solely the responsibility of authorities.

It is also concluded that EE approaches should differ from area to area, if and when required, in response to inherent variation amongst these housing areas. In addition to this, it was concluded that further efforts beyond the use of EE and community participation, to improve waste management, are required in Lwandle. The following section presents a summary of recommendations for improvement of the waste management system in Lwandle.

CHAPTER FOUR: CONCLUSIONS AND RECOMMENDATIONS

This final chapter is divided into two subsections. The first is a summary of the results and conclusions drawn from the various investigations of the study. The second subsection highlights aspects of the study that were identified as avenues for further research.

4.1 SUMMARY OF RESEARCH RESULTS AND CONCLUSIONS

Variation in housing structures across Lwandle inevitably leads to variation in waste collection service within the various housing areas. This variation in waste collection occurs in terms of waste collection approach, related efficiency and effectiveness, and resultant cleanliness of each area.

4.1.1 The waste collection system

Variation in service delivery is prevalent throughout the study areas, irrespective of the fact that waste management services in Lwandle is the responsibility of one operational authority, the Department of Civil Engineering within Helderberg Municipality. The actual waste collection operation is contracted to a private waste collection company, Wasteman.

The nature of the housing area and its inherent accessibility are the main factors leading to variation in waste collection in Lwandle. Areas that have high accessibility *viz.* the Brick housing and the Site-and-service scheme areas, are serviced by door to door (kerbside) waste collection by Wasteman. The frequency of waste collection in these areas is a highly efficient 'five times per week' and these areas are therefore kept relatively clean. This waste collection frequency was concluded to be too high because some households seldom put their waste out for collection on each of the five days of collection. The recommendation is therefore to reduce this collection frequency according to the average amount of waste produced in the area per week and the average rate of filling of the waste bins.

Areas that have limited accessibility, *viz.* hostel, flats, and roll-over areas are serviced with communal collection. The frequency of collection in these areas varies from five times per week', predominant in the roll-over area, to once per week and once per fortnight in the none-

renovated hostel area. Despite this variation, the predominant waste collection system throughout these three areas is twice per week. The Non-renovated hostel area was where collection frequency was predominantly lowest, at once in two weeks. This variation in collection frequency was due to inconsistency of collection by the municipal workers and Wasteman (i.e. it does not occur throughout the five working days of a week). The roll-over area, because of being more accessible than others, also occasionally has collection by Wasteman.

The approach to waste collection through partnership between the municipality and Wasteman personnel was concluded to be efficient to a certain extent, given the general limited accessibility of these areas. However, there is room for improvement, because of inefficient informal collection of kitchen waste, particularly in the Non-renovated hostel area where adverse waste conditions were observed. Recommendations in this regard are that there should be synchronised operation in terms of days of collection between Wasteman and municipal workers.

4.1.2 Waste collection in squatter areas

In the squatter areas where skips are used, factors that played a major role in the nature of waste collection were found to be positioning of on-site storage containers and total number of people per area (i.e. total number of people per container). In this regard it was recommended that an increased number of skips, proper positioning thereof and increased frequency of waste collection would minimise reported and observed adverse impacts associated with odours and vermin. The number would need to be determined mainly by the number of people per area, as this determines the filling rate of the container.

In Ezinkomeni and some parts of Mgababa B, there was limited collection to the extent that illegal dumping was the norm. This was associated with the legal recognition of these as residential areas by the authority. This presumably is the main decider with regard to whether a place is serviced with waste collection and other basic services such as sanitation and potable water, which were also limited. Measures to improve this situation would first require understanding of the housing situation in Lwandle and current efforts to alleviate housing problems in the area. In the interim, a number of skips could be placed in areas where there is no collection, to cover all the areas. This should be coupled with measures to

prevent further extension of the squatter area. Because the latter has proved to be difficult, development of site-and-service schemes or roll-over settlements is recommended. Waste collection similar to that used in the roll-over area could then be developed for these areas.

