Section M
Solid waste management

The Neighbourhood Planning and Design Guide

Part II

Planning and design guidelines

Symbols at text boxes

More detailed information is provided about the issue under discussion

Important considerations to be aware of are highlighted

Relevant content from a complementing resource is presented

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Section M

Solid waste management

The Neighbourhood Planning and Design Guide

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M.1 Outline of this section

M.1.1 Purpose

Settlements (and neighbourhoods as the 'building blocks' of settlements) are integrated systems in which the various components are interconnected, and this section highlights the role of solid waste management in this system. Urbanisation, population growth, economic growth and accompanying lifestyle changes result in the use of more consumer products and consequently the generation of more waste. The additional waste that is generated has wide-ranging impacts on settlements: it puts additional pressure on municipal service delivery and on landfill sites, it may result in the pollution of soil, air and water resources, and it can have negative public health implications. Sound solid waste management practices and the appropriate and efficient storage, collection, transport, treatment and disposal of waste can potentially prevent or mitigate these impacts.

The National Environmental Management: Waste Act, 2008 (NEM:WA) as amended and the National Water Act, 1998 provide legal definitions for waste. In the context of this Guide, waste refers to solid materials, substances or objects that are unwanted, rejected, abandoned, discarded or disposed of, or that are intended or required to be discarded or disposed of by the holder, irrespective of their value or potential to be reused, recycled or recovered. Waste ceases to be waste once it is reused, recycled or recovered.

Solid waste management differs from most other municipal (engineering) services in a significant way: Communities are not only expected to pay for the waste removal service – they have to take specific actions in order for the waste to be removed, including the sorting of waste and making waste available for collection on the sidewalk or at a communal point. It is therefore critical that waste collection infrastructure and services are responsive to the needs of the communities being served.

This section has a direct link with **Section F** (Neighbourhood layout and structure), **Section I** (Transportation and road pavements) and **Section L** (Stormwater).

M.1.2 Content and structure

This section (Section M) is structured to support effective decision-making related to solid waste management. The decision-making framework is outlined in Figure M.1, and the structure of this section is briefly described below.

Universal considerations

General aspects that should be taken into consideration when making higher level decisions regarding solid waste management are highlighted, including the following:

- The regulatory environment, including key legislation, policies, frameworks and strategies
- The key objectives that should be achieved as a result of the application of the guidelines provided
- Local or international approaches, mechanisms, concepts and current trends that could possibly be utilised to achieve the key objectives
- Contextual factors specific to the development project to be implemented such as the development type and setting

Planning considerations

Factors to consider when making more detailed decisions regarding solid waste management are outlined, including the following:

Outline of this section

- The characteristics of the development, including the nature of the proposed neighbourhood, the anticipated number of residents and specific features that would have to be incorporated or requirements that would have to be met
- The existing features of the site and immediate surroundings (built and natural environment) as determined by the physical location of the proposed development
- Options related to solid waste management that are available for consideration

Design considerations

Guidelines to assist with the design of solid waste management systems and infrastructure.

Glossary, acronyms, abbreviations

A glossary, a list of acronyms and abbreviations, and endnotes (containing sources of information, explanatory comments, etc.) are provided at the end of Section M.

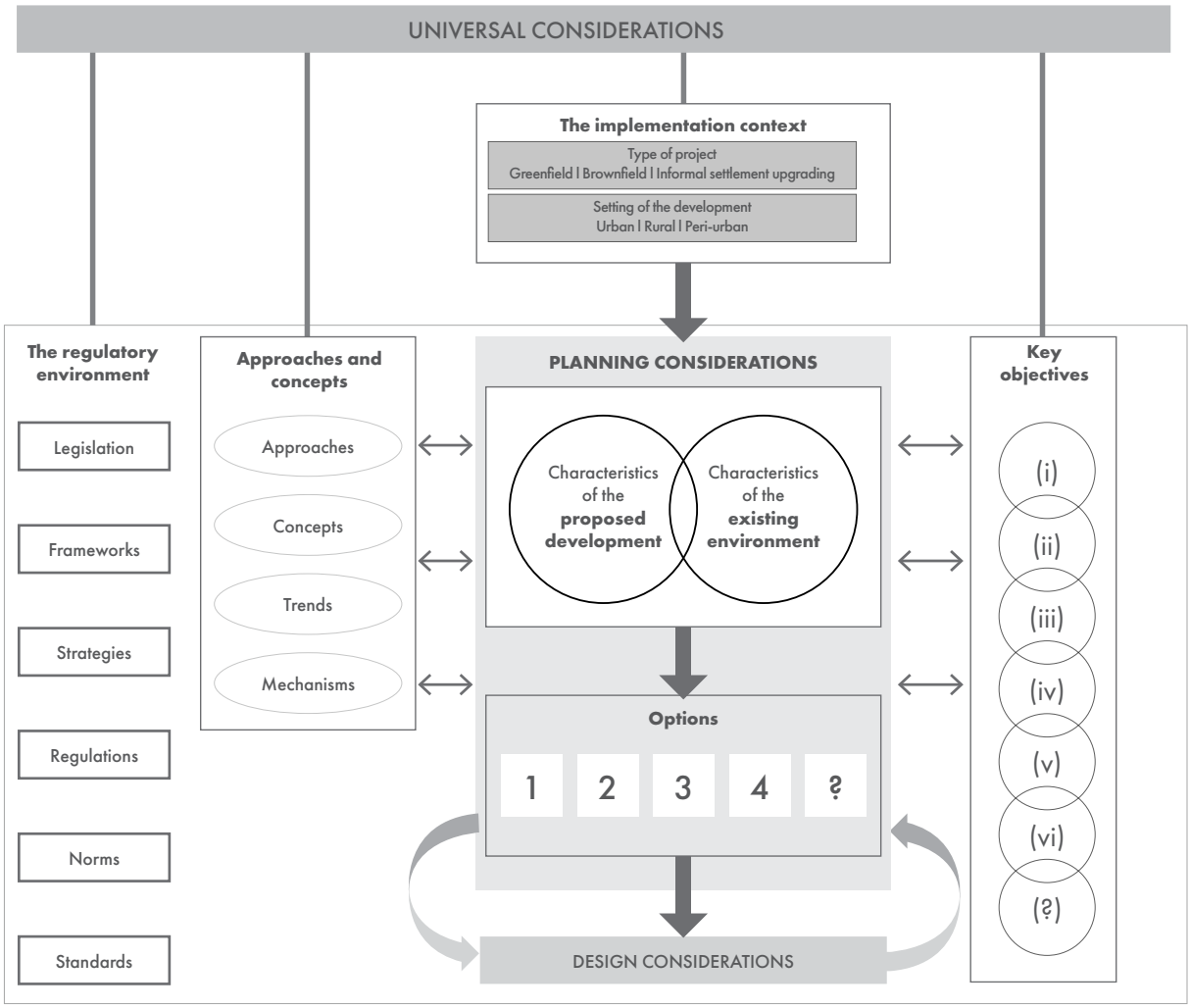


Figure M.1: A framework to assist with planning and design decisions

M.2 Universal considerations

M.2.1 The regulatory environment

A range of legislation, policies and strategies guide the planning and design of solid waste management services and related infrastructure. Some of these are listed below. Since they are not discussed in detail, it is vital to consult the relevant documents before commencing with any development. The intention of waste management legislation, policies and strategies is to regulate waste management activities and to divert waste away from landfilling towards alternative management options while providing an appropriate service to protect human health and the environment.

All three spheres of government - national, provincial and local - play a role in waste management, whether through providing the legislative framework, implementing the prescribed norms and standards or delivering municipal waste management services.

As regulator, the National Department of Environmental Affairs (DEA) is responsible for the drafting of legislation, regulations and national norms and standards. National DEA is also the licensing authority for hazardous waste management activities, as well as for general waste management activities that will affect more than one province or traverse international boundaries. Provincial departments responsible for environmental affairs are the licensing authorities for general waste management activities and landfills within their areas of jurisdiction. District municipalities are responsible for bulk infrastructure such as regional landfills and bulk waste transfer stations for use by more than one local municipality. Metropolitan and local municipalities are responsible for waste management service delivery, i.e. street cleaning, waste collection, waste minimisation and disposal in their areas of jurisdiction.

(i) Legislation

The objective of the National Environmental Management: Waste Act, 2008 (NEM:WA) is to improve waste management in South Africa. The NEM:WA introduces the waste management hierarchy (discussed in Section M.2.3) as the basis for waste management decision-making. According to the act, each municipality must develop an Integrated Waste Management Plan (IWMP) that should be included in the municipal Integrated Development Plan (IDP). Among others, the act also describes the licensing requirements of certain waste management activities, provides guiding principles for waste management charges and makes provision for the classification and assessment of waste for disposal.

Waste classification

The NEM:WA divides waste into two classes based on the risk posed:

- **General waste:** This type of waste does not pose an immediate hazard or threat to public health or the environment. It includes domestic waste, building and demolition waste, business waste or any waste classified as non-hazardous waste.
- **Hazardous waste:** This type of waste contains organic or inorganic elements or compounds that may – owing to the inherent physical, chemical or toxicological characteristics of that waste – have a detrimental impact on public health and the environment. It includes hazardous substances, materials or objects inside business waste, residue deposits and residue stockpiles. Although hazardous waste management falls outside the mandate of municipalities, planners must take note of these waste streams as they need to be collected and transported to licensed facilities.

