SOUTH AUSTRALIA

LANDFILL AUDIT

FEBRUARY 2000

Environment Protection Agency
Government of South Australia

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This report has been modified for public distribution from the original report prepared in January 1999 for the Environment Protection Agency (EPA) by the consultants Waste Audit and Consulting Services (Aust) Pty Ltd and C.R Hudson and Associates. The conclusions made in this report do not necessarily reflect the views of the EPA.

Waste Audit and Consultancy Services (Aust) Pty Ltd

C. R. HUDSON & ASSOCIATES PTY. LTD.
(INCORPORATED IN VICTORIA)

Environmental Consultants

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CONTENTS

FOREWORD

In South Australia, just as nationally and globally, the management of waste presents many challenges and opportunities. Economic and population growth create rising demand for goods and services. Most South Australians put a high value on economic development and growth, so that everyone in the community can enjoy a better standard of living. It is imperative that we also undertake these activities in a sustainable way. through waste avoidance, reduction, re-use, recycling and recovery, and we can reduce energy and materials consumption and use our physical and economic resources more wisely.

The effective and efficient management of our waste is therefore an important objective of the South Australian Government. Within the Department for Environment, Heritage and Aboriginal Affairs, waste minimisation and the recovery of resources from our waste stream is a major aim of the Environment Protection Agency (EPA) and the Waste Management Committee.

To assist Government to improve waste management for the benefit of all South Australians, it is necessary to have a clear understanding of the nature and quantity of waste that is being produced and disposed to landfill. The *Integrated Waste Strategy for Metropolitan Adelaide 1996-2015* (Waste Strategy) released by the EPA in June 1996 highlighted the need to gather reliable data to provide a clear picture of the type and amount of waste in our waste stream.

By commissioning a Disposal Based Survey (Landfill Audit) the EPA has obtained valuable information on waste. Over the period of the Landfill Audit totals of the three waste streams domestic, commercial and industrial, and building and demolition were recorded.

The information gathered provides a base line from which to measure on going performance. The wealth of data provides the ability to analyse our waste stream and supports informed decision making. Issues such as infrastructure planning, resource recovery and waste minimisation initiatives can be considered more effectively using the knowledge obtained from the Landfill Audit.

Although disposal of waste to landfill will remain a necessary part of an integrated approach to waste management, final disposal in a landfill site should only be for those components of the waste stream which are unable to be effectively recovered.

Continuing to provide a framework which considers waste as a potential resource is fundamental to the Government's Integrated Waste Management Strategy and future waste management initiatives. This is the challenge for the 21st Century.

ROB THOMAS

EXECUTIVE DIRECTOR
ENVIRONMENT PROTECTION AGENCY

1. EXECUTIVE SUMMARY

In August 1998 the South Australian Environment Protection Agency commissioned Waste Audit and Consultancy Services (Aust) Pty Ltd and C.R. Hudson & Associates Pty Ltd to undertake a disposal based audit of waste disposed to landfills within the Adelaide metropolitan area. The primary aims of this project were to estimate the quantity, source and composition of commercial/industrial (C/I) and building/demolition (B/D) wastes entering the six nominated landfills.

" In total 37,099 tonnes of waste ... was disposed to the six landfills during the period over which they were audited. "

The project was undertaken from 19 November 1998 to 8 December 1998. The primary data gathering phases (ie physical and visual audits) were conducted at the Adelaide City Council (ACC), Wingfield landfill site. This site was selected because a high percentage of Adelaide's C/I and B/D waste loads are disposed at this landfill.

The restriction of all activities to the one site during the first seven day auditing period offered many advantages to the project. It enabled maximum resources to be committed to the set-up of the physical auditing, and also made full use of the superior infrastructural aspects of the ACC, Wingfield site.

Another major advantage was that it enabled all auditors to be on the one site, to witness both the physical and visual auditing activities, and to continually check on the consistency of auditing of incoming waste materials.

During the second week of the visual auditing program, data was collected from five other landfills, namely Integrated Waste Services (IWS) at Wingfield, Lucas at Maslins Beach, Remove All Rubbish at Nuriootpa, Southern Region Waste Resource Authority (SRWRA) at Pedler Creek, and Western Region Waste Management Authority (WRWMA) at Garden Island.

The methodology for the project (see Section 4), required physical audits of 1% of C/I and B/D waste loads to enable the project team to develop accurate density data for a range of predetermined waste categories. This information was then used in conjunction with the visual audits conducted at all landfills to estimate the weights of individual waste category materials, being landfilled in the Adelaide metropolitan area.

In total 37,099 tonnes of waste (C/I, B/D, domestic and special waste) was disposed to the six landfills during the period over which they were audited. This comprised 5,830 tonnes of C/I waste, 19,704 tonnes of building/demolition waste; 10,196 tonnes of domestic waste; and 1368 tonnes of special waste.

" During the audit period approximately 670 tonnes of garbags were landfilled at the six sites. "

Of the total disposal quantities for the six sites, 15,248 tonnes was received at the ACC site.

The predominant categories of the C/I waste stream were food/kitchen (23% by weight), cardboard (17% by weight), garbags (11.5% by weight), paper (9% by weight) and wood/timber (7% by weight).

The main industry sector generating C/I waste was the manufacturing industry at 45% (by weight) of the total C/I waste stream.

The fact that cardboard was such a significant contributor to the weight of waste being disposed of at the landfills, is all the more important due to its relatively low density. It was clearly evident that cardboard was the single largest contributor to the total volume of C/I waste being landfilled, in total contributing an estimated 980 tonnes to the C/I waste stream during the seven day audit period (excluding the contribution from garbags). This would equate to about 15,000 m^3 of relatively loosely compacted material.

The significant quantity of garbags present in the C/I waste stream was targeted for particular attention during the physical audit program. This enabled an estimate to be made of the contribution of garbags to the individual waste categories, and ensured that their contents did not remain as an 'unknown' in the project results.

On an average composition, this would add an estimated 250 t paper, 200 t food/kitchen, and 130 t of plastic bags/film to the individual quantities for these categories of waste.

The total amount of food waste present in a load was generally not readily evident. Much of the moisture that drained from compactors and absorbed into cardboard was generated from food waste but would not normally be assessed as food/kitchen material. This situation was confirmed during the physical auditing process and an allowance was made in the volume to weight calculations to ensure that the liquid was attributed to the food waste component and did not incorrectly inflate the cardboard weights.

The B/D waste stream comprised predominantly soil (33%w/w), clean fill (23% by weight), clay (16% by weight), rubble (8% by weight), concrete (7% by weight), and rocks/bricks (7% by weight). During the audit period a large amount of soil/clay/clean fill was deposited at the SRWRA site from two large infrastructural projects being carried out in the area. The SRWRA site accounted for approximately 50% by weight of the total amount of these three categories of waste which were deposited at the six landfills during the audit period.

Factors such as these must be recognised when extrapolating the data to give annual disposal estimates.

The main industry sector generating B/D wastes were institutional/government building and development at 36% (by weight), and residential building and development, at 28% (by weight) of the total B/D waste stream.

The visual and physical audits programmes clearly demonstrated that there are significant quantities of potentially recyclable materials being disposed of to landfill.

This shows that the introduction of programmes targeted towards industry sectors generating these materials should assist in reducing the amount of waste being disposed of to landfill.

2. INTRODUCTION

In June 1996 the South Australian Government released the *Integrated Waste Strategy for Metropolitan Adelaide 1996-2015*. This strategy was developed, following extensive community consultation, to provide guidance for the next two decades of waste management in the Adelaide metropolitan area.

"Those responsible for the development of waste management strategies have realised that the collection of accurate data on quantities, types, source and frequencies of waste generation is an absolute vital first stage in this process."

The strategy outlined a broad range of objectives and programmes to ensure that South Australians have a waste management system that meets best-practice environmental management techniques and is based on reliable data.

Those responsible for the development of waste management strategies have realised that the collection of accurate data on quantities, types, source and frequencies of waste generation is an absolute vital first stage in this process.

This is not an issue that is unique to South Australia; it is being addressed in other Australian States and internationally.

In 1997, the New South Wales Environment Protection Authority (NSW EPA) commissioned a disposal based Waste Census for commercial/industrial (C/I) and building/demolition (B/D) wastes. The objectives of this census were to estimate the quantity, source and composition of C/I and B/D waste disposed of to landfill in NSW.

The results of this project have not yet been released by the NSW EPA, but the information has been used by the eight Waste Planning and Management Boards to develop their Regional Waste Management Plans.

The Victorian EPA is moving down a similar path, and in late 1998, commissioned a study into waste classification and waste reporting procedures at Victorian landfills.

In 1997, the South Australian Environment Protection Agency (EPA) released a project brief for the conduct of a disposal based survey of C/I and B/D wastes disposed of to Adelaide metropolitan landfills.

To achieve the depth of data required by the EPA, the choices in methodology were:

- Source based audit – in which the quantity and type of waste materials generated are determined from a broad range of individual C/I and B/D organisations
- Disposal based audit – in which the quantity of wastes received at a site (eg landfill or transfer station) is measured as to weight and composition from sectors under consideration.

Whilst a source based audit has the potential to provide more detailed information on waste streams at the point of generation , it could not cover a major portion of the total waste stream without incurring prohibitive costs.

The disposal based option was selected by the EPA as it offered an opportunity to gain a more comprehensive overview of Adelaide's waste on a more cost effective basis.

A key component of these types of studies is the collection of data in a consistent manner. This has now been made possible through the development and subsequent acceptance by governments of the Australian National Waste Database. This National Waste Database has been developed to ensure a uniform national system for classifying, collecting and reporting waste management data.

The information gained from this disposal based audit (as a forerunner to targeted source based audits), will allow the EPA to select specific waste types and/or industry sectors which can then be prioritised as part of their strategy to reduce waste to landfill.

The Project Team viewed occupational health and safety for this project very seriously and at all times ensured that site specific requirements in conjunction with safe working practices were addressed. A training session was conducted over a half day for all staff which combined theoretical instruction with visits to sites within the landfill to raise awareness on specific safety issues.

A selection of photographs taken at various landfill sites is provided in Appendix 1.

3. PROJECT OBJECTIVES

The methodology adopted for this project was designed to meet the objectives of the project as specified by the South Australian EPA. These objectives were to:

- estimate the quantity, source and composition of commercial/industrial and building/demolition waste disposed to landfill
- enable the accuracy of the existing EPA municipal waste disposal data to be evaluated
- establish the groundwork for the development of an integrated database to assist in the formulation of waste reduction strategies and policies
- disaggregate and classify waste tonnage data into meaningful categories
- provide independent estimates of the accuracy of data supplied by landfill operators.

The project brief requirement was to collect the above information on C/I and B/D waste disposed to landfill. Detailed analysis of domestic waste deposited to landfill was not included as part of the project brief.

4. METHODOLOGY

4.1 General Methodology

The methodology for this project was developed in conjunction with the EPA, with consideration given to the NSW EPA *Waste Stream Collection Methodologies*[1]. This methodology was subsequently modified to that detailed in this document, following preliminary site investigations and discussions with both the NSW EPA and SA EPA. Importantly, the methodology was developed to protect the health and safety of all personnel involved in the project at all times, while ensuring meaningful data was gathered.

This project was undertaken from 19 November 1998 to 8 December 1998. Specific activities were:

- 19 – 20 November 1998 – audit site preparation and set up at ACC Wingfield
- 20 November 1998 – classroom training for on-site auditors
- 21 November – physical and visual audit practical training
- 23 – 29 November 1998 – physical auditing and Week 1 visual auditing
- 30 November 1998 – 4 December1998 – week 2 visual audit at RAR Nuriootpa
- 30 November 1998 – 1 December 1998 – demobilisation of ACC Wingfield and audit site preparation and set up at other sites
- 2 – 8 December 1998 – week 2 visual audit at IWS, WRWMA, Lucas and SRWRA.

This project was divided into two distinct phases. These were:

- Physical audit process (Week 1)
- Visual audit process (Weeks 1 and 2).

[1] Unpublished work from NSW EPA

4.1.1 Site Selection

The Adelaide City Council (ACC) site at Wingfield was selected as the site to conduct the physical audits and the first week of visual audits. Preliminary investigations of all sites indicated that this site receives approximately 70% of the C/I and 50% of the B/D loads deposited into the nominated landfills within the Adelaide metropolitan area. Therefore, by concentrating both the physical and first visual audits at this site, a true representation of the overall C/I and B/D waste streams could be achieved whilst ensuring consistencies in data collection (ie categorisation of waste and calibration of auditors 'eyes' in visually auditing waste loads).

The EPA nominated all the landfill sites (see Appendix 2). Those selected for the second week of the visual audit programme were:

- Integrated Waste Services, Wingfield (IWS)
- Southern Region Waste Resource Authority, Pedler Creek (SRWRA)
- Western Region Waste Management Authority, Garden Island (WRWMA)
- Lucas Earthmovers Southern Waste Depot, Maslins Beach (Lucas)
- Remove All Rubbish, Nuriootpa (RAR).

4.2 Data Collection and Management

4.2.1 Waste Audit Forms and Document Control

Proformas for the collection of data were developed using the NSW EPA *Waste Stream Collection Methodologies* as a general guide. These proformas were modified before the physical and visual audits began to meet the specific requirements of this project.

Proformas used were:

- Gatehouse log
- General visual assessment log
- Physical audit log.

The control of all documents used to record data was given priority to ensure the integrity and completeness of data. The following standard document control procedures were employed to manage all data input sheets:

- One staff member was allocated the responsibility for maintaining document control and auditing the issuing and collection of all documents before starting the day's audits, and at the end of the day.
- All proformas were allocated a document control number and a revision number (indicating the previous version replaced) if required.
- All proformas of the same type were printed with sequential numbers.
- Auditors were required to sign out all proformas removed from their individual packages and sign in all returned proformas. This information was recorded on a Log Sheet Schedule.

4.2.2 Data Collection and Recording

A senior member of the audit team (auditor), was stationed in the gatehouse during site operating hours.

All vehicles entering the landfill site were required to enter through the weighbridge or gatehouse. Details of the type of waste, weights and vehicle and contractor details were logged by the operator as part of his/her normal duties. As part of this audit programme, the auditor stationed at this point recorded the following information (to minimise operational disruption, most information was recorded as the operator requested it from the vehicle driver, with supplementary information requested as the driver awaited the docket from the operator):

- time entering the landfill site
- vehicle registration number
- vehicle class
- waste type (eg domestic, B/D, C/I or special)
- net weight
- industry type that the vehicle collected from

- main industry code
- main collection suburb
- Local Government Area (if possible)
- disposal point (eg tip face, specials pit, recycling area)
- contractor or name of company transporting the waste material.

This information was recorded on the Gatehouse Log Sheet.

The information on the truck registration number and waste type was then conveyed by two-way radio to auditors at the appropriate site unloading area.

The vehicles entering the landfill were then directed as per normal landfill operations to the appropriate disposal point, except in the first week at ACC Wingfield if the vehicle had been selected for the physical audit process (when it was then directed to the physical audit site).

At the disposal point, the visual audit details of the load, together with the time, truck registration and type, were recorded on the Visual Audit Log by the auditor.

At the physical audit site, data was recorded on log sheets during the physical audit, as skips and containers were weighed. This data was then consolidated onto the Physical Audit Log for entry into the database.

4.2.3 Data Entry

During the first seven days of the audit, a data entry office was established at the ACC Wingfield site. This was manned by the team member responsible for the database development, and by agency data processors. Audit sheets were relayed from the site data collection areas to the office on an hourly basis.

During the second seven day audit period, a data entry station was set up at the Lucas landfill. Data from the SRWRA site was transferred daily to this office, whilst data from the WRWMA, IWS and RAR sites was regularly couriered to the Lucas site.

4.2.4 Database

A Microsoft Access database program was developed for this project. The program made maximum use of pre-entered data and 'pull-down' menus to simplify data entry and to minimise errors.

Gatehouse Log Sheet data was entered before the corresponding visual audit data.

The main links between the two sets of data were the date, time and the vehicle registration number.

On entering visual audit data, the entry of the vehicle registration number, date and time immediately accessed the data screen for the corresponding Gatehouse Log entry. This enabled any data inconsistencies to be immediately addressed.

4.2.5 Data Quality Management

If the linked details on the gatehouse and visual audit logs did not match, the visual audit entry was not accepted by the database. This was also the case if the sum of the category percentages did not equal 100% or if critical data was missing.

At the end of each day, an error report was generated which highlighted visual audit logs that had not been accepted. These errors generally related to the interpretation of registration numbers. They were resolved each day by the Data Manager, referring to the individual auditors and manually cross-checking Gatehouse and Visual Audit Logs.

During the first five days of the audit at the ACC Wingfield site, tonnages received were also checked daily, according to weighbridge figures and database figures.

4.3 Classification

4.3.1 Vehicle Type

Classification codes for vehicles together with size are provided in the following table. Classification of vehicle types was based on the EPA system employed by the landfill operators.

Class	Vehicle Type
1	Cars and station wagons
2	Utilities and trailers (up to 6x4)
3	Large utilities and trailers (exceeding 6x4)
4	Open trucks and containers (up to 15 m^3)
5	Open trucks and containers (16 m^3 to 22 m^3)
6	Open trucks and containers (23 m^3 to 29 m^3)
7	Open trucks and containers (greater than 29 m^3)
8	Enclosed compactors (up to 8 m^3)
9	Enclosed compactors (9 m^3 to 12 m^3)
10	Enclosed compactors (13 m^3 to 19 m^3)
11	Enclosed compactors (20 m^3 to 32 m^3)
12	Enclosed compactors (33 m^3 to 42 m^3)
13	Enclosed compactors (greater than 42 m^3)
14	Other

4.3.2 Industry Sector

Industry codes allocated were based on the Australian and New Zealand Standard Industry Classification (ANZSIC).

Code	Industry Sector
A	Agriculture, Forestry and Fishing
B	Mining
C	Manufacturing
D	Electricity, Gas and Water Supply
E	Construction
F	Wholesale Trade
G	Retail Trade
H	Accommodation, