B4
Waste

Guiding principles

Access and equity: The remoteness of many Indigenous communities means they are often required to manage their own waste but lack the capacity to move it through the system. Information services and resources to improve practices are limited. The differences in scale between typical urban and Indigenous communities are also significant. For example, a single bin collection round per week is not equitable when there are 10 people in a house rather than the urban average of 2.6.

Health and safety: Many remote communities lack an understanding of the health risks posed by untreated waste and have difficulty obtaining adequate support or assistance to deal with common hazardous materials. Risk management through education, correct handling of hazardous materials and good facilities design will ensure a safe living and working community environment.

Environmental health: Effective waste management is essential to minimise associated health and environmental risks. Concern is often expressed at the amount of litter and old car bodies in some remote Indigenous communities, but it is important to distinguish genuine health risks from aesthetic considerations. Successful waste management is more likely to follow from a clear understanding of the health issues than from notions of tidiness.

Appropriateness: Waste management approaches differ according to climatic conditions, particularly in the design of landfills where rainfall is a consideration. Appropriate measures to minimise waste generation by reducing packaging and implementing waste reuse and recycling will reduce landfill and environmental impacts.

Affordability: The high costs of collection prohibit many small communities from establishing and maintaining a waste management service. Recycling has been introduced on a small scale into some communities with programs for cans, car bodies, vehicle parts and heavy metal, but is often difficult to sustain economically with fluctuating market prices and subsidies.

Sustainable livelihoods: Almost all management of waste and rubbish in a community relies on the involvement of its Indigenous members, both as users of the service, and through employment in waste collection and landfill operation. Appropriate, affordable local solutions are crucial in effective waste management, particularly in providing a sustainable source of local employment and income.

Systems overview

Waste management infrastructure is required at two levels: the household and the community.

Household infrastructure mainly concerns the types of bin present at the house. The external bin choice should reflect community priorities and practices.

Community infrastructure ranges from the type of vehicle used to collect waste from households and service buildings to the equipment at the landfill or transfer station site.

Generally, waste in communities is disposed of in internal bins, which are emptied into external bins. These are in turn collected by community trucks and transported to a landfill site, which may or may not be effective in containing waste. Methods to increase a landfill site's effectiveness include wind breaks, fencing, water drainage, and any other mechanism for retaining waste without jeopardising nearby environmental factors such as groundwater. Most products arriving in communities ultimately stay there because distance and low economy of scale limit the options for disposal.

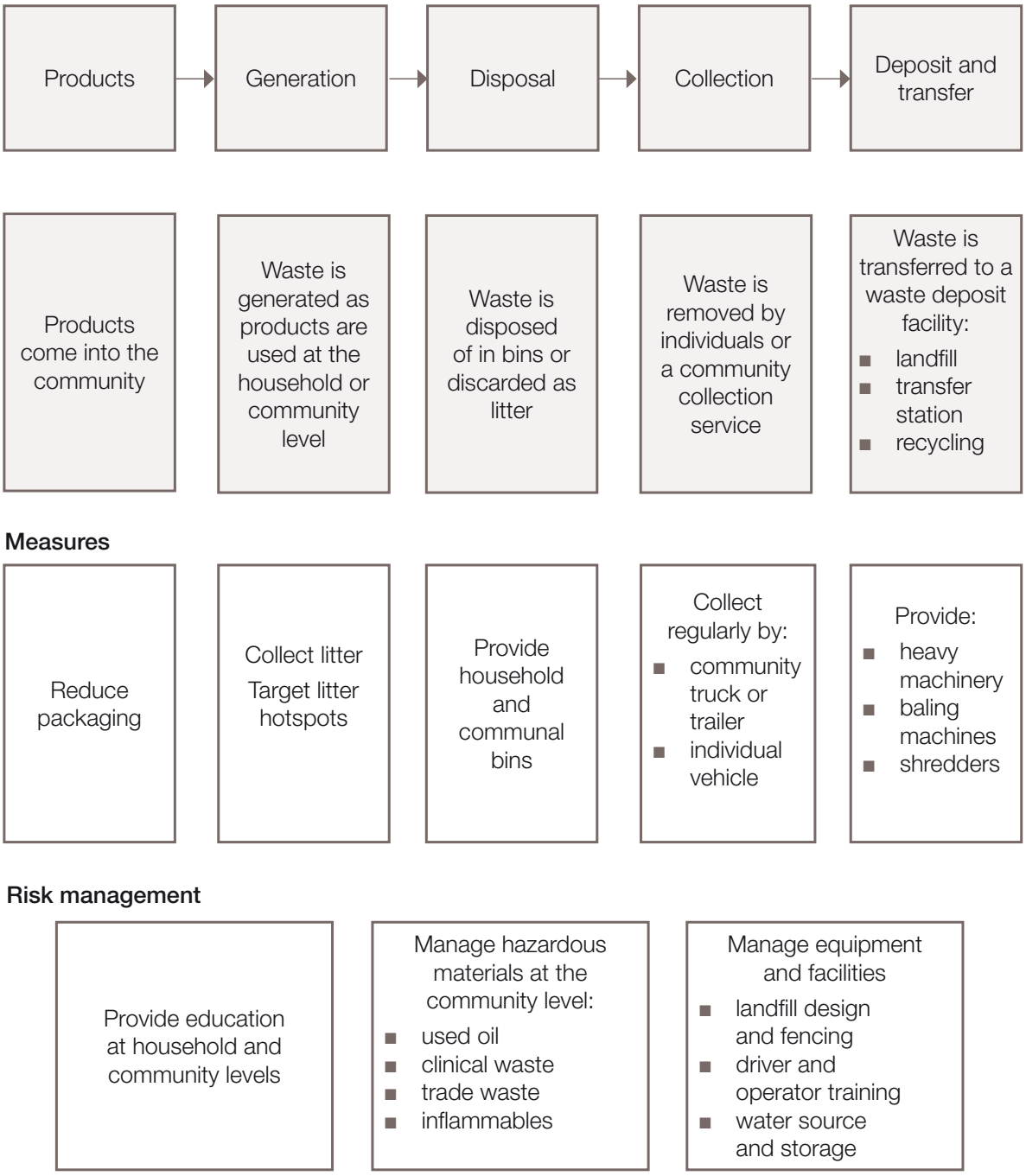
The main components in a community waste management system (Figure B4.1) are:

- bins
- rubbish collection and collection vehicles
- waste deposit and transfer facilities
- separation and recycling
- management of hazardous materials.

This chapter deals primarily with management systems for solid waste, but there is a significant need for coordination with other infrastructure systems such as transport, water, wastewater and stormwater. This includes:

- transporting waste away from the community to landfill sites or recycling depots
- coordinating waste disposal and bore field siting to protect the community's water resources
- designing landfill sites to prevent flooding damage by wastewater and stormwater.

Figure B4.1: Community waste management system



Source: Centre for Appropriate Technology, 2009

Current service delivery arrangements

Waste management services are the responsibility of the community council or local shire council depending on the jurisdiction, the size of the community and its proximity to major service centres. It is becoming more common for councils to contract out waste management services. Smaller communities tend not to have waste management services at the levels common in larger towns, which can fund full-time landfill workers and recycling services. Some smaller communities may be assisted by outstation resource agencies, but often manage the waste themselves (see Table B4.1). Specific regulatory requirements for waste management by state and territory are listed in Table B4.2.

Table B4.1: Responsibilities and arrangements for managing waste in communities and outstations

State/ territory	Regulator	Responsible body for communities with more than 200 people	Responsible body for communities with fewer than 200 people
NSW	Department of Environment and Climate Change Environment Protection Authority	Local council	Local council
NT	Department of Natural Resources, Environment, The Arts and Sport Environment Protection Authority	Local government shire or municipal council — post June 2008	Community council — up to June 2008 Local government shire — post June 2008 Outstation resource agency
Qld	Environmental Protection Agency	Local government	Local government
SA	Environment Protection Authority	Community council	Community council
WA	Environmental Protection Authority	Local shire	Community council or shire

Table B4.2: Relevant Australian guidelines and standards for waste management

State	Regulatory body and associated Acts	Landfill licensing
NSW	The waste regulatory framework is established under the *Protection of the Environment Operations Act 1997*. The *Waste Avoidance and Resource Recovery Act 2001* promotes waste avoidance and resource recovery.	Most landfill sites in 'environmentally sensitive' areas require licensing. Facilities that store, transfer or recover more than 30 000 tonnes of waste per year require an environment protection licence.
NT	Natural Resources, Environment, The Arts and Sport (NRETAS) and the Environmental Protection Authority are responsible for administering the *Waste Management and Pollution Control Act*. Specifications for landfill facilities are set out in: *Guidelines for the Siting, Design and Management of Solid Waste Disposal Sites in the Northern Territory*.	The Act requires that a landfill servicing the waste disposal requirements of more than 1000 people must be licensed.
Qld	The Environmental Protection Agency is responsible for administering the Environment Protection (Waste Management) Policy and Regulation 2000.	Licensing applies to landfills that receive more than 50 tonnes of solid and/or inert waste per annum.
SA	Development and operation of landfill facilities must be carried out in accordance with the *Environment Protection Act 1993*. Guidelines are provided in the Environment Protection Authority's *EPA Guidelines for Environmental Management of Landfill Facilities (Municipal Solid Waste and Commercial and Industrial General Waste*).	All landfills require licensing. For new landfill sites a landfill environmental management plan (LEMP) is required as part of the development application process. For existing landfill sites and sites with development approval, review and updating of the LEMP is required.
WA	The waste management branch of the Department of Environment and Conservation administers: *Environmental Protection Act 1986 —* Part VIIA *Environmental Protection (Landfill) Levy Act 1998* *Waste Avoidance and Resource Recovery Act 2007* Environmental Protection Amendment Regulations 2006 Environmental Protection (NEPM — UPM) Regulations 2003.	Levies apply to waste received by metropolitan disposal premises, which may pass on these costs to any local government shire that uses their landfill. Likewise, any local government that receives metropolitan-area waste is liable to pay a levy.

Involving the community

The level of participation in decision making about waste management services and practices will vary for each community, and should be addressed on a case-by-case basis. In general, communities want to know what services are in operation but may not necessarily wish to be involved in detailed discussions about landfill design or the purchase of infrastructure. However, people may want to participate in making choices about sites for landfill, the types and numbers of bins, and the placement of communal bins. Community involvement is essential to the success of schemes that seek to minimise the volume of waste through recycling or reuse.

Raising awareness about waste management should include a range of information-sharing sessions that assist Indigenous people to determine their own level of decision making and support their participation. An example of a discussion point to raise awareness might be the need to offset the convenience of having readily accessible spare car parts against the risks posed by children playing in old car bodies, from physical injury or spider bite.

Some specific participatory activities and tools that can be used to engage or raise awareness among community members about waste management issues in the community include:

- transect walks
- photo and voice
- waste matrix tools — identifying and mapping litter hot spots in the community[2]
- the identification of waste management responsibilities.

Community involvement is vital in helping to plan waste management for communal gatherings (such as sports weekends, funerals). Information such as the numbers of people expected to attend and the location of camping sites helps organisers plan for litter hot spots at these events.

For health and safety reasons, many jurisdictions are moving to ban the still-common practice of burning waste in drums or receptacles. Education is needed, but waste collection arrangements also need to be sufficiently frequent and reliable to make household burning unnecessary.

Developing innovative ways to reuse materials either within the community or externally may assist in stimulating enterprise. For example, small businesses could be created to salvage readily accessible spare parts from landfill and elsewhere that could be resold or reused.

[2] Waste matrix tools are tables developed with the residents that identify each litter hot spot, its location, and the person(s) who are to take responsibility for managing its removal (and reducing any further build-up).

Appraising community requirements

The first step in establishing effective waste management is to assess what waste is generated, its sources, and how it is currently managed in the community. This can be done by conducting an audit, using a waste assessment tool based on questions such as the example below.

Types of audits include:

- visual assessment of landfill, the community area and pick-up arrangements
- assessment by measurement: volume of waste produced daily or weekly, degree of sorting, recycling volume if any.

After the audit, possible ways to reduce waste production within the community should become clear (for example, buying items with less packaging; ensuring that building contracts require the removal of trade waste). There are also opportunities to involve community stores and develop relationships with transport companies (who may, for example, allow waste to be transported on returning grocery trucks). These positive steps can remove a large amount of packaging from the community landfill.

Questions to ask when appraising a community's requirements:

Context

- Where is the community located?
- What are the rainfall/seasonal patterns of the community?
- What forms the community's water supply and is it at risk of contamination?
- Where is the water supply located?
- Who looks after the community's waste management services?

Current waste collection services

- What do the services include?
- How is waste managed at the household level (such as types of bin)?
- How often is waste collected from houses?
- How is waste collection resourced by the community (for example, Community Development Employment Projects)?
- Where are the communal access bins (such as store, outside council buildings, parks)?
- How is waste otherwise disposed of (for example, burning)?

Landfill

- Where is the current landfill site located?
- How is the landfill managed and whose responsibility is it?
- What is the site's capacity (height, length, width and fill level)?
- Is the waste compacted, and if so, how?
- What infrastructure is used on the landfill site?
- Is it adequately fenced and secured?
- Is the groundwater affected by the landfill site placement?

Recycling

- Is any form of recycling being carried out?
- Has recycling been tried but discontinued? What factors affected these changes?

Hazardous waste

- Are there sources of hazardous waste in the community?
- How are these currently managed?

Choosing appropriate solutions

In making decisions about how to manage waste effectively, it is important to know what the potential components of a waste management system are and how they fit with broader initiatives and activities at the community level.

Figure B4.1, in Systems overview at the beginning of this chapter, shows how waste moves through the community. Infrastructure plays a vital role in managing the waste stream from collection to landfill, from recycling to transporting.

Disruption or poor practice at any point in the system will cause breakdown, resulting in increased litter and risks to health and the local environment.

Bins

Bins are pivotal for the collection of waste at both household and communal levels. In many communities, only outdoor bins are used: 45% of households in Indigenous communities do not have an indoor bin (see the *National Indigenous Housing Guide* Part C4). Lack of bins within the house can lead to health problems associated with vermin and spread of disease, and undermine the value of rubbish collection. Where households rely on external bins, there is a risk that these will be overturned by scavenging dogs, moved or vandalised by children, scattering the waste. Internal bins with sealable bag liners are the best means of avoiding this problem. Incineration of waste in external bins is also common, particularly where collection is infrequent.

The types of external bin used in communities (see Table B4.3) depend on historic precedent, cost, rubbish amount, availability of bin types and climatic conditions.

Internal bins

Internal bins (with liner bags) are important in managing waste within the house, keeping bin loads intact and getting rubbish to external bins.

Ensure that:

- household bins and liners are readily available from the local store.

Consider:

- working with the clinic to promote the use of internal household bins from a health point of view.

External bins

Ensure that:

- every household in a community has at least one external household bin
- all bins have a secure stand (this can be a simple post and chain) to prevent them being knocked over by dogs
- all bins have a secure lid to reduce access by vermin
- secure outdoor bins (with stand and lid) are available in key areas of the community, particularly litter hot spots such as community parks and ovals, and all community service centres (clinic, school and store)
- the community is aware of the proper use of bins, and health and financial costs of inappropriate use
- collections for household waste are sufficiently frequent that residents do not need to resort to burning waste at home
- community members are aware of the risks associated with burning rubbish, particularly in plastic bins, and encouraged to avoid burning where collection services are provided

- the immediate areas (10 metre radius) around bins are free of fire risks such as vegetation and other combustibles
- special arrangements are made for the collection or deposit of hazardous waste such as paint, batteries, oil and clinical waste.

Consider:

- allowing waste management service providers or operators to charge customers a fee to cover some of the costs of providing waste management services (bins, collection, landfill management)
- using bin enclosures in communities where large feral animals such as camels and wandering stock present a problem
- using lockable bin stands if bins are going missing
- child-proofing bins if necessary by reinforcing lids, drilling holes in the bottom and using lockable bin stands
- buying and stocking replacement wheels and lids for wheelie bins as required.

Maintenance

Ensure that:

- household bins are emptied at least once a week
- community bins are emptied at least once a week and immediately following community events (such as sports carnivals)
- regular audits of the state of bins are conducted, problems noted and parts ordered and fitted to maintain bins in good order.

Table B4.3: External bins used in communities

Type	Typical sizes	Cost (approx.)	Advantages	Disadvantages
44 gallon drums: recycled old fuel drums — commonly used for burning rubbish	220 litres	Free to $10–20 (used drums)	■ very low cost, robust, simple ■ stand not always needed	■ no lid — birds or dogs can scatter contents ■ extremely heavy and awkward to move when full — two people are needed to lift loaded bin for disposal into collection vehicle ■ will corrode after numerous fires ■ limited availability
Wheelie bins: heavy duty plastic bin on wheels as commonly used in urban centres	60, 80, 120, 240, 660, 1100 litres	$80–200	■ easy to move ■ replacement lids and wheels available from most manufacturers ■ bin stands and lid-lifting devices readily available ■ available in different colours to assist in separation, sorting and recycling ■ designed for emptying by machine	■ less robust — wheels and lids fall off with misuse ■ wheelie bins and lids are sometimes used as toys by children ■ not fireproof: often burnt deliberately or accidentally by people burning rubbish
Robust bin (CAT or similar): a modified metal drum custom made for use in Indigenous communities	220 litres	$320	■ lidded to prevent access by birds and dogs ■ two handles for easier handling ■ ventilated — best choice if burning cannot be avoided	■ expensive ■ two people are needed to lift loaded bin for disposal into collection vehicle

(continued)

Type	Typical sizes	Cost (approx.)	Advantages	Disadvantages
Plastic garbage bins	Up to 200 litres	$10–60	■ cheap and easy to source ■ easy to move when empty	■ fragile ■ need custom-made bin stand; lid easily lost ■ often too small — many households require two for a weekly collection run ■ require protection from dogs and vermin
Skips: large metal bins for industrial/bulk waste disposal	2 cubic metres or larger	Often hired by the week	■ extremely robust ■ suitable for commercial quantities of waste ■ may be useful for bulk collection of recyclable metals	■ forklift or other heavy equipment required for moving, emptying and transporting

Rubbish collection and collection vehicles

Collection is an essential component of all waste management systems. Householders should not be expected to dispose of waste themselves by burning, burying or adding it to the wastewater load.

The ways in which rubbish is moved from bins in households and other buildings to the landfill site or transfer station varies according to community size.

Larger communities may use custom-built garbage trucks with loading arms and compactors. While garbage trucks are the most efficient option for handling large quantities of waste, they are expensive to buy and require specialist maintenance.

Smaller communities often use simpler options such as 2–4 tonne general-purpose trucks or flat-bed trailers onto which bins are loaded then transported to the landfill site. While this option is cheap and efficient on a small scale, it is more labour intensive and carries greater occupational health and safety risks than using garbage trucks.

Advantages and disadvantages of different garbage collection vehicles are listed in Table B4.4.

Table B4.4: Major garbage collection infrastructure

Type	Capacity (no. of wheelie bin loads)	Purchase cost	Ongoing costs	Advantages	Disadvantages
Garbage truck with compactor and tipper	200	High	High	■ reduces volume of material reaching landfill ■ highest capacity ■ very low pick-up time ■ best operator occupational health and safety performance	■ requires specialised maintenance, which may be difficult to access ■ heavy rigid driver's licence required ■ more difficult to ensure safe use at community level
Garbage truck with tipper	100	High	High	■ low pick-up time ■ high capacity ■ good operator occupational health and safety performance	■ requires specialised maintenance, which may be difficult to access ■ medium or heavy rigid driver's licence required
Small general-purpose truck	30	Medium	Medium–High	■ multipurpose ■ can be fitted with automated arms for loading rubbish	■ limited capacity ■ poor operator occupational health and safety performance ■ light rigid or higher driver's licence required
Hydraulic tipping trailer	20	Low–medium	Medium	■ multipurpose ■ easy to offload ■ can be hitched to any vehicle	■ low capacity ■ poor operator occupational health and safety performance ■ prone to breakage — high maintenance
Trailer	20	Low	Low	■ multipurpose ■ readily available ■ no specialised licence required ■ can be fitted with automated arm for emptying bins ■ can be hitched to any vehicle	■ low capacity ■ poor operator occupational health and safety performance

Light rigid (LR) vehicle = 4.5 to 8 tonne gross vehicle mass
Medium rigid (MR) vehicle = 2 axle, greater than 8 tonne gross vehicle mass
Heavy rigid (HR) vehicle = 3 or more axles, greater than 8 tonne gross vehicle mass

Appropriate choice, design and installation

Ensure that when choosing a garbage collection vehicle:

- the type of vehicle is suited to the type of bin used
- the type of vehicle is suited to the landfill design (such as adequate room for manoeuvring in the landfill, entering and exiting the site)
- the vehicle is not too large for the community's needs
- the collection vehicle is designed for easy loading, unloading and cleaning (for example, with automated arms on trucks and ramps on trailers)
- garbage vehicle drivers have the appropriate licence and training to drive and operate the vehicle safely.