In addition to the NEM:WA, the following legislation also has implications for waste management:

- **National Environmental Management: Air Quality Act, 2004**
  This act specifies that waste incinerators for the thermal treatment of hazardous and general waste require an atmospheric emissions licence. The Dust Control regulations (2013) under this act are also applicable to waste facilities (landfills, composting facilities, etc.).
- **National Water Act, 1998**
  If waste is the cause of water pollution, Section 19 of the act will apply. This section places a responsibility on owners of land, a person in control of land, or a person who occupies land to prevent and remedy the effects of pollution emanating from that land on water resources.
- **National Health Act, 2003**
  This act makes provision for the Minister of Health to intervene if waste services rendered do not meet sufficient standards.

(ii) Policies and strategies

Policies and strategies under the NEM:WA include the following:

- **Municipal Solid Waste Tariff Strategy (2012)**
  This strategy outlines, among others, the financial and subsidy framework within which municipal tariff setting fits, including sources of revenue for municipal solid waste services and tariff-setting approaches. It outlines the general principles for municipal solid waste tariff setting and the different tariff options.
- **The National Waste Management Strategy (2012)**
  This strategy was developed to achieve the objectives of the NEM:WA.
- **The National Policy for the Provision of Basic Refuse Removal Services to Indigent Households (2011)**
  This policy aims to ensure the equitable provision of domestic waste removal services to indigent households. Indigent households are not expected to pay for waste removal services. The costs of providing these services therefore have to be recovered from somewhere else, typically through cross-subsidisation, and should be planned for.
- **National Organic Waste Composting Strategy (2013)**
  This strategy stipulates that composting of garden waste should be incorporated into municipal planning and recognises the job creation, SMME establishment and partnership opportunities.
- **National Policy on Thermal Treatment of General and Hazardous Waste (2009)**
  The thermal treatment of waste is an acceptable waste management option in South Africa but the feasibility under local conditions must be confirmed.

(iii) Norms, standards and regulations

Norms, standards and regulations under the NEM:WA include the following:

- **The National Domestic Waste Collection Standards (2011)**
  This document sets national standards for equitable, affordable and practical waste collection services and includes standards for separation at source; the collection of recyclable waste; receptacles; bulk containers; communal collection points; frequency of collection; drop-off centres for recyclables; collection vehicles; health and safety; communication; awareness creation and complaints; and waste collection customer service standards for kerbside collection. These standards are uniformly applicable to all municipalities.

- **Norms and Standards for Storage of Waste (2013)**
  These norms and standards aim to ensure uniform and best practices for the design and operation of new and existing waste storage facilities.
- **List of Waste Management Activities that have, or are likely to have, a detrimental effect on the environment (2013)**
  The list specifies the waste management activities that require licensing. Depending on the type and scale of an activity, a full Environmental Impact Assessment (EIA) or a scoping level assessment should be conducted as part of the licence application process for all waste management activities that may have a detrimental effect on the environment. All waste management licences are site-specific and licences for municipal solid waste activities are issued by the relevant provincial department dealing with environmental affairs.
- **Norms and Standards for Assessment of Waste for Landfill Disposal, and Norms and Standards for disposal of Waste to Landfill (2013)**
  These norms and standards stipulate that domestic waste, business waste (not containing hazardous waste or chemicals), non-infectious animal carcasses, and garden waste are pre-classified waste streams for which disposal is only allowed at Class B landfills. All new municipal landfills and new cells at existing municipal landfills must be designed and constructed in line with the specifications for Class B landfills.
- **Norms and Standards for the Extraction, Flaring or Recovery of Landfill Gas (2013)**
  The purpose of these norms and standards are to control extraction, flaring or recovery of landfill gas to prevent or minimise the potential negative impacts on the bio-physical and socio-economic environments.
- **Waste Information Regulations (2012)**
  Municipalities must keep record of all waste disposed of at their landfills and must report the data to the relevant waste information system, according to the South African Waste Information System (SAWIS) regulations.
- **Waste classification and management regulations (2013)**
  These regulations are relevant to all waste streams except those that are pre-classified. Generators of waste are responsible for the classification of waste and for the safe disposal of their waste once classified. All waste must be treated, reused, recovered or disposed of within 18 months of generation.

Each provincial department dealing with environmental affairs has its own norms and standards which may be stricter than national norms and standards. Metropolitan and local municipalities must promulgate by-laws specifying the waste management services that they provide, as well as the actions required by the residents within their area of jurisdiction.

Be aware that the establishment of new waste management facilities and the outsourcing of municipal waste management services potentially have high costs and long timeframes due to possible extensive legal processes. Some of the required processes can be run in parallel and consultation processes can be combined, but this will require integrated planning. Outsourcing of municipal services is subject to approval of a Section 78 assessment in terms of the Municipal Systems Act, 2000.

M.2.2 Key objectives

Solid waste management has strong linkages to a range of global and local issues such as climate change, public health, poverty reduction, food and resource security, and sustainable consumption and production. Waste management is therefore included, either explicitly or implicitly, in a number of the Sustainable Development Goals

(SDGs). Objectives related to solid waste management have been formulated in a range of South African policy and planning publications, and the planning and design assistance included in this Guide aims to support these. Infrastructure and service provision related to solid waste management at a neighbourhood level should lower the risk to human health, minimise adverse impacts on the environment, grow the waste sector's contribution to the economy and contribute to a better life for all.

(i) Lower the risk to human health

Solid waste management should limit health hazards and prevent the spread of infectious diseases. All waste should be stored, collected, treated and disposed of in a controlled manner. Uncollected waste, for instance, attracts pests such as flies and vermin, which are potential carriers of disease. Uncollected waste can also block drains, which results in stagnant water (increasing the risk of disease transmission and water contamination). The blocking of drains due to uncollected waste can also aggravate the impact of flooding, which can cause damage to property or endanger lives.

(ii) Minimise adverse impacts on the environment

The implementation of a sound solid waste management system should minimise waste's adverse impacts on the natural environment by preventing pollution. In addition, such a system should minimise added harmful impacts on the environment that can possibly result from the methods that are used for the storage, collection, treatment and disposal of solid waste. For example, the burning of waste should be limited to prevent air pollution and landfills should be designed in such a manner that leachate is prevented (to protect underground water resources).

(iii) Grow the waste sector's contribution to the economy

The maximum possible value should be extracted from solid waste. Waste that is currently disposed of at landfills has potential to benefit communities economically. For instance, by re-introducing recycled materials to the economy, new markets can be developed (e.g. for energy or for compost). Waste collection (including recycling services) is labour intensive and could contribute to job creation in the waste sector. Waste management services should therefore be planned to involve informal recyclers (local entrepreneurs) as part of the formal waste management system.

(iv) Contribute to creating a better quality of life for all

Waste collection services should be extended to all, irrespective of income level. A better quality of life should be made possible by creating neighbourhoods that are free of pollution (water, air and soil contamination) and are attractive places to live (without litter, odours and smog).

M.2.3 Approaches and concepts

This section briefly describes the waste management hierarchy and the waste management system as concepts that support the objectives discussed in Section M.2.2.

M.2.3.1 The waste management hierarchy

Rapid urbanisation, population growth and lifestyle changes (resulting in an escalation in the use of consumer products) have led to a significant increase in the volume of waste generated in settlements. Disposing of waste at landfill sites is becoming more and more challenging, due, in part, to the shortage of suitable land in densely

populated settlements and the cost of transporting waste. This could lead to an increase in illegal dumping, uncollected waste and other forms of pollution, which would pose a threat to the natural environment.

It has been recognised internationally and locally that a comprehensive, holistic approach to the management of waste is required to limit the reliance on landfill sites and reduce the negative impact of solid waste on the environment. A range of actions to reduce and deal with waste has been identified and prioritised according to their potential impact on the environment. These actions are structured in a hierarchical system, with actions that will have the least impact on the environment positioned at the upper end of the hierarchy. This system is referred to as the 'waste management hierarchy'. The intention with this hierarchy is to encourage everyone (including households, industries and government entities) to extract the maximum practical benefits from resources and products and to generate the minimum amount of waste. Various permutations of the waste management hierarchy exist, but in essence the key components remain the same. It is usually presented as an inverted pyramid as illustrated in Figure M.2.

Waste management actions are arranged in order of preference, with those that will make the most significant contribution to the effective and efficient utilisation of resources, to reducing greenhouse gas emissions and pollutants, and to conserving energy, ranked highest in the hierarchy. Therefore, according to the hierarchy, initiatives aimed at eliminating waste should be prioritised, followed by attempts to reduce waste. Waste could be eliminated or reduced by, for instance, designing and manufacturing goods in a particular way, or by reducing unnecessary consumption.

The next action in the hierarchy relates to the reuse of a product when it reaches the perceived end of its lifespan. Rather than discarding such goods, in many instances they could be refurbished, repaired or repurposed. Recycling involves the separation of certain goods from the waste stream and utilising them again as products or raw material. Certain types of waste could also be recovered to be used as fuel for energy. Disposing of waste is the least desirable method to adopt, and efforts should therefore be made to implement as many of the actions higher up in the hierarchy to reduce the volume of waste that ends up at a landfill site.

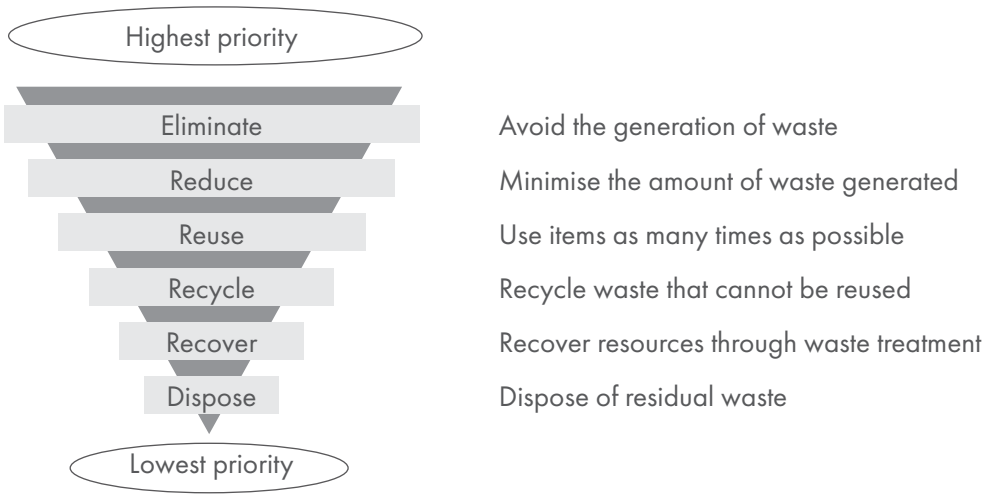


Figure M.2: The waste management hierarchy

M.2.3.2 The waste management system

The waste management system involves a range of inputs, outputs and actions. Once waste is generated, it follows a process that involves a number of stages. The stages involved would depend on the nature of the waste and the manner of disposal, as illustrated in Figure M.3. In some instances the process may be very basic, simply involving

the collection of waste and its transportation to a landfill site. In other cases, especially when waste is separated at source, the process may become more complex and involve a range of other stages or actions. This may involve various recovery and treatment methods that would result in a range of outputs such as fuel, compost and recycled metal, paper, glass and plastic.

Separation of waste at source

- If only one container is used to dispose of waste, the waste is not sorted and therefore may include a mix of organic waste (garden and food waste), recyclables (paper, glass, metal, plastic) and non-recyclable waste.
- If waste is disposed of in two containers, one container is usually used for mixed recyclables and the other for a combination of organic and mixed non-recyclable (residual) waste.
- Three or more containers would allow for further separation of the different types of recyclables and/or the separation of organic and residual waste into different containers.

The waste management system illustrated in Figure M.3 is a generic system that may have to be modified to suit specific conditions and local contexts. The way in which waste is disposed of in a particular area may change over time, and therefore the system should be adaptable. For example, initiatives may be implemented to minimise waste generation and encourage reuse, which will reduce the volume of waste to be collected, transported and treated. Similarly, if it becomes mandatory for households and other waste generators in a particular area to separate waste at source, the way in which waste is collected, stored and treated may change substantially (e.g. a clean Materials Recovery Facility (MRF) may be needed instead of a dirty MRF).

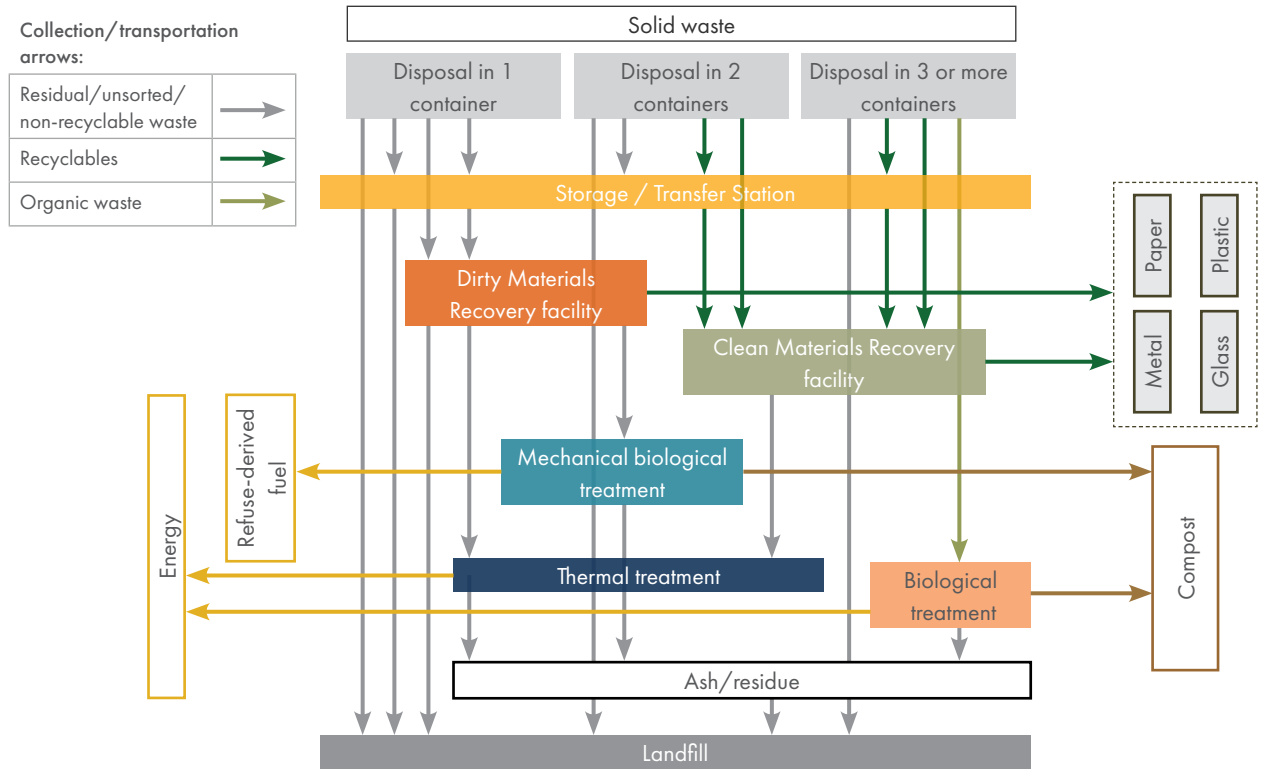


Figure M.3: The waste management system

M.2.4 The implementation context

This section highlights the contextual factors that should be considered when making decisions regarding solid waste management, specifically related to the type of development and its setting.

M.2.4.1 The type of development

(i) Greenfield development

Deciding on a solid waste collection system for a greenfield development would normally be influenced by the anticipated needs of the residents and the cost implications of a proposed system. Other factors that would influence the choice and design of a solid waste collection system include the topography and geotechnical conditions on the greenfield site. Illegal dumping sites may exist on the proposed greenfield site. These will have to be rehabilitated to discourage continued dumping or they may be converted to legal dumping sites if the final layout of the neighbourhood allows. If there is an existing waste collection service in adjacent neighbourhoods, the additional pick-up points and additional volumes of waste of the new development might affect the capacity of the existing waste management facilities and the distances to be covered by vehicles collecting the waste.

(ii) Brownfield development

Since brownfield sites are part of the fabric of an existing city or town, a solid waste removal system may exist, which may be able to accommodate the additional volumes of waste. A change in land use brought about by the brownfield development, e.g. the conversion of office blocks to blocks of flats, or using a parking lot to construct an office block, will affect the solid waste management service that is needed. Brownfield developments are often associated with higher population densities, which will increase waste volumes per area.

The existing topography and access conditions of the site (e.g. widths of streets, steep gradients and cul-de-sacs) may affect the collection of solid waste, while the availability of space and the geotechnical conditions of the site may determine whether additional waste management facilities can be provided. Illegal dumping spots may exist and would need to be rehabilitated to deter future dumping at these spots.

(iii) Informal settlement upgrading

Informal settlement upgrading projects are usually complex undertakings that require extensive community participation, specifically to agree on the solid waste management system to be provided. The layout of the upgraded settlement may have an effect on waste collection. For instance, narrow street widths can make it difficult for collection vehicles to pick up waste from individual houses. Alternative waste collection options should then be considered, e.g. central collection points that can be reached by waste collection vehicles.

Informal settlements could be located in established parts of towns or cities where they can be linked to existing waste collection systems. Often informal settlements are located on the peripheries of cities and towns where no solid waste collection systems are in operation. This would require careful planning to link the upgraded neighbourhood to the existing waste collection system and would possibly involve the establishment of new waste management facilities as part of the upgrading initiative. Informal settlements often have central points where waste is dumped. When planning the waste management service, these illegal dumping sites should be considered as sites for formal waste management facilities.

M.2.4.2 The setting of the development

(i) Urban

Urban settings can take on different forms and this will influence the type of waste collection system to be provided. Within urban areas, large volumes of waste are usually generated in relatively small areas due to population and housing densities. This can result in sufficient thresholds to improve efficiencies in the waste management system. Larger distances to landfill sites may require more transfer stations and increase the need for long-haul vehicles.

(ii) Peri-urban

The nature of developments within peri-urban areas can vary considerably, and so will the solid waste systems to be provided. As with the other development settings, it is important that the service provided must be responsive to the needs of the residents. When deciding on service levels in peri-urban areas, the service levels in the neighbouring urban areas should be noted as they may have an (sometimes unpredictable) impact on the waste management services in the entire area. For example, areas serviced by wheelie bins are often victims of bin theft if neighbouring areas are not issued with similar bins. Constant replacement of stolen bins can be more costly than simply upgrading the service in the peri-urban area.

(iii) Rural

Development sites in rural areas will vary in nature depending on the location, for instance whether the site is situated in a rural town or in a dispersed settlement. The waste collection system appropriate to the setting will also vary and be dictated by a range of factors. Due to lower population densities, the provision of solid waste collection systems in rural areas may sometimes require approaches that differ from those taken in cities or towns. For example, the distance to the nearest large landfill site or to recycling markets may affect the choice of waste management system. If on-site solid waste disposal (usually the burning of waste) is the only option, it should be done under supervision of a relevant municipal official. Assistance with the supervision of on-site disposal can be arranged with district municipalities or provincial departments responsible for environmental affairs.

M.3 Planning considerations

This section deals with the planning of solid waste services and infrastructure. In this context, the term 'planning' means making informed decisions regarding the storage, collection, transport, treatment and disposal of solid waste, and then choosing the most appropriate options based on a thorough understanding of the context within which the planned development will be implemented.

The decisions regarding solid waste management must be informed by a clear understanding of the features and requirements of the proposed project. This would require an assessment of the characteristics of the proposed development. Furthermore, the characteristics of the environment in which the new development will be located need to be examined and possible services and infrastructure that could be utilised must be identified.

This section outlines a range of questions should be asked and factors that have to be considered before deciding on the most appropriate solid waste management infrastructure and service.

M.3.1 Characteristics of the proposed development

Decisions regarding solid waste management infrastructure and services need to be guided by an assessment of the characteristics of the proposed development and an understanding of the requirements or needs that will have to be met. Aspects that should be considered are discussed below.

M.3.1.1 The nature of the proposed development

The type of development will determine the potential users of a solid waste management service and, in turn, the types of waste streams as well as the volumes of each waste stream that can be expected. This information is needed in order to plan an appropriate solid waste management service and to calculate whether existing solid waste management facilities will have sufficient capacity to handle the increase in waste volumes. The following questions can be asked to gain clarity:

- What is the dominant land use of the proposed development?
- What types of housing will be provided in the proposed development? What population densities are anticipated in the proposed development?
- What other land uses will form part of the proposed development? The number and size of different business properties, public open spaces, schools, clinics and public transport facilities will affect waste generation.

M.3.1.2 The residents of the area to be developed

Decisions regarding a solid waste management system should be guided by information about the residents of a neighbourhood. Usually, the identities of the actual occupants of the houses to be provided are not known when a development is planned and designed. It may be possible to make assumptions regarding the expected profile of the future residents by assessing the surrounding neighbourhoods or similar developments in comparable locations or contexts. It is important to establish the following:

- The total number of residents to be accommodated. Actual numbers may be higher than anticipated because the provision of houses and services may attract more people than originally planned.
- The number of households and the range of household sizes. The household information will likely be aligned with the anticipated residential building type, for instance single detached housing, semi-detached housing, attached housing or flats. This will provide an indication of the number of solid waste collection points that have to be serviced as well as the number of households to be serviced at a point.
- The range of residents with special needs that would have to be accommodated, for example people living with disabilities. Waste management facilities should (where relevant and possible) be accessible to all residents and users. Waste storage receptacles should be fit for use by all.
- Income and employment levels and spending patterns. This would, for instance, indicate the anticipated ability of the intended users to pay for waste collection services. It could also give an indication of the volume of waste that will be generated in the area.

M.3.2 Characteristics of the existing environment

Decisions regarding solid waste management need to be guided by an assessment of the context within which the development will be located. Issues that should be considered are discussed below.

M.3.2.1 The physical location of the proposed development

Constraints and opportunities posed by the project site could influence the solid waste infrastructure and service to be provided.

(i) Topography and geotechnical characteristics

The topography and geotechnical conditions of the project site might affect the type of solid waste management service that is selected. The following has to be considered:

- Do the access roads in the neighbourhood have steep slopes? Heavy solid waste collection vehicles have difficulty climbing steep slopes. The collection of solid waste may be more expensive in neighbourhoods with steep slopes due to the increased time it takes for trucks to move along steep roadways.
- The type of soil and the presence of water sources in the area may have an impact on the type of waste management facilities that can be provided. For instance, a landfill facility may not be appropriate in an area that has a relatively high water table.

(ii) Adjacent land uses and edge conditions

Adjoining properties have an impact on each other. Therefore, it is important to be aware of the land uses adjacent to the development site as well as of the edge conditions that affect the site. Some of the questions that need to be asked include the following:

- What are the existing land uses in the area or in surrounding neighbourhoods? Information on the type and amount of waste generated by the different land uses in the vicinity will inform decision-making on solid waste management services and infrastructure.
- Are there illegal dumping sites in the area? Where are these located? What are the possible reasons for the illegal dumping and how can it be avoided in future? Could any of these sites be developed into formal waste management facilities?

M.3.2.2 Available infrastructure and services

New developments create additional demand for services and therefore have a potential impact on existing services and infrastructure. The following information on existing solid waste management infrastructure and services in the area or in surrounding neighbourhoods has to be considered:

- What waste management facilities are currently operational in the area? (Refer to Section M.4.3)
- What is the capacity of existing waste management facilities and will these facilities be able to handle additional waste loads? What impact will the additional waste loads have on the lifespan of the existing waste management facilities?
- What vehicles and equipment are available for waste collection, storage and disposal?
- Does the road infrastructure of the area – the layout, length and width of streets – support easy access and manoeuvrability for waste collection vehicles to render an efficient and cost-effective waste collection service? Can the existing roads carry the waste loads between different waste management facilities and between waste management facilities and collection points?
- Are there existing initiatives for waste minimisation, reuse and recycling in the area? If yes, do households and businesses separate waste at source? Who is responsible for recovering recyclables? Are there existing markets for additional recyclables or will new markets have to be created?

The first port of call to find information on existing solid waste management is the Integrated Waste Management Plan (IWMP) for the municipality. The IWMP provides input to the Integrated Development Plan (IDP).

The IWMP includes a situation analysis with a description of the population in the area, a description of the services that are provided and the number of persons in the area who are not (yet) receiving waste collection services. The situation analysis also refers to existing institutional, financial, legal and physical conditions. The planning of waste management services in the municipality for the next five years is also included as part of the IWMP.

More information is available in the *Guideline for the development of Integrated Waste Management Plans.*[1]

M.3.3 Solid waste management options

M.3.3.1 Factors to consider when choosing waste collection options

Waste is generated at, among others, residences, businesses, schools and clinics. The type of waste from each of these points will differ, and the waste management service requirements will differ accordingly. A thorough understanding of the types and volumes of waste that will be generated in any new development will assist the municipality in minimising negative public health and environmental impacts that might result from inadequate solid waste management. Knowing the expected volumes and types of waste will assist in selecting an appropriate waste collection service for a neighbourhood (Section M.3.3.2) and subsequently the receptacles and storage at the point of generation (Section M.4.1), the number and size of collection vehicles (Section M.4.2), as well as the size, capacity and expected turnaround times of waste management facilities (Section M.4.3).

Waste flow projections are used to predict the volumes and types of waste that will be generated. This section provides guidance on how to do waste flow projections for an area by calculating future waste generation, estimating the composition of municipal solid waste and assessing the mass of municipal solid waste.

(i) Current and future solid waste generation

A first step towards doing waste flow projections is to determine the current solid waste generation of the neighbourhood. Calculate the waste generation per household per year or per population per year by using existing per capita information. Waste generated per capita may be based on available local figures or on existing estimates for domestic waste generation. Estimates can range from 0.41 kg/capita/day for low-income households to 1.29 kg/capita/day for high-income households.[2] The population of the area refers to the total number of people living in the area.

Equation M.1: Waste generation per household (tonnes/annum)

$$\text{waste generated per capita (kg)} \times \text{number of people per household} \times \frac{365}{1000}$$

Equation M.2: Waste generation for an area (tonnes/annum)

$$\text{waste generated per capita (kg)} \times \text{population of the area} \times \frac{365}{1000}$$

Using the current waste generation as a baseline, projections can be done for new developments. An expected waste generation growth rate can be based on anticipated population growth and/or anticipated economic growth. Domestic waste generation estimates are calculated using population growth rates, while industrial waste generation estimates are calculated using economic growth rates. This formula does not apply to garden waste estimates.

Equation M.3: Future waste generation (tonnes/annum)

$$\text{waste generation } (t/a) \times \text{population growth estimate (\% per annum)}$$

(ii) Composition of solid waste

Different waste streams require different types of storage, collection and treatment. Although the composition of municipal waste varies depending on local conditions, estimates can be made of waste generation per waste stream.

The *National Waste Information Baseline Report* [3] suggests that about 44% of all municipal solid waste originates from households. The following general assumptions can be useful when estimating the composition of municipal solid waste (the percentages are per weight):

- 15% organic (garden and food waste)
- 20% construction and demolition waste (builders' rubble)
- 25% mainline recyclables (paper, plastics, glass, tins and tyres)
- 40% non-recyclable waste

(iii) Solid waste mass

Information on the mass of solid waste is critical when determining the capacity requirements for waste transport and for waste disposal facilities. Waste data may be available in volume (m^3) or weight (kg). Use waste densities to convert waste volumes to estimated weights and vice versa. Waste densities differ depending on the type of waste and whether or not the waste has been compacted. Refer to Table M.1 for densities of different types of waste to estimate the waste mass by using the equation below.

Equation M.4: Waste mass (kg)

waste volume (m^3) x density (kg/m^3)

Table M.1: Typical densities by solid waste type [4]

Waste category	Waste type	Density (kg/m^3)
Domestic	Domestic waste compacted in rear-end loader	500
	Domestic waste (uncompacted)	200
	Mixed domestic /garden waste (more domestic than garden)	200
	Mixed domestic /building rubble (more domestic than building)	250
Commercial/Industrial	Packaging (paper and plastics)	200
	Timber/metal	150
	Tyres	150
Inert waste (construction waste)	Building rubble/concrete/sand/fibreglass/brick/ceramics	750
	Building rubble/industrial mix (more building than packaging)	350
	Building/garden mix (more building than garden)	250
Garden waste	Loose grass/small branches	200
	Large logs	400
	Garden /building mix (more garden than building)	250
Perishable waste	Food waste/animal fodder	840

M.3.3.2 Collection options for municipal solid waste

Municipalities should plan a waste management service that will comply with legislation and with service expectations, while ensuring that the key objectives are met (refer to Section M.2.2). A basic refuse removal service can be defined as the most appropriate level of waste removal service based on site-specific circumstances.[5] Although an equitable waste collection service must be provided to all households, the *National Domestic Waste Collection Standards*[6] (set in line with the NEM:WA) recognise that service levels may differ between areas depending on contextual considerations.

Cost recovery for solid waste management

Solid waste management services are financed through municipal rates and taxes. However, municipalities often struggle to pay for the necessary infrastructure and the other costs associated with solid waste management of new developments. New development projects should ideally not place a financial burden on existing rate payers. Costs for new site-specific infrastructure can potentially be recovered through a contribution or levy that is paid by the developer to the municipality. Therefore the waste management service provision in new development projects (greenfield, brownfield and informal settlement upgrading) should be determined and costed (in cooperation with the municipal department responsible for solid waste management) before approval of the project by a municipality.

Similar arrangements are often made to recover costs of engineering service infrastructure for water supply, sanitation and electricity. Existing municipal policies on development contributions or levies could be expanded to include solid waste management.

The choice of service level for solid waste collection will be influenced by the size, density and waste-generating potential of a neighbourhood, as well as issues such as road conditions and the distance between the neighbourhood and waste management facilities. Deciding on the most appropriate waste collection system is an iterative process that requires information on the following:

- Waste flow projections to determine the amount of waste that will be generated for each waste stream and the frequency at which this waste will likely be generated (refer to Section M.3.3.1).
- The spatial distribution of the waste generation points. This can be done by considering the spread of land uses, housing types and densities.
- The possibility of recycling and recovering of solid waste (refer to Figure M.3 for an illustration of the waste management system). Will enough waste be generated to sustain the implementation of alternative treatments?
- The options for labour-intensive or job-creating collection services. This consideration is relevant to all neighbourhoods, but in particular to neighbourhoods where the provision of conventional services might be challenging (e.g. where long distances have to be covered or where municipal waste collection vehicles are not able to access an area).

Four conventional collection systems are presented below. Different systems are usually implemented in combination.

(i) Door-to-door or kerbside collection

In this system, domestic and non-hazardous business waste are placed (in receptacles) on the sidewalk to be collected by the municipality, service provider or local entrepreneur. The collection is usually done with purpose-built vehicles.

Kerbside collection increasingly also has to cater for recyclables that are separated at source. Different receptacles are required for source-separated waste (refer to Section M.4.1). Aspects to consider for the kerbside collection of different waste streams include the following:

- One vehicle can be used for collecting different waste streams by using a split compartment vehicle or a truck-and-trailer combination.

- Different vehicles can be used for different waste streams. Implementing separate vehicle collections will reduce the load collected by each vehicle per collection point but could affect traffic movement in the area on collection days if the streets are not wide enough.
- The municipality can partner with local entrepreneurs to collect some of the waste.

(ii) Central collection points

In this system, households or local entrepreneurs are required to place the waste or recyclables into strategically positioned bulk containers for collection and removal by large motorised vehicles. These containers must be placed at a convenient location not far from households and accessible to waste collection vehicles for easy removal.

A central collection point is often used in areas where poor access hampers kerbside collection, for example in informal settlements or high-density areas where the layout and/or road conditions restrict the access of waste collection vehicles. This system is also an option for household waste collection in rural areas where it may not be financially feasible for the municipality to do door-to-door collection.

Central collection points, combined with drop-off or buy-back centres (see Section M.4.3), can be considered for source-separated recyclables in areas without kerbside collection for recyclables. Central collection point systems may include exchange and underground containers (refer to the sections below). Containers used at central collection points should be fit for use to a range of users. For example, children or people with disabilities should be able to deposit waste into the container without any difficulty.

(iii) Exchange-container collection systems

Exchange-container collection systems entail replacing the full container with an empty one on the collection day. Static compactors and skips are examples of exchange containers. This collection system is typically used at the following locations:

- Markets or other places where high volumes of waste must be removed on a daily basis
- Industries and places where (usually non-biodegradable) waste is collected less frequently than household waste
- Building sites where building rubble must be collected and removed
- Waste transfer stations, where solid waste is deposited into large containers for storage until it is collected for long-haul transport to landfill sites
- Central solid waste collection points such as recycling centres

(iv) Underground container systems

This system makes use of specially designed waste containers that are positioned underground or partially underground. The underground system can either be a stand-alone collection point or it can incorporate an automated vacuum collection system (also referred to as a stationary pneumatic collection system). Underground containers can hold large quantities of waste and have the advantage that the waste is protected from the elements (specifically rain and wind). The chances of the waste polluting the immediate surroundings are therefore limited.

Underground containers are used in public open spaces, in areas with high pedestrian densities, and in urban areas where conventional door-to-door collections are challenging due to topography or limited space for waste containers. Underground containers come in a variety of designs and forms, and usually require specialised vehicles for lifting.

Photo credit: Pikitup

Figure M.4: Specialised vehicles are used to empty underground containers

Solid waste collection frequency

The frequency of solid waste collection depends on the type of waste. For instance, restaurant waste is collected daily while household waste is collected weekly. The collection could also be event-specific, for example after an event at a sports stadium. The following frequencies are recommended for waste collection:

- Remove non-recyclable (residual) waste once a week to avoid waste-related nuisances and possible public health impacts.
- Remove recyclable waste at least once every two weeks. This should be coordinated with recyclers or local entrepreneurs to minimise cost and to ensure that local waste management facilities have enough capacity to accept and process the recyclables.
- Empty containers at communal collection points when they are full, to prevent the spilling of waste.
- Collect putrescible waste generated by hotels, restaurants, food shops, hospital kitchens and canteens daily to prevent the waste from decomposing and presenting a possible health risk.

M.4 Design considerations

Once an appropriate waste collection system has been selected, the solid waste management service and accompanying infrastructure can be designed. Decisions should be made regarding storage, transport, treatment and disposal of solid waste.

The location of proposed waste management facilities has to be considered when the layout of a new or upgrading project is done (refer to **Section F** for guidelines on neighbourhood layout and structure). The decisions regarding solid waste management services must take place in tandem with the design of engineering services (including water provision, sanitation and stormwater management) to ensure that the service will be ready for implementation at the time of occupation of the new development. Apart from the obvious convenience to the user, the availability of a solid waste management service will assist in preventing illegal dumping. Clearing of illegal dumping and littering is usually more expensive than providing effective and reliable waste collection services from the start.

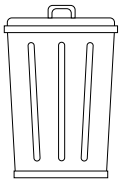
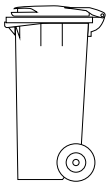
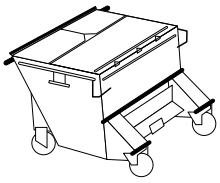
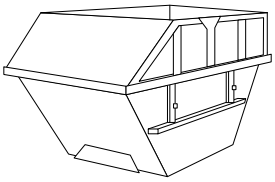
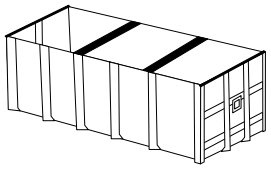
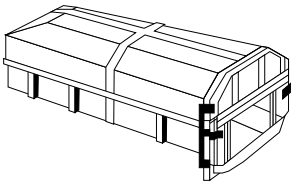
M.4.1 Receptacles and storage at point of generation

This section describes the storage of waste at the point of generation, which can include different types of housing (e.g. single detached or blocks of flats), shopping centres, clinics, schools, etc. Waste is also stored at collection points for recyclable materials and at transfer stations where waste is accumulated before being transported over longer distances (see **Section M.4.3**).

M.4.1.1 Solid waste receptacles

If a kerbside collection service is selected, bins or bags are placed on the sidewalk for collection. The empty bins or bags are returned to the sidewalk. Municipalities are not obliged to provide individual domestic bins to residents. However, the provision of a bin per household has proved to lower the risk of illegal dumping.[7] In South Africa, formal neighbourhoods are typically serviced by means of 240 *l* wheeled bins, although other sizes are also available on the market. Bulk containers ranging in size from 5 m^3 to 30 m^3 and large static compactors are mostly used for business waste. Static compactors are recommended for all office developments larger than 5 000 m^2.

Table M.2 shows examples of receptacles that are compatible with a kerbside collection service. Containers will differ depending on the waste collection system that is suitable for a specific area and whether waste is separated at source.

Table M.2: Containers for on-site storage				
Description	Common usage		Collection methods	
85 to 105 *l* plastic bin liners	• Domestic/household • Small business and industry • Public amenities		By hand on site, or on sidewalk Liners deposited directly into collection vehicle	Storage containers emptied on site
85 *l* rubber/ galvanised steel bins	• Domestic/household • Small business and industry • Public amenities		By hand on site, or on sidewalk Liners deposited directly into collection vehicle	
120, 140 or 240 *l* mobile refuse bins (wheelie bins)	• Domestic/household • Small business and industry • Public amenities		Rear-end loading compactors with special lifting equipment	
1.0 and 1.2 m^3 mobile refuse containers	• Small business and industry		Rear-end loading or front-end loading compactors with special lifting equipment	
4.5, 5.5, 6, 9 and 11 m^3 bulk containers	• Large business and industry, garden refuse, building rubble, public amenities • Bulk waste and communal collection systems		Skip loaders Rear-end loading compactors with special lifting equipment	Exchange storage containers
15 to 30 m^3 open bulk containers	• Large business and industry, garden refuse, building rubble • Bulk waste and communal collection systems		Roll-on/roll-off vehicles	
11, 15 and 35 m^3 closed containers	• Large shopping centres, transfer stations and selected industries		Roll-on/roll-off vehicles	

M.4.1.2 On-site storage of solid waste

An on-site waste storage facility is used for storing waste from the time of generation until it is collected. Bulk containers, compaction units and large numbers of bins that are ready to be collected require on-site storage facilities that are accessible to waste collection vehicles. The preferred position of the waste storage area is close to the main entrance or service entrance of the property. Consider the following:

- A housing complex with fewer than 10 units usually does not require a central storage space, but this would depend on the overall layout of the units (e.g. whether there is space for a wheelie bin at each individual unit, or whether waste at each house is collected in bags to be transferred to wheelie bins in a storage area).
- Housing complexes with 10 to 20 units are best serviced by a single centralised waste storage area where there is enough space for the collection vehicle to load the waste inside the property and minimise the impact of waste collection on traffic.
- Larger complexes of more than 20 units require a site-specific plan to ensure effective and efficient waste collection. The plan can include door-to-door collection if road access is sufficient (refer to **Section M.4.2** on the requirements of different collection vehicle types) or collection from central points where bulk containers or static compactor units are provided in centralised waste storage areas. There are various types of compactors available to suit different types and sizes of developments.

In instances where central collection points are the most practical service option (including attached housing, flats/apartments and office blocks), additional storage space is often required. For more information on the need for additional storage space, refer to the *National Domestic Waste Collection Standards*.[8]

The dimensions of the two common bin types that are used in South Africa are provided in Figure M.5. Sometimes static compactors are also provided on site. The space required will vary depending on the container capacity. The site should be designed to accommodate the compactor, containers and a roll-on/roll-off vehicle.

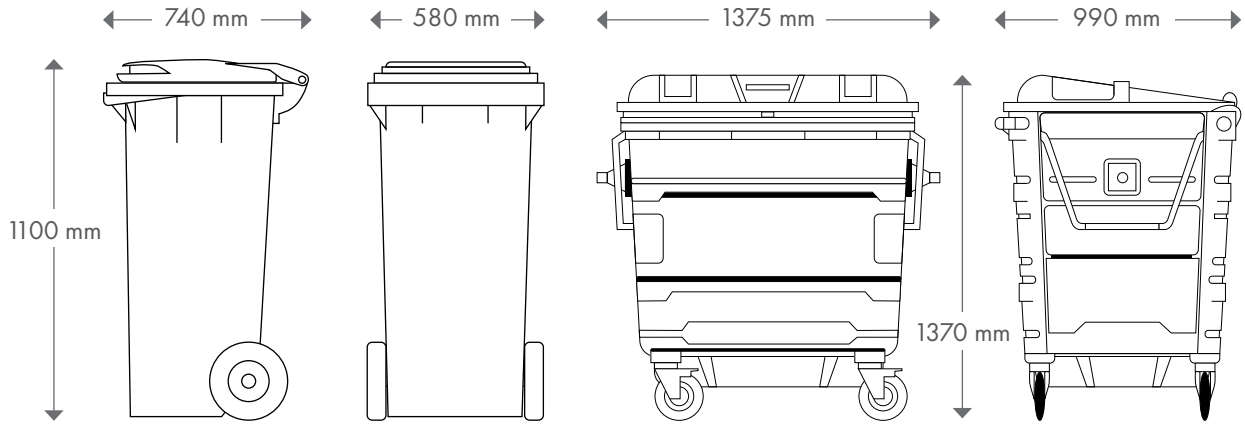


Figure M.5: Waste receptacles commonly used in South Africa include the 240 *l* bin (L) and the 1 100 *l* bin (R)

Public cleaning services

It is the responsibility of municipalities to sweep streets, maintain and clean road verges, empty bins and clean public open spaces. The collection of illegally dumped waste and the prevention of illegal dumping also form part of municipal solid waste management. Measures to prevent litter include the following:

- Avoid empty spaces that are prone to become illegal dumping spots. Beautify areas such as street corners and add adequate waste and recycling bins that are emptied regularly.
- Provide enough strategically positioned and clearly marked litter bins (for residual waste and recyclables) in public open spaces and along pedestrian walkways. Match the number and size of bins in public open spaces with the following:
  - The foot traffic density
  - The frequency at which bins will be emptied
  - The foot traffic mobility (free-flowing or queueing?)
  - The activity in the area (e.g. local taxi ranks typically generate more waste than suburban parks)

The management of solid waste and specifically the avoidance of litter are critical to the efficient functioning of stormwater management systems. Litter can block sewers and stormwater canals which may lead to pollution. It may also aggravate the impact of flooding, causing damage to property and endangering lives. Refer to Section L for guidance on the planning and design of neighbourhood stormwater management systems.

M.4.2 Transport of solid waste

Solid waste collection and transport in South Africa is mostly done using motorised vehicles. Consider the waste collection vehicle to be used and the accessibility of the neighbourhood when designing for the transport of solid waste.

M.4.2.1 Waste collection vehicles

The types of vehicles used by the waste management industry in South Africa range from basic hand carts to technically sophisticated and motorised front- and rear-loading compaction vehicles. When deciding on a type of vehicle, the following should be considered:

- Select a vehicle that is appropriate for the type and volume of waste. For example, a caged truck is suitable for waste that does not need compaction.
- Select a vehicle type that is appropriate for the specific road conditions in the area. For instance, a tractor and trailer may be appropriate for a rural gravel road where trucks may have difficulty to drive.
- Select a vehicle size that is appropriate to the street layout in the area. For example, the turning circle of a large compaction vehicle is not compatible with small cul-de-sac streets.
- Ensure compatibility between supplied waste containers/receptacles and collection vehicles.

Determine the number of vehicles required to provide an effective waste collection system by considering the capacity of the collection vehicle, the number of households to be serviced per day, the average waste generation per household and the distance to the disposal facility (see Section M.3.3.1).

The dimensions (e.g. ground clearance, length, height, width, weight and required turning circle) of waste collection vehicles have to be taken into consideration in the planning and design of neighbourhood street layout and road pavements to ensure that these vehicles can access neighbourhoods without difficulty (refer to Section M.4.2.2). The waste collection and transport vehicles that are most widely used in South Africa are presented below. Information about the features of the various vehicles is provided and issues to consider in the design of neighbourhood waste collection systems are highlighted. A short distance is regarded as being below 5 km, while a medium distance would be between 5 and 20 km and longer distances exceed 20 km.

(i) Push carts or caged waste tricycles

The dimensions of push carts and waste tricycles vary, but these vehicles often have capacity for between 1 m^3 and 3 m^3 of waste. Push carts are mostly used by local entrepreneurs or recyclers to collect waste from individual households. These types of vehicles are particularly suitable for the collection of recyclable and/or residual waste in small to large informal communities without formal waste collection and in areas with central collection points (see Section M.4.3.4). Push carts are increasingly used in middle- to high-income neighbourhoods as well, where they are used for collecting recyclables.

Push carts and waste tricycles can only cover short distances and would need a waste management facility (see Section M.4.3) such as a buy-back centre or drop-off facility within its operational range. A central collection point can also take the form of a large collection truck that serves an area once a week (on the day that household waste is placed on the sidewalk for collection).

(ii) Animal-drawn carts

Animal-drawn carts are sometimes used to collect waste in rural, peri-urban or low-density areas where low volumes of residual and/or recyclable waste have to be transported over longer distances. The capacity of an animal-drawn cart varies according to the design of the vehicle. These carts can cover short to medium distances and would need a waste management facility (see Section M.4.3) such as a buy-back centre or drop-off facility within its operational range.

Photo credit (L): Annemarie Loots

Figure M.6: Waste can be collected by local entrepreneurs using a push cart (L) or by using a tractor and trailer (R)

(iii) Tractors and trailers

Tractors and trailers are often used to collect and transport waste in smaller towns and in rural areas. A tractor and trailer combination can operate where road conditions are not suitable for trucks. The capacity of the trailer varies according to the design. These vehicles can cover medium-range distances (between 5 and 20 km) and would need a waste management facility (see **Section M.4.3**) such as a drop-off facility or a transfer station within operational range.

(iv) Caged trucks

Caged trucks are often used for waste that does not need compaction and has to be transported over medium-range distances. The capacity of the vehicle depends on the design of the cage and the size of the truck.

Figure M.7: Examples of a caged truck (L) and a tip truck (R) that are used for waste collection

(v) Tip trucks

Tip trucks are used to transport heavy waste loads over medium to long distances. These vehicles have a back part that can be raised at one end so that the waste falls out. With large tip trucks, the weight of the moving waste can assist with compaction.

(vi) Front-end loaders

Front-end loaders are used to collect waste and transport heavy waste loads over medium to long distances. These trucks are equipped with a bin lifter at the front of the vehicle. The driver operates the bin lifter from within the cabin to lift waste containers over the truck. Once it gets to the top, the container is flipped upside down and the waste is emptied into the vehicle. The waste is compacted and when full, the waste is discharged from the back of the vehicle. Front-end loaders have a large carrying capacity and are specifically suitable for the collection of bulk containers.


Figure M.8: Examples of a front-end loader (L) and a rear-end loader (R) that are used for waste collection

(vii) Rear-end loaders

Rear-end loaders are used to collect waste and transport heavy waste loads over medium to long distances. These trucks have an opening at the rear for the disposal of waste. Waste bags are thrown in by waste collectors or bins are emptied into the truck by using a bin-lifting mechanism. The waste is compacted and when full, it is discharged from the back of the vehicle. Rear-end loaders usually have a large carrying capacity due to waste compaction.

(viii) Skip loaders

A skip loader is a specially designed truck for loading and transporting skips (large open-topped waste containers). Skip loaders collect waste containers from industries, large businesses and building sites and transport the waste over medium to long distances. Skips are often used at central collection points in communities with or without kerbside collection.


Figure M.9: Examples of a skip loader (L) and a roll-on/ roll-off vehicle (R) that are used for waste collection

(ix) Roll-on/roll-off vehicles

Roll-on/roll-off vehicles are specially designed trucks that transport rectangular waste containers between collection and disposal points. The truck raises a hydraulically operated bed to roll the container onto the ground. A cable and winch system or a hook-lift system is used to lower the container onto the ground and to pull the filled container onto the truck. Roll-on/roll-off vehicles collect waste in bulk containers from industries, large businesses and building sites and transport the waste over medium to long distances. Some of these containers are enclosed (not open on top) and can compact the waste. Compaction increases the capacity of these containers.

(x) Rail

Waste removal by rail is used to transport heavy waste loads over long distances, especially to regional landfill sites. It is also suitable for hauling recyclables to recyclers over long distances. It is a cost-effective transport option with available (often underutilised) infrastructure, especially if operated during off-peak periods. Transport of waste still has to take place to and from the railway depot, using one of the vehicles discussed earlier.

M.4.2.2 Waste collection vehicle access

Waste collection vehicles should be able to access neighbourhoods without difficulty. When designing street layout and road pavements, the following should be considered to ensure that road infrastructure (streets, bridges, entrances, structural foundations) can accommodate waste collection vehicles:

- **Loading**: Road pavements should be designed to have the structural capability to carry a waste collection vehicle that is filled to capacity. Refer to **Section I** for guidance on the load-bearing capabilities of roads.
- **Space for manoeuvring**: Turning areas (often in cul-de-sacs) should be sufficient to allow the waste collection vehicle to turn with no more than three manoeuvers (refer to **Section F.4** for guidance on street width). Motorised collection vehicles should move in a forward direction most of the time. In the exceptional circumstance where such a vehicle is required to reverse, the distance should be very short and should not be up or down a slope or ramp.
- **Clearance**: Bridges and entrances/gates (at residential, retail and industrial complexes) should be wide enough and high enough to allow easy access for waste collection vehicles. Waste collection vehicle dimensions give an indication of access requirements (e.g. gate width or overhead clearance) when designing facilities.

The planning of waste collection as part of a brownfield project or an informal settlement upgrade project will have to adapt to the existing neighbourhood street layout. Alternative waste collection methods (e.g. collection by local entrepreneurs) may have to be introduced in areas that do not have sufficient access for large waste collection vehicles.

M.4.3 Solid waste management facilities

Waste management facilities deal with the storage, sorting, treatment and final disposal of waste and may include transfer stations, buy-back centres, drop-off centres, materials recovery facilities, treatment facilities and landfill/disposal sites. Different waste management facilities are required as part of a waste management system (see Figure M.3) that is aligned with the waste management hierarchy (see Figure M.2). New solid waste management facilities that are provided in a neighbourhood must be appropriate to local conditions. The following should be considered:

- Match the proposed waste management facilities with the type of waste generated and the waste collection method that is used in the area.

- Find agreement on the exact location of a proposed waste management facility in collaboration with the local community. Facilities should be placed such that they do not interfere with pedestrian movement, create an eyesore, or become a public nuisance because of dust, odour or poor maintenance. Position larger or more sophisticated waste facilities at a location that will allow easy access to major routes.
- Consider converting existing illegal dumping spots to legal waste management facilities if the layout of the neighbourhood allows. It is often difficult to stop people from using a dumping site that was established informally. Refer to *Municipal waste management – good practices*[9] for ideas on how to turn illegal dumping spots into areas that communities take ownership of.
- Comply with the requirements of both the local and provincial authorities, particularly in respect of road pavement design and traffic flow at intersections and access roads. The increased number and higher frequency of heavy waste collection vehicles may have an impact on the character of a neighbourhood.
- Design the layout of waste management facilities to ensure the easy, fast and effortless flow of day-to-day operations and the convenience of those frequenting the facilities (e.g. residents making use of drop-off centres).
- Develop facilities to form part of an integrated waste management system and avoid stand-alone entities. Any service expansion will have an impact on the existing solid waste management system in the municipality. Such an expansion should be carefully planned, designed and managed to ensure that the entire solid waste management system becomes more sustainable over the longer term.

M.4.3.1 Materials Recovery Facilities

A Materials Recovery Facility (MRF) is a specialised plant that receives, sorts and prepares recyclable materials for end-user manufacturers or recycling companies.

- A clean MRF accepts recyclable materials that have already been separated at the source from non-recyclable municipal solid waste. The recyclables are mixed and need to be sorted further before being baled.
- A dirty MRF accepts municipal solid waste that has not been sorted according to recyclable and non-recyclable materials. At the dirty MRF, the recyclables are separated from the non-recyclable municipal solid waste, sorted further and baled.

Waste is usually brought to MRFs by waste collectors (local entrepreneurs) and community members. After sorting, the recyclable materials go to relevant end-user manufacturers or recycling companies. Residual waste (that remains after sorting) is removed by the local municipality and usually disposed of at landfill sites.

MRFs can use simple technology such as sorting tables and conveyor belts, and these can potentially employ high numbers of low-skilled staff to do the sorting and baling. Sophisticated machinery can also do the sorting with only one or two skilled staff members employed to operate the system. The level of mechanisation required at a MRF will therefore depend on the type of waste handled, the need for job creation and the available funds. Indicative thresholds regarding volumes handled, operational areas and level of automation are provided in the *SALGA Good Practice Guide to: Waste Transfer Stations, Materials Recovery Facilities and Buy-back centres.*[10]

Figure M.10: Recyclables offloaded at a clean MRF (L) and sorting tables at a dirty MRF (R)

M.4.3.2 Buy-back centres

Buy-back centres are run as small businesses that buy recyclable materials from community members or waste collectors (local entrepreneurs). The waste is then sorted, crushed and/or baled and sold to members of the recycling industry. Buy-back centres are usually viable in low-income areas, where community members are rewarded for collecting recyclables. However, with more waste collectors active in middle- and high-income neighbourhoods, buy-back centres may become viable in these areas. Buy-back centres for recyclable waste can be set up at shopping malls, parks, schools and churches. Mobile buy-back centres are sometimes used to put facilities within reach of more users and to shorten the distances for those making a living from collecting and selling recyclables. Guidance on specifications for buy-back centres is provided in the *SALGA Good Practice Guide to: Waste Transfer Stations, Materials Recovery Facilities and Buy-back centres.*[11]

M.4.3.3 Transfer stations

A waste transfer station is a facility where solid waste is transferred from collection vehicles to more appropriate long-haul vehicles before the waste is transported over longer distances (exceeding 20 km) to dirty MRFs, treatment facilities or for final disposal at landfills. The purpose of these stations is to reduce the transport unit cost of collection vehicles (by achieving more cost-effective payloads) and to achieve quicker turnaround times for collection vehicles. Decide on the number of transfer stations and the degree of sophistication required according to the volume of waste generated, the collection system implemented and the distance to the disposal site. For further assistance, consult the *SALGA Good Practice Guide to: Waste Transfer Stations, Materials Recovery Facilities and Buy-back centres.*[12] A break-even point can be calculated where it will be more economical to build a waste transfer station than to haul waste materials over long distances. In the equation below, the waste transfer station (WTS) cost refers to the cost to build, own and operate the transfer station (in R/tonne) and the distance of the haul refers to a two-way distance (in km).

Equation M.5: Break-even point for transfer station

Cost of Direct haul = [distance (km) x trucking cost (R/km)] / direct haul payload (tonnes)

Cost of Transfer = [WTS cost (R/tonne) + distance (km) x trucking cost (R/km)] / transfer haul payload (tonnes)

M.4.3.4 Central collection points

A central collection point is often used in areas where poor access hinders the provision of kerbside collection services. For example, the layout or road conditions in high-density informal settlements may not be suitable for use by heavy waste collection vehicles. Central collection points can be combined with buy-back centres (see Section M.4.3.2) or drop-off facilities (see Section M.4.3.5) in areas where kerbside collection for recyclables is not implemented.

Waste is usually brought to central collection points by waste collectors (local entrepreneurs) and community members. The locality of the collection point is critical to ensure easy access for all users. Refer to Section F for guidance on neighbourhood layout. Where necessary, ramps must be provided to facilitate easy access for placing the waste inside the containers.

M.4.3.5 Drop-off facilities

Drop-off facilities are similar to buy-back centres, but these facilities are not managed as businesses. Recyclables are dropped off without the expectation to receive any form of compensation for either the effort to bring in the waste or the separated recyclables itself. Garden refuse sites are examples of drop-off facilities.

When deciding on the need for drop-off facilities in a development, consider providing multi-purpose drop-off sites. A multi-purpose drop-off facility would typically take garden waste as well as paper, plastic, glass and cans. The reduced number of household trips to drop off waste does not only add to the convenience of users, but will ultimately result in a smaller carbon footprint. Drop-off facilities for recyclable materials can be set up at shopping malls, parks (see Section G), schools and churches, but should be well maintained.

Figure M.11: Examples of multi-purpose drop-off facilities

M.4.3.6 Treatment / Recovery facilities

The recovery of waste resources, as referred to in the waste management hierarchy (Figure M.2), includes various waste treatment options such as organic waste composting or digesting biodegradable wastes to produce usable gases. Waste treatment options may include the following:

- Advanced biological treatment (including in-vessel composting and anaerobic digestion)
- Advanced thermal treatment (including pyrolysis, gasification and incineration)
- Incineration of unprepared - raw or residual –municipal solid waste
- Mechanical biological treatment (separation and then treatment/ treatment and then separation)
- Mechanical heat treatment

When deciding on the possible treatment of waste, consider the following:

- Most technologies are waste-stream-specific and therefore require source-separated waste to function optimally. Waste that has not been separated at source will have to be separated at a MRF or will have to be pre-treated before it can be processed.
- Alternative treatment technologies are expensive to implement relative to disposal at landfill and require economies of scale to be feasible.
- The residues from alternative treatment technologies are mostly concentrated waste streams with higher risk levels than untreated municipal solid waste. These waste streams therefore require classification and assessment prior to disposal at landfills.

Depending on the size of the facility and the type of treatment at the site, treatment facilities would most likely require a waste management licence. An Environmental Impact Assessment (EIA) will have to be done in terms of the NEM:WA. The key issues that should be considered in the EIA include emissions, dust, odour, flies, vermin and birds, noise, impact on water resources and visual intrusion.

These facilities may also generate additional traffic in an area. For a 50 000 tonne per annum capacity plant up to 30 waste collection vehicles per day can be anticipated.

M.4.3.7 Landfill sites

Landfilling is the least desired option for disposal of waste. Only waste with no recycling or recovery alternative should be disposed of at landfills. The design of landfill facilities falls outside the scope of this Guide, but the following should be noted when designing a waste management service in a neighbourhood:

- Make provision for final disposal of residual waste, irrespective of other waste diversion strategies and technologies implemented, because all treatment technologies have a portion of residual waste that needs to be disposed of.
- Follow the specifications for disposal of pre-classified and listed waste, as well as the requirements for classification of waste that is not pre-classified to ensure proper disposal according to the *National Norms and Standards for Disposal of Waste to Landfill*[13] set in line with the NEM:WA. There are specified waste acceptance criteria for each class of landfill. For example, no tyres (quartered, shredded or otherwise) may be disposed of at a landfill. There are also restrictions on the disposal of garden waste at landfills and alternative facilities are required for garden waste disposal.

For detailed formulae and explanations on how to calculate landfill site life, the *Minimum Requirements for Waste Disposal by Landfill*[14] can be consulted.

Figure M.12: Different vehicles are used for the disposal of solid waste at landfill sites

Glossary, acronyms, abbreviations

Glossary

Baling
Baling is the process to compress or bundle waste material into a block or bale which can then be secured by plastic or wire strapping. Bales are easy to store and transport.

Building and demolition waste
Waste, excluding hazardous waste, produced during the construction, alteration, repair or demolition of any structure. It includes rubble, earth, rock and wood displaced during construction, alteration, repair or demolition. Also sometimes referred to as builders' rubble.

Business waste
Waste that emanates from premises that are used wholly or mainly for commercial, retail, wholesale, entertainment or government administration purposes.

Buy-back centre
A facility where recyclable waste materials can be exchanged for money, food or clothing. Buy-back centres purchase recyclable waste from collectors (formal and informal) of waste, bale the waste and sell it on to recycling industries.

Compaction
Waste compaction is the process of reducing waste in size by means of compaction. This is done so that more waste can be stored in the same space. Waste compaction is often done in the waste collection vehicle, while a more thorough compaction is done at the landfill to conserve valuable airspace and to extend the landfill's life span. The amount this volume is reduced by is called the compaction ratio. For example, a compaction ratio of four to one indicates that four times the volume of compacted waste can be placed in the same storage space occupied by the non-compacted waste.

Composting
A controlled biological process in which organic materials are broken down by micro-organisms.

Container
A disposable or reusable vessel in which waste is placed for the purposes of storing, accumulating, handling, transporting, treating or disposing of that waste. This includes bins, bin-liners and skips.

Development contribution
A financial contribution which an applicant for development is required to make to fund the provision of engineering services to the land to be developed.

Disposal
The burial, deposit, discharge, abandoning, dumping, placing or release of any waste into, or onto land.

Domestic waste
Waste, excluding hazardous waste, that emanates from premises that are used wholly or mainly for residential, educational, health care, sport or recreational purposes.

Garden waste
Organic biodegradable waste material generated from the likes of a typical garden.

General waste
Waste that does not pose an immediate hazard or threat to health or the environment and includes:

- Building and demolition waste
- Business waste
- Inert waste

Hazardous waste
Any waste that contains organic or inorganic elements or compounds that may have a detrimental impact on health and the environment, owing to the inherent physical, chemical or toxicological characteristics of that waste.

Incineration
Any method, technique or process to convert waste to gases and residues by means of oxidation.

Litter
Waste products that have been disposed of improperly, without consent and in an inappropriate location.

Materials Recovery Facility
A processing facility where waste materials are sorted and prepared for sale or transport to end users.

Medical waste
Waste generated by hospitals, clinics, nursing homes, doctor's offices, medical laboratories, research facilities and veterinarians, which is infectious or potentially infectious.

Minimisation
The avoidance of the amount and toxicity of waste that is generated and, in the event where waste is generated, the reduction of the amount and toxicity of waste that is disposed of.

Organic waste
Waste of biological origin that can be broken down, within a reasonable amount of time, into its base compounds by micro-organisms and other living things and/or by other forms of treatment.

Recovery
The controlled extraction or retrieval of any substance, material or object from waste.

Recycling
A process of reclaiming waste for further use, which involves the separation of waste from a waste stream and the processing of that separated material as a product or raw material.

Reuse
Utilising the whole, a portion of or a specific part of any substance, material or object from the waste stream for a similar or different purpose, without changing the form or properties of such substance, material or object.

Solid waste
Waste of a solid nature generated by a person, business or industry.

Sorting
The authorised separation of solid waste materials for the purpose of recycling or disposal, either at the source of generation or at a solid waste management facility.

Storage
The accumulation of waste in a manner that does not constitute treatment or disposal of that waste.

Treatment
Any method, technique or process that is designed to

- change the physical, biological or chemical character or composition of a waste,
- remove, separate, concentrate or recover a hazardous or toxic component of a waste,
- destroy or reduce the toxicity of a waste,

in order to minimise the impact of the waste on the environment prior to further use or disposal.

Waste
Any substance, material or object that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of by the holder of that substance, material or object, whether or not such substance, material or object can be reused or recycled.

Waste management services
Waste collection, treatment, recycling and disposal services.

Waste transfer facility
A facility that is used to accumulate and temporarily store waste before it is transported to a recycling, treatment or waste disposal facility.

Waste treatment facility
Any site that is used to accumulate waste for the purpose of storage, recovery, treatment, reprocessing, recycling or sorting of the waste.

Acronyms and abbreviations

DEA	Department of Environmental Affairs
EIA	Environmental Impact Assessment
IDP	Integrated Development Plan
IWMP	Integrated Waste Management Plan
MRF	Materials Recovery Facility
NEM:WA	National Environmental Management: Waste Act
SALGA	South African Local Government Association
SAWIS	South African Waste Information System
SDG	Sustainable Development Goal
SMME	Small, Medium and Micro-sized Enterprise
WTS	Waste transfer station

Endnotes

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14 Department of Water Affairs and Forestry. 2005. Third edition. *Minimum Requirements for Waste Disposal by Landfill*. Department of Water Affairs and Forestry, Pretoria.

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