The waste collection approach used in the roll-over settlement is recommended because of its merits. It is the best long-term option, and it has been realised that skips are unsuitable as a waste collection method for residential areas. This is due to a number of factors including:

- associated dumping of waste on the sides of the skip;
- likelihood of the waste being blown by wind, hence littering;
- use of skips for all sorts of waste, hence exposure to unhealthy conditions, particularly to children, as it not covered and is easily accessible;
- possibility of erratic collection frequency, leading to overfilling and resulting in the above; and
- inevitable unpleasant conditions related to overfilling, odours insects and vermin.

Therefore the use of skips as permanent waste collection approach is not favoured.

4.1.3 Waste collection contract and socioeconomic conditions

Other aspects that were concluded to play a major role in the waste conditions in Lwandle are the contract and the socio-economic conditions in the area. Predominant socio-economic conditions found in Lwandle are high unemployment, low education qualifications, low monthly income, and a short (less than ten year) period of residence.

In terms of socio-economic conditions in the area it was concluded that a large section of the population of Lwandle was unemployed. The people in occupations with potential for high income were very few. In some cases households were involved in activities that were directed towards the acquisition of subsistence income, and led to production of waste that required special collection, but was not regularly collected or not collected at all. This also requires revisiting of the use of alternative waste collection methods that would be aimed at absorbing some of these households in the waste management operation, thus reducing the quantity of waste generated and creating minimum income.

Review of the waste collection contract revealed that the contract was generally sufficient to ensure that there is collection in the area. However, it did not cover problematic aspects of waste collection in informal areas where there is squatting. As a result, it is recommended that the contract should be specific in terms of typical problematic aspects of waste collection in developing areas. Factors that need to be thoroughly spelled-out in the contract are positioning of on-site collection containers and frequency of waste collection. In addition, if the use of skips can not be avoided, there are other factors that need to be included in the conditions of the contract. These are: total number of people serviced and corresponding number of skips, (strategic) positioning of skips, and management of waste that ends up around the skips. In general, the contract should aim at stipulating minimum requirements to be met in terms of waste conditions when skips are used.

4.1.4 Categories of waste generated in Lwandle

The predominant kind of waste produced from the study area in terms of weight is kitchen waste, followed by plastic and then paper. Kitchen waste is inherently wet and dense and this is a cause of concern because waste in the Non-renovated hostel area, where about one fifth of the total households live, was concluded to be inadequately managed. Consequently, adverse aesthetic conditions result and there is potential for serious health risks, especially for children.

4.1.5 Community perceptions, community participation and environmental education

Community perceptions on waste management conditions, community participation and environmental education were found to be determined to a large extent by prevailing socio-economic conditions. Perceptions of the level of adequacy of waste collection services were underpinned by the frequency of collection. In cases where the frequency of collection was high, the service was considered highly efficient, and in cases where the frequency was low, the service was perceived to be inefficient. Other factors that elicited negative perceptions were insufficient handling of kitchen waste and use of skips and associated adverse conditions. Therefore, sentiments of inefficiency and efficiency differed from housing area to housing area and were based on the method of waste collection used and the frequency of collection.

In terms of community involvement in waste management, the study indicated that there is almost no involvement of the community in waste management. This is despite the perceived high importance associated with this service. It was related to lack of awareness in relation to recycling and related opportunities, employment commitments, lack of interest, and the belief that waste management is the sole responsibility of the authorities. Therefore the general perception was that waste management simply is a delivery service wherein the community has no input. This situation is complicated by the desperate socio-economic conditions in the area, where unemployment and housing (or lack of) seemed to take centre stage.

Recommendations related to community participation waste management are that further involvement of the community in waste management is required. This would be through sensitising the community to such aspects as recycling, reuse and composting. Furthermore, involvement of the community in waste management (to initiate co-responsibility in maintaining clean surroundings) through adopting some alternative form of waste collection is also forwarded. To this end, specific studies related to the use of alternative waste collection methods in Lwandle would first need to be undertaken.

The research revealed a need for awareness campaigns and EE. Awareness of waste management in general and resultant negative impacts of mismanagement such as health risks, littering and general danger to children was high. Further EE is however required to change attitudes, and extend awareness into positive actions. Specific aspects targeted by such EE initiatives were identified as:

- generating of area-specific waste management systems;
- consideration of wider socio-economic conditions in development and implementation of waste management systems;
- ensuring efficiency;
- instilling a sense of ownership of services and the surroundings; and
- initiating community participation in waste management.

It was concluded that community participation and EE are interdependent and need to be undertaken concurrently over a continuous period. In addition, undertaking these would need

to be preceded by appropriate investigations to ensure that specific methodologies and goals are set.

4.2 FUTURE RESEARCH IN HOUSEHOLD SOLID WASTE MANAGEMENT

In undertaking the research, several factors that were seen to be related to the waste management systems were only studied at desktop level and, in some cases, were only mentioned in passing. This is because of the focused nature of the research, and associated limited time and resources available for detailed investigation. As a result, these factors have been noted and are presented in this subsection as research topics for future investigations. It is realised that detailed examination and understanding of these would result in a comprehensive explanation of the interrelationship between spatial conditions, and urban residential growth. Research avenues that were identified in the study in this regard are:

Use of GIS in waste management in developing urban areas

The use of GIS in waste management has been highlighted in several studies. However, use of this tool requires further exploration in relation to waste management in informal settlements or in residential areas with informal settlements. There is great potential for the use of GIS in areas associated with informal settlements due to inherent spatial problems that dominate, and the associated limited accessibility to households necessary for proper waste service. Moreover, in cases where communal waste collection approaches are adopted, the positioning of waste containers may be optimally decided with the aid of GIS.

Influence of community attitudes and perceptions on local environmental issues

This study has, to some extent, highlighted the influence of community attitudes and perceptions related to waste collection, but no clear conclusions could be drawn in this regard. Based on these, it was realised that further research into the nature and the extent of influence of community attitudes and of the perception of local environmental issues and waste management would greatly contribute to ideal improvement. Environmental education endeavours are often aimed at changing behaviour that is greatly influenced by perceptions and attitudes. Therefore understanding these in the context of waste management would be among the initial steps towards achieving the aims of EE efforts.

Alternative methods of waste collection in developing urban areas

Alternative waste collection methods in developing urban areas are indicated to have led to success in some cases. Despite this, the general feeling is that such success is area specific and therefore greater knowledge and understanding is required before their use can be fully acknowledged and recommended. Consequently, it is concluded that detailed investigations related to the use of alternative methods of waste collection in developing urban areas, which cover a wide purview of set-ups to enable broader understanding, is required.

Economic and health implications of insufficient management of waste in developing urban areas

Economic and health implications of mismanagement of waste in informal areas have been mentioned as one of the major components that would support efforts for improving waste management. Economic implications are considered to be the costs incurred in undertaking clean-up campaigns, removal of illegally dumped waste and other activities related to the maintenance of receiving environments. Such activities include unblocking of storm-water drains and clearing of canals, streams and rivers. An investigation of this nature may be undertaken on a small scale (i.e. at settlement level, or be undertaken at a broader municipal local area basis). Appraisal of the costs involved in these activities would lead to clarification of another dimensions of the adverse impacts of improper waste management.

Epidemiological studies related to insufficient waste management in developing urban areas were concluded to be other research initiatives that are worth undertaking. Results of such an investigation would lead to clear and more specific understanding of the extent of the problems that are prevalent in developing urban areas.

Development strategies leading to improved service provision in developing urban areas

Further research on the development of strategies aimed at improvement of waste management based on overall improvement of living conditions in developing urban areas is acknowledged as the main approach to attainment of sound and sustainable services. This is because waste management as a dilemma has been indicated to be a 'symptom' of other problems that highlighted in this research. These include unemployment, lack of housing, and low education level. Other aspects that may also be considered include: migration patterns and housing policies, development of squatter settlements in consideration of

historical influences and current socio-economic circumstances. Such investigations may be undertaken in the context of broader developmental strategies such as Local Agenda 21, Healthy Cities Initiatives and the Reconstruction and Development Programme.

In most cases these subjects that are highlighted as possible research topics for future studies overlap, and are interrelated, therefore it could also be advisable to examine them concurrently.

As a closing statement, it is worth noting that the quest to improve waste management in developing urban areas depends not on one factor but an array of aspects. All these aspects conform to the specific conditions the of the local environment that includes bio-physical, economical, social and political attributes. Accordingly, a multifaceted and tailor-made waste management system with varying emphasis on inherent attributes to suit the conditions of the local environment would therefore need to be developed. This waste management system should among other objectives be aimed at reducing the level of unemployment and improving conditions of the surrounding environment. Such measures need to be underscored by the understanding that:..."The health status of communities is directly affected by the quality of their housing. When infrastructure and services are designed, environmental health risks and the particular community's knowledge, attitudes and practices concerning the environment and health should be taken into consideration. "(Mathee & Von Schirding, 1996: 129).

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**ADDENDUM A: QUESTIONNAIRE DOCUMENT USED IN THE
RESEARCH**

QUESTIONNAIRE ON HOUSEHOLD SOLID WASTE MANAGEMENT IN LWANDLE

SECTION A: PERSONAL INFORMATION

1. What is your home language?

Xhosa	Sotho	English	Afrikaans	Other
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2. How old are you (years)?

3. For how long have you been staying in Lwandle (number of years)?.....

4. How many people are presently staying in the house?

Please specify the number

3. Are there back-yard shack(s) present on the premises? Yes No

b) If Yes,

i) How many are they? Specify the number

ii) How many people (total) stay in them? Specify the number

6. What is the highest educational qualification you have reached?

None	Sub A – Std 4	Std 5- 7	Std 8-10	Diploma	Degree
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7. What kind of work do you do (e.g. teacher, policeman, truck driver, unemployed, student, informal sector, etc.)?

Specify.....

8. What is the total household income per month?

None	R001 – 150	R151 – 300	R301 – 600	R601 – 1000
	R1 001 – 1 500	R1501- 2000	R2001 – 3000	>R3000

SECTION B: GENERATION AND MANAGEMENT OF SOLID WASTE

1. In general terms, what do you consider as waste? Please explain.....

.....
.....

2. What are the predominant categories of solid waste produced in your home in terms of quantities?

Plastic	Metal	Glass	Other non-organic waste.....		
Food waste		Paper	Ash	Other organic waste	

3. Is there any waste collection service provided at present? Yes No

a) If No, how is the household solid waste handled?

Burned	Buried	Dumped in the open	Other
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b) If Yes, where is the waste placed before collection?

In a (black) plastic refuse bag	In a plastic bag placed in a metal or plastic waste drum	In a plastic bag placed in just any container
In a metal waste drum	In a black plastic waste drum	In just any convenient container
Other		

4. What problems occur with regard to the containers used?

None	Scavenging/disruption of containers by animals	Waste picking
Other(s) please specify		

5. Do you undertake waste clearing around your own yard? Yes No

6. If you own a garden, how is the garden waste handled?

Not applicable (N/A)	Burned	Buried	Combined with household waste
Placed in a special container		Dumped in the open	Composted
Other			

7. If you own any animals how is the animal waste handled?

N/A	Burned	Buried	Combined with household waste
Placed in a special container		Dumped in the open	Composted
Other			

8. If you work from home;

a) What kind of waste does your work produce (e.g. production of ash from brewing)?

N/A	None	Plastic	Metal	Other non-organic waste.....	
Paper		Food waste		Ash	Cloth
Other organic waste (e.g. wood)					

b) How is the waste handled?

N/A	Burned	Combined with household waste		
Placed in a special container		Dumped in the open	Composted	
Other				

9. How do you dispose off special waste (e.g. builders rubble, paint, batteries, wood, car parts, insecticides etc.)?

a) Please

explain.....

b) Indicate if there are any problems experienced in this regard.

None	Not accepted by waste collector	Other (specify)
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SECTION C: NATURE OF WASTE COLLECTION SERVICE

Only to be answered by people with access to waste collection service, i.e. those who answered yes to question 3 of Section B.

1. How much per month do you pay for the removal of waste?

None	R 0.01 - 10	R10.01 - 15	R15.01 - 25	> R 25	Do not know
------	-------------	-------------	-------------	--------	-------------

2. How do you pay for this service?

Not applicable (N/A)	As part of rent	As part of payment for other services
Other (please specify)		

3. Which collection organisation collects your waste?

Wasteman Helderberg Municipality Do not know

4. What collection method(s) do they use?

Curbside collection	Communal (skips)	Other
---------------------	------------------	-------

5. Are you satisfied with the method(s) of collection? Yes No

6. If No, which method would you prefer, and why?

Please explain.....

7. How often is your waste collected?

Once / 2 weeks	Once / week	Twice / week	> Twice / week	Do not know
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8. Are there instances when the waste is not collected for a period of more than two weeks? Yes No

9. How serious is the problem of uncollected solid waste?

N/A	Major problem	Minor problem	No problem
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10. How do you deal with this problem? Please explain.....

11. What are the potential adverse impacts of uncollected waste?

Creates bad smell	Creates litter	Health risk/ attracts disease vectors, e.g. flies	
Leads to blockage of drains		Danger to children	Visually unattractive
Other (please specify)			

SECTION D: ATTITUDES TOWARDS SOLID WASTE MANAGEMENT

1. On a scale of 1- 3, where: **1 = very important; 2 = important; and 3 = not so important**, indicate how you regard each of the following services in terms of importance, also indicating to which of them you already have access.

Services	Importance	Already have access
Solid waste collection/ removal		
Water supply		
Electricity supply		
Phone		
Sewerage system		
Roads (improved)		

If there is no access to a solid waste collection/ removal service, please omit questions 2 to 4 below.

2. With regard to the adequacy of the waste collection/removal service provided, how would you rank it?

Highly adequate	Moderately adequate	Inadequate	No comment
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3. Is the frequency of collection perceived as adequate?

Yes Please explain

No Please explain, and indicate the associated problems

4. If you make use of skips, is their positioning satisfactory?

Yes Please explain

.....

No Please explain, and indicate the associated problems

.....

...

5. Do you regard open dumping of solid waste as a problem?

Yes

Because.....

.....

...

No Because

.....

.

6. Is there any involvement of the community in solid waste management?

Yes No

a) If Yes, please indicate how it is involved, e.g. through clean-up campaigns.....

....

b) If No, please indicate if

i) You would like to be involved, and clarify how.....

.....

.....

...

ii) You would not like to be involved, and please specify why

.....

.....

.

7. Is there any recycling and/ or re-use (outside the household) of your waste materials?

Yes No

8. If Yes, please indicate:

- a) Which materials are re-used and/ or recycled
- b) Who reuses/ recycles it (e.g. a private individual, a company, etc.)
- c) The amount of income received per month from recycling/ or re-use outside the household.

a) Material(s)	b) Re-use/ recycled by whom	c) Income per month
Plastic bags		
Glass, e.g. bottles		
Wooden material		
Paper		
Tins and cans		
Other(s) (specify)		

6. Is there a role that environmental education can play in the management of waste in Lwandle?

Yes No

State the reasons for the preferred option.

Yes, because

No, because

THANK YOU FOR YOUR ASSISTANCE!