Consider the following question before purchasing custom-built garbage trucks:

- Can the community can afford to maintain a heavy vehicle: is there access to an on-site mechanic or ongoing funding for contract maintenance? The smaller and more remote a community, the less able it will be to maintain heavy vehicles.

Ensure that with trailers:

- the wheels and tyres on the trailer can cope with landfill conditions (such as high risk of punctures) and are secured against theft
- the trailer's tipping mechanism is compatible with the landfill design (that is, so operators do not have to reverse the trailer to the edge of a vertically cut trench that could collapse).

Consider with trailers:

- using non-standard automotive wheels and hubs with solid or foam-filled tyres to reduce the risk of tyres being removed for spare parts or being ruined by punctures
- installing hinged ramps on the back of trailers to assist in loading wheelie bins.

Maintenance

Ensure that:

- there is a regular maintenance schedule for garbage collection vehicles
- external contractors are required to undertake vehicle and trailer maintenance regularly (for example, checking brake lights, wheels and trailer brakes).

Consider:

- providing suitable training and awareness to workers to minimise maintenance requirements and costs.

Related services

In cyclone-prone areas, damage and injury can result from flying debris during high winds. Communities in urban environments such as Darwin may be able to make use of existing pre-cyclone season clean-up and collection services, or coordinate their own local services on an annual basis. They should also consider what equipment, resources and organisation might be needed for disposal of damaged vegetation and other waste material after severe weather events.

Waste deposit and transfer facilities

Landfill

Managing rubbish tips or landfill sites is a key component of the overall waste management system of a community. Preparation and maintenance of a landfill operation is expensive and requires careful planning (Table B4.5).

Table B4.5: Examples of landfill site assessment criteria

Category	Criteria to be considered
Planning – Appropriate zoning	■ land ownership ■ available buffers ■ environmentally sensitive or sacred sites ■ land use agreements
Technical – Integration with existing and future waste network	■ opportunities for regional cooperation ■ centrality ■ accessibility ■ existing services and utilities ■ capacity — area required
Environmental and geological – Impact on and from the environment	■ effect on surface water ■ effect on groundwater ■ impact of flooding ■ ecology ■ topography ■ visual amenity ■ traffic ■ noise ■ dust ■ odour
Community – Social	■ social impacts

Landfill can pose health and environmental risks, so there are strict guidelines for siting, design and management. These guidelines differ from state to state, and in many cases licences are required (see Table B4.2). Some of the key criteria are outlined below. However, guidance must be sought from the relevant state or territory body before proceeding with any plans to develop or upgrade a landfill facility.

Siting a new landfill site is a particularly challenging task. It is important to consider features of the climate or landscape (such as groundwater) that may affect the location of landfill; sites are often located and designed in ways that are unsuitable or unsustainable. Indigenous communities typically obtain advice and guidance through their local shire council or environmental protection agency to assist in siting a new landfill. Communities should also check for and conform with local Indigenous land use agreements and heritage clearance processes. They should determine who owns the existing site and whether there are any sacred sites or land management activities nearby.

Ensure the site is:

- at least 1 kilometre from residential areas and 100 metres from public roads
- above the 100-year flood line
- sloped with a gradient of less than 1:5
- big enough to carry a minimum of 10 years' waste
- downwind from the community, based on prevailing winds
- fenced with a gate or entrance situated away from the downwind side (a gate on the downwind side would allow waste to blow out)
- designed so that community water sources, particularly groundwater and surface water supplies, are not at risk from leachate or contamination
- provided with adequate all-weather road access.

Consider:

- locating the landfill adjacent to sewage ponds (as both have similar requirements for distance from community), but designing them to prevent leaching in either direction.

Appropriate choice, design and installation

Ensure that:

- the site is cleared of vegetation
- the landfill site is graded to drain water away from the waste disposal area
- table drains are established around the perimeter of the site or localised bunding is established around pits to prevent surface water entry (see Chapter B2 Stormwater)
- final cover on landfill sites is low porosity soil compacted, mounded or graded to prevent the flow of water into trenches.

Consider:

- providing an area of landfill space for separation of bulky or recyclable materials (for example, metals such as cars, white goods, construction material), which should not go into the same trench or cell as household and packaging waste
- basing designs on the heavy equipment and machinery already available at the community
- providing garbage collection vehicles with enough room for manoeuvring in the landfill and entering and exiting the site
- providing machinery (such as backhoe, front-end loader) used to move, compact or cover the landfill site with enough room to manoeuvre in the site and out of the pits or trenches
- keeping the working space as small as possible to prevent spread of loose waste (while leaving effective working room for vehicles)
- providing a firebreak around the edge of the site
- installing gates that can be secured to manage potential health risks (for example, physical danger to children, toxic contamination, unstable ground, exposure to putrescible waste)
- calculating how long the landfill site will last and possible locations for a replacement site, preferably with at least a 10-year life span
- establishing regional landfill sites for communities that are located reasonably close together, so that economic and environmental costs can be shared
- constructing suitable buildings for hazardous and recyclable materials.

Larger communities: fencing should be at least 1.8 metres high; mesh fencing is the most common type. Some suggest that 0.2 metres of the fence should be buried to deter burrowing animals.

Smaller communities/outstations: 1.2 metre high fencing may be appropriate for stock control. Fence height specifications may vary between jurisdictions. Check with state or territory guidelines or with the local council for the applicable requirements.

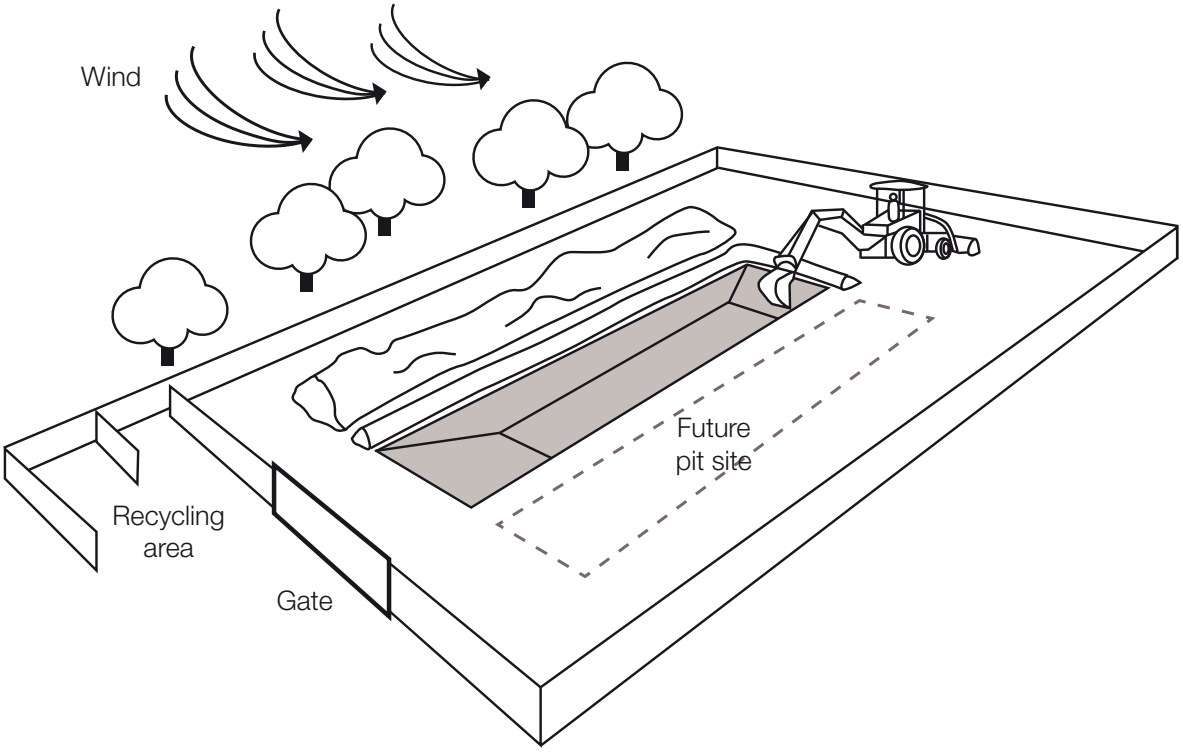
Landfill methods

Three methods of landfill design are most commonly used: trench landfill, area fill and cell landfill. Waste landfill cages may also be appropriate for very small communities.

Trench landfill

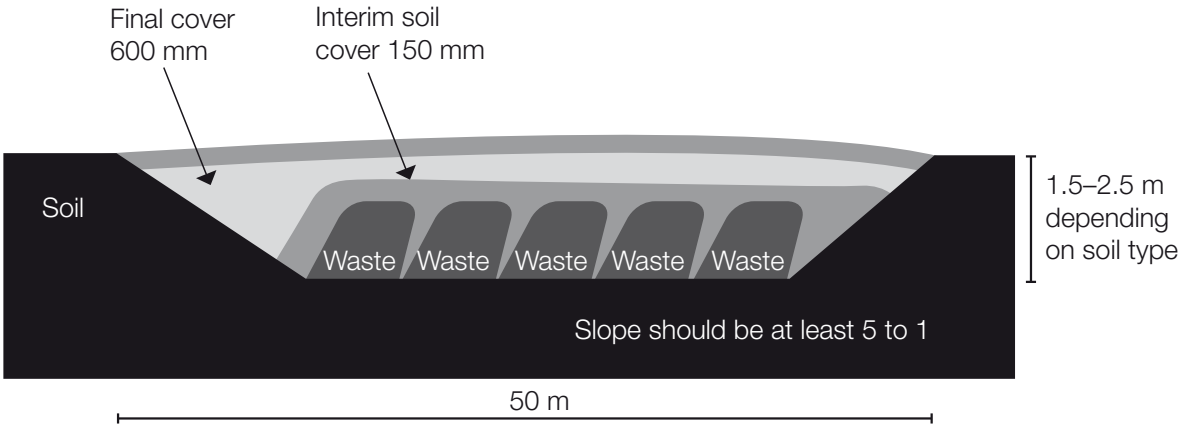
The trench landfill method (Figures B4.2–B4.4) is a long narrow channel in the ground in which waste is placed then covered with soil. It is most commonly used in small communities in low-rainfall regions. Trenches are dug across the contour of the slope and waste is compacted into one end using a front-end loader or backhoe. Each trench is typically 2.5 metres deep, 6–7 metres wide and 50 metres long. Trenches are suited to sites with soil that is easy to excavate, but not rocky ground.

Figure B4.2: Diagram of the trench method



Source: Centre for Appropriate Technology, 2009

Figure B4.3: Longitudinal section of a trench



Source: Centre for Appropriate Technology, 2009

Figure B4.4: Trench landfill

Source: Centre for Appropriate Technology, 2009

Used white goods, car bodies and construction materials are often located at landfill sites. Parts from waste products are sometimes reused, so they should be publicly accessible but placed away from the trench. It is important to minimise opportunities for scavenging from the trench site because of the risk of wall collapse or injury from sharp objects.

Ensure that:

- the trench is graded so that vehicles can drive safely in and out
- interim cover depth of soil over rubbish is 150 millimetres, and final cover is 300–600 millimetres
- the maximum height of rubbish is 1 metre
- trenches are oriented at right angles to the prevailing wind.

Consider:

- maintaining trenches properly, including interim waste cover and weed control
- piling up earth around the landfill to make a bund or increase the size of the existing bund — in some high-rainfall areas, trench landfill may be at risk of leaching (that is, water pooling and failing to drain, or even flooding).

Absorption trenches

Typically, leachate collection systems are limited in remote communities. Highly engineered systems that collect and treat leachate from landfill are often too expensive. An absorption trench may be an affordable option.

These systems use a perforated pipe, which is surrounded by gravel and buried in the ground (also called a 'leach drain'). Leachate flows into the pipe, then out into the gravel and soil. Pathogens and other pollutants are removed by filtering and through decomposition by microorganisms in the soil. Loamy soil is best where the water drains away but not too quickly.

Consider:

- soil type — leachate drains slowly into clay and quickly through sandy soils; contaminated surface water may be directed to an evaporation pond or a septic tank.

Area fill

This design is used in larger communities or sites in tropical regions and some high-rainfall temperate locations (Figure B4.5). Instead of digging a trench, rubbish is filled in a flat, low area or depression to bring it to the same height but no more than 2 metres above the ground. It requires 150 millimetres of cover and a final cover of 300 millimetres. The active face should be at right angles to the prevailing wind direction.

For the area fill method a large quantity of cover (fill) material must be imported.

Figure B4.5: Area fill

Source: Centre for Appropriate Technology, 2009

Cell landfill design

The cell landfill method involves creating a bund wall of earth against which waste is pushed. The bund wall prevents stormwater from running into the waste and diverts it away from the landfill. The cell method is used for large communities and stony sites. It is the best method for flood-prone areas (tropical areas).

As with the area fill method, a large quantity of bund and cover fill material needs to be imported. The bund should be constructed to the height of the landfill. There should be a flat section on top to allow a backhoe or other earthmoving machinery to cover the waste. The side of the bund should be compacted firmly to prevent soil erosion. The slope of the outside of the bund should be 5:1; the slope inside should be 2:1. Waste should be covered with 150 millimetres of material when pushed up against the slope.

Fill material: consists of soil (being clay, silt or sand), gravel and rock. The industry refers to fill material as 'clean fill'. Fill material may contain contaminants above background levels and may not be suitable for all uses (care needs to be taken in an agricultural environment and an assessment made of contaminant levels and its intended use). In the community landfill context, fill is used for bunding and cover purposes.

Putrescible waste: Problems often associated with putrescible waste landfills include vermin, seagulls, dust, odour, flies and other insects, fires, litter, and surface water and groundwater contamination by leachate. The design and operating requirements for a putrescible waste landfill are generally more stringent than for a site accepting solid inert waste only.

Figure B4.6: Cell landfill

Source: Centre for Appropriate Technology, 2009

Waste landfill cage

Waste landfill cages may be appropriate for very small communities. A pit is dug that is not as wide as the cage. The cage is towed into place over a pit that is filled with waste materials that are most often burnt. The burning process helps to reduce the mass so further materials can be dumped. The same pit preparation and siting considerations for landfill apply here.

Design

Ensure that:

- the design allows the cage to be moved to a new site when the pit is full
- the cage is wider than the pit
- cages are fire resistant
- cage design takes into account the types of vehicles or trailers used for waste collection.

Consider:

- other methods of waste disposal that do not require burning, to reduce carbon emissions into the atmosphere and the health risks associated with burning.

Management and maintenance of landfill sites

Understand and plan activities related to the day-to-day operation of the site including:

- staff training
- environmental management controls
- ongoing promotion of occupational health and safety
- community education
- arrangements for direct public deposit of waste material by car or trailer
- management of scavenging and material recovery.

Signage will help with landfill management, particularly if personnel are not on the site daily. It could include:

- the name of the facility manager
- hours of access
- emergency phone numbers
- directions to waste disposal areas for green waste, general household waste, white goods, etc
- a list of items that are not allowed to be dumped
- warnings about scavenging, lighting of fires, littering and illegal dumping.

Ensure that:

- the community identifies who is responsible for the operation and maintenance of the site
- records of existing and previous landfill locations are kept to ensure successful community planning outcomes
- new landfill material is compacted when deposited at the site (compaction will extend the landfill life and reduce the risk of site subsidence)
- waste is covered periodically by 150 millimetres of soil to stop vermin and reduce odour and litter
- a final cover of 300–600 millimetres of soil is added when the trench or landfill area is full
- requirements for management of construction or demolition waste are clearly stated in any capital works contracts; construction waste can be either removed from the community or disposed of in a separate pit dug, filled, compacted and reinstated by the contractor
- burning is avoided, especially at times of high fire danger
- firefighting equipment is provided at the landfill site or with the collection vehicle (water supply and pump or fire trailer, knapsack, hand tools, rakes, shovels, etc).

Consider:

- sharing expensive plant such as front-end loaders, excavators and bulldozers on a regional basis; this machinery (including equipment to transport it) can also be used for community work such as clearing firebreaks, road maintenance and heavy haulage
- establishing occupational health and safety equipment and facilities for handling and managing waste (that is, water supply at the landfill site for emergency wash down)
- the type and frequency of supervision of the site
- the management of traffic, dust and noise from the site.

Case study 9 — Considering landfill options

A small remote community located on a busy seasonal tourist route owned a waste management landfill site that had reached its capacity. They needed a new site, but did not have the equipment or funds to rehabilitate the old site and establish a new one.

A local non-government organisation was offered some limited funds to employ a project manager to assist the community to manage the situation. He identified the following issues:

- *The community was on a small block of land excised from a local cattle station property, which restricted options for locating a new landfill site appropriately.*
- *The community was very close to the state government–managed tourist route and the road easement was potentially an issue in siting the landfill.*

(continued)

- *The local government shire, while not able to support the community waste management system except through annual inspections and advice, requested that the project manager conform to its standard design for landfill waste management facilities.*
- *The shire approved a landfill design that included criteria such as minimum dimensions; outer compound fence (vermin proof, lockable); inner litter fence; excavated trench with chamfered walls; overburden placed parallel to the trench; and appropriate siting and drainage to prevent seasonal floodwaters from filling the trench.*
- *The community did not have its own earthmoving equipment to handle this work. It issued a 'call for tenders' based on the shire-approved specifications and seeking contractors with appropriate plant and equipment.*

This tendering process revealed the high cost of mobilising contractors over the 300 kilometre route between the community and the nearest regional centre — all tender returns were over budget.

The project manager set about investigating ways to reduce costs. From experience, he was aware that locking and attempting to vermin-proof the landfill was optimistic. Wrecked motor cars and parts were often taken to the landfill site, but community members continued to rely on these as a source for spare parts. Any attempt to lock a community landfill site would tend to result in damage to the compound as people tried to gain access. However, leaving the compound unlocked made it harder to keep the landfill vermin-proof.

The project manager was able to negotiate with the shire to delete reference to 'vermin proofing' the fence. This meant that standard cyclone fencing could be used, which was less expensive and did not need to be buried to a depth of 300 millimetres. This reduction brought the costs down within budget.

Several years later during the wet season, water flowed through the landfill, filled the trench, and carried waste through the community. On closer inspection, the project manager realised that the landfill's drainage bunds had been breached by a grader performing routine maintenance and had also become eroded. These issues were rectified, so the site could continue to be used until reaching capacity.

Transfer stations

There is a nationwide trend in solid waste disposal towards the construction of large regional landfills rather than small, rural, and often unsupervised landfill sites. This move is intended to achieve larger well-engineered operations with improved environmental controls and opportunities for increased resource recovery. In conjunction with this, many smaller rural locations are now opting to develop transfer stations.

In its simplest form, a transfer station is a facility with a designated receiving area where waste collection vehicles and/or small, self-haul customers deposit their waste. The waste is then sorted and loaded into larger vehicles for long-haul transport to a regional waste deposit site (landfill, treatment facility, resource recovery facility or reprocessing plant).

Transfer stations play an important role by providing a means of consolidating recyclables and waste. This is particularly the case in regional areas where the feasibility of disposing waste locally may be limited.

Transfer stations often have separate collection areas for pre-sorting materials at the time of deposit. Additionally, they may resell reusable material to the public (the 'tip shop'). Ideally, there is no long-term storage of materials at a transfer station — all wastes and recyclables are consolidated and loaded into larger vehicles for movement off-site.

In developing transfer stations, consideration should be given to broader resource recovery networks, transport logistics and the potential for regional cooperation.

Design

Ensure that:

- the waste types and estimated volumes the station will process is assessed, including:
  - light recyclables (plastics, aluminium, paper and cardboard)
  - heavy recyclables (batteries, metals such as steel or copper)
  - tyres
  - white goods
  - general waste (packaging)
  - waste oil.

Consider:

- the impact of waste volumes on selection of the appropriate material handling equipment to be used at the station, and appropriate sizing for transfer bins, storage containers and storage areas for recyclable items
- the types of structures that can be used, including:
  - enclosed structures
  - open structures
- the natural topography of the site and how to make best use of wind barriers and visual screens; existing slopes can be used to provide benches and to divert water flows from operational areas.

Management and maintenance

The management and maintenance requirements identified under landfill facilities apply equally to transfer stations, with the exception of items that relate specifically to landfill compaction and covering.

Separation and recycling

An increasing range of infrastructure is available to assist in the handling of recycled products. Much of this is designed for larger commercial operations, but some units are suitable for small and remote communities. These include crushers, balers and shredders that compress and repackage recyclables for storage and transport.

Many of the considerations in planning a local recycling initiative relate to its economic feasibility. There may be benefits for the community in recycling waste that has an economic value, such as metals, catalytic converters and beverage containers. Communities in South Australia in particular can benefit from utilising a legislated container deposit scheme to provide a deposit and refund on beverage containers.

The processing of recyclable products usually occurs at a material recovery facility (MRF). Each MRF is designed to process certain materials. Some will only process metals or plastics or various other materials. Individual materials such as plastics require specific processing due to the combination of chemicals they contain. Some plastic containers have a symbol (an arrowed triangle) with a plastic identification code (PIC 1 to 7); however, the MRF may not be set up to process any given particular type of plastic container.

The costs of handling and transporting recyclables must also be weighed against the alternative of disposal at the community.

Consider:

- costs associated with collecting the materials (such as providing and managing a deposit-funded subsidy or collector fee; extracting the material from the normal waste stream)
- equipment capital costs and appropriate sizing
- equipment maintenance and operating costs
- the cost of transporting recyclables to a recycling depot
- the potential for coordination at a regional level to rationalise transport costs
- additional environmental or social benefits and costs
- the projected income
- the availability of grant funding for capital costs, including transportation
- the amount of material being generated and handled

- a sensitivity analysis including changes in the prices paid for products (noting that market prices for recycled metals can fluctuate dramatically), the mix of recyclables collected, and higher or lower yields from the collection process itself
- management issues including the storage and security of the infrastructure
- staff capacity.

Compare:

- the base case of no recycling with all waste going to landfill.

Aluminium can crushers

Can crushing reduces the volume of aluminium cans by a factor of 10 or 20, which assists in lowering associated transport costs. Crushing units suitable for community use are able to crush many cans in one operation into blocks that can be stacked.

For smaller-scale initiatives, cans may simply be collected in cloth bales mounted on simple metal frames, closed with bag hooks when full, and transported away if suitable haulage can be negotiated.

Multiple product baling machines

Commercial crushing and baling units are used by recycling merchants to bale waste products such as paper and plastic into manageable blocks for recycling. Most units are not appropriate for small remote communities because of their cost ($30 000–70 000 per unit), specialised maintenance needs and three-phase power requirements. The cost of transporting bales to larger centres for recycling can also be prohibitive unless arrangements can be made with operators such as mining companies whose trucks pass through some remote communities.

Plastics need to be sorted into their material categories for acceptance by the recycling merchant.

Shredders

Shredding units are often used by small-scale recycling facilities to process waste products such as paper, plastics and rubber. The cost of a shredder is not necessarily prohibitive. A new three-phase shredder costs approximately $25 000; some cheaper, second-hand models may also be available. In remote areas, products may need to be transported to larger centres for processing.

Consider:

- compaction rates
- covered secure space for storing the infrastructure, and its efficient work layout
- equipment may require three-phase power supplies.

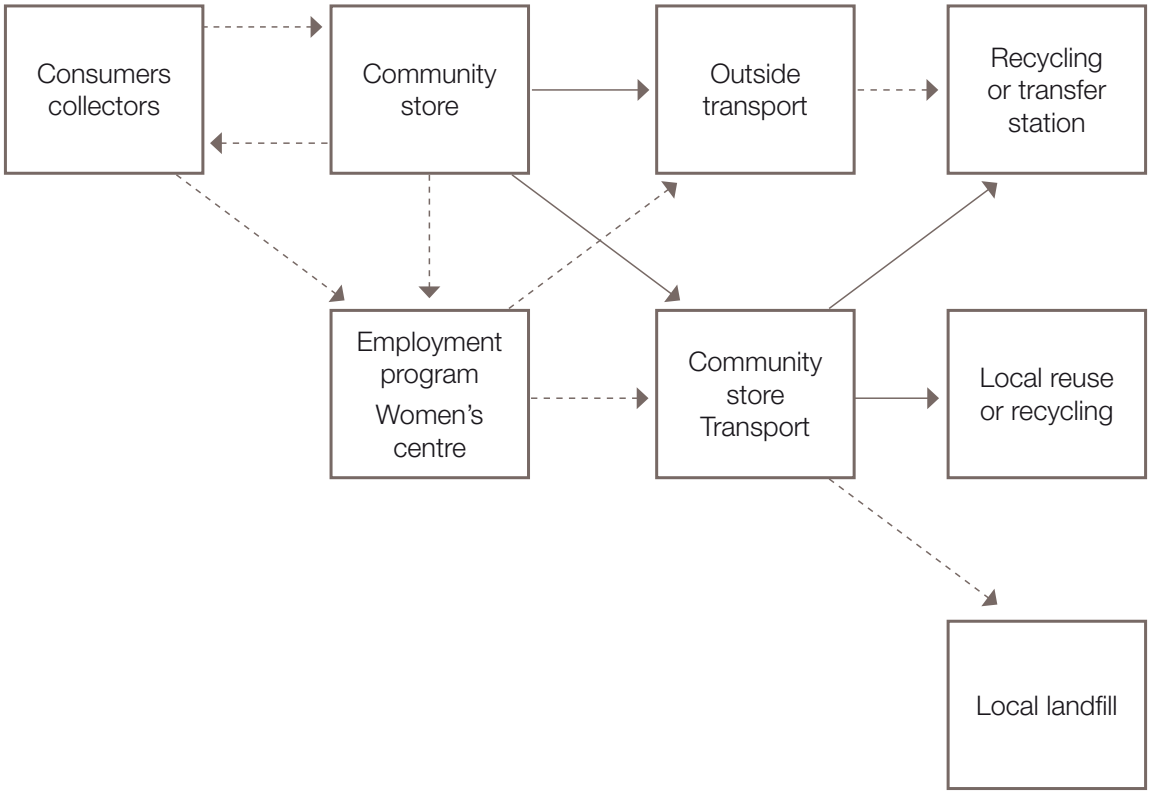
Management and maintenance

Specific occupational health and safety requirements for handling these machines include the need for closed footwear, gloves and a well-ventilated but covered area. For processing plastics, removal of toxic fumes must also be considered.

Case study 10 — Designing a container deposit scheme

Most aluminium and plastic containers in a community were not making it to the landfill site. The community council and other community stakeholders were concerned at the number of containers in the litter stream and canvassed their waste minimisation options. They supported the idea of a container deposit scheme in which consumers and community groups (such as school groups) would be responsible for collection. They enquired about recycling options, including funding assistance from the state government and on-ground help from the Centre for Appropriate Technology. The result was a plan for a container deposit scheme in which community members would be responsible for collection. Figure B4.7 shows the pathways for the container deposit scheme that were developed by the community.

Figure B4.7: Container deposit scheme



Dotted lines highlight workable pathways

Source: Centre for Appropriate Technology, 2009

(continued)

The community store and progress association supported the project by collating data on sales of aluminium cans and plastic drink bottles. As part of the agreement, the store increased prices of selected items to a level deemed appropriate by the store committee. This meant a 10 cent increase on the original price of drinks containers. This amount would then be reclaimed by individuals returning empty containers, and would therefore remain in the community if all items were returned for recycling locally.

The store also arranged for transport out of recycled materials with companies that normally delivered produce to the community, at a negotiated price. A community elder administered the daily collection and storage of containers on premises supplied by the shire council. Community members and organisations such as the women's centre, health clinic and school groups collected containers within the community and returned them to the recycling shed for sorting and baling before the items were placed onto pallets. They were then transported for processing at a waste recycling facility in a regional centre 550 kilometres away. Council employees used a ute to collect containers from elderly and disabled residents who were unable to take items to the recycling shed.

During the latter part of the project a transport company approached the community offering to assist with removing waste steel such as car bodies. As a result, an agreement may be reached in the future where aluminium cans are carried as part of these shipments. The benefit from such an arrangement would be a discounted transport rate. The possibility also exists for mining companies to assist with the funding to set up infrastructure for this or additional waste management schemes.

A commercial baling machine was purchased from Adelaide. The project provided training in operation of the machine and employment opportunities for three community members. Over the 12 months of the initial project funding, thousands of aluminium cans and plastic bottles were returned for recycling. Anecdotal evidence also pointed to the community streets being much cleaner as a result.

Management of hazardous materials

It is important that community members are informed about specific local sources of hazardous waste, and understand how to manage them appropriately to avoid injury to themselves and their children.

Handling and disposal of the following forms of hazardous waste are discussed below:

- used oil
- asbestos-related materials

- trade waste
- clinical waste.

Used oil

Used oil is a hazardous byproduct from cars, generators, boats and trucks. It can have toxic effects even at low levels of exposure. Oil should not be deposited in landfill or on the ground, as it presents both a fire hazard and a contamination threat to underlying groundwater. Therefore the safe collection, storage and transport of used oil away from the community need to be considered.

The principles of management are:

- collect all used oil in one place away from other buildings to reduce the pollution and fire risk
- store the oil safely
- transport it out to a recycler as soon as possible.

Used oil facilities should be:

- under cover and on a concrete slab
- well ventilated and away from strong acids and alkalis, heat and ignition sources
- located in a well-drained site, away from houses
- accessible and able to be monitored
- well signed to indicate toxic waste and flammable liquids (see Figure B4.8).

Storage options within the facility include:

Drums

- store under a roof to stop corrosion
- seal drum lids securely
- avoid use for long-term storage; it is preferable to store oil in a tank.

Tanks

- tank construction and siting must comply with relevant standards; a structural engineer should advise
- the best environmental protection is ensured by double-skinned, above-ground steel tanks with corrosion protection
- all pipes should be above ground so that they can be inspected.

Figure B4.8: A waste oil facility

Source: Centre for Appropriate Technology, 2009

Management and maintenance

- prevent spills of waste oil by regularly inspecting drums, generators or pumps for leaks
- regularly inspect tanks for leaks, including the valve, taps and hoses.

Asbestos

Asbestos was a commonly used building material throughout Australia until 1980. It has excellent insulation and fire-resistance properties but is extremely hazardous to long-term health if ingested as dust. Under no circumstances should asbestos be cut, drilled into or broken.

In some instances asbestos is safe if left in place, provided no disturbance or breakdown of the material structure is likely to occur. Handling or disposal of asbestos, including related waste, is a specialist task. Contact should be made with the local council or environmental protection agency for further advice.

Trade waste

Trade waste includes a variety of materials that can be hazardous in terms of their flammability, toxicity, or the physical risk they present. In addition to oil and asbestos highlighted above, examples include:

- paints and solvents
- screen-printing waste
- metal and glass offcuts, nails, screws, broken glass, old car bodies and parts.

Appropriate handling, storage and disposal of each of these waste products should be considered in terms of the particular risk they pose to children, who may knowingly or unknowingly pick up, eat or drink, trip over or be trapped in them. Accumulations of some waste materials also provide cover for venomous snakes and spiders.

Clinical waste

Clinical waste is a byproduct of medical, dental or veterinary activities, and has the potential to cause disease; it includes:

- *discarded sharps* — objects with sharp points or cutting edges such as used needles, scalpel blades, scissors and broken laboratory glass
- *human tissue waste* — includes blood and blood components such as plasma, material heavily contaminated with blood, human tissue removed during medical procedures and some other bodily fluids
- *laboratory waste* — a specimen or culture discarded in the course of dental, medical or veterinary practice
- *animal waste* — any discarded material including carcases, body parts, blood or animal bedding contaminated with an infectious agent.

Disposal and handling

Clinical waste associated with medical or dental work is normally managed by the health centre in the community, and any specific issues should be discussed with the medical or (for animal waste) veterinary staff. Dead animals at the side of the road or animals put down due to old age or injury do not have to be disposed of as clinical waste.

Hypodermic needles must always be disposed of in rigid-walled, puncture-resistant containers, and all possible care should be taken to safely dispose of any other waste. Sharps discarded at premises that generate clinical or related waste must be disposed of into an Australian Standards–compliant container.

Useful terms

Biosolid	A solid end product from a wastewater treatment process.
Bund	An artificial embankment formed from natural material, used to contain waste, prevent inundation and/or screen it from view.
Clinical waste	A byproduct of medical, dental or veterinary activities with the potential to cause infection (eg discarded sharps, used bandages).
Material recovery facility (MRF)	The destination for bulk recyclable materials, typically where these are initially processed for reuse.
Organic waste	Organic material consisting of anything that was or is living such as garden waste (eg vegetation, bark), kitchen waste (eg food including skin and eggshells) and waste from animal sources (eg horse hair and manure) and other products that are biodegradable by composting such as paper, cardboard and biosolids.
PIC	plastic identification code
Prescribed waste	The most hazardous category of waste. Requires special handling or strict control measures to reduce its impact on the environment. Includes explosives and reactive or corrosive substances that may pose a threat to human and/or environmental health. Such controls are enforced by state and territory environment protection legislation and regulations.
Putrescible waste	A subset of organic waste including food waste, animal waste and biosolids that are likely to decay much faster than other organic matter).
Solid inert waste	Hard waste that does not break down readily (eg plastics and dry vegetative material.
Trade waste	Byproducts from industries such as building or demolition, metal and fabrication, automotive repair trades and other production and maintenance work carried out by tradespeople that can include waste oil, scrap metals and products that may be contaminated with toxic or hazardous materials.

Transfer station	A facility located at a point intermediate between the source of waste and the landfill site, which enables waste and recyclables to be deposited, separated, sorted and stored temporarily, then consolidated for bulk carriage to the landfill site or material recovery facility.
Waste matrix tools	Tables developed with the residents that identify each litter hot spot, its location, and the person(s) who are to take responsibility for managing its removal (and reducing any further build-up).

Further reading

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Useful websites

Information on safe removal practices for asbestos:

- www.nsw.gov.au/fibro
- www.workcover.nsw.gov.au (type ‘asbestos’ in the search box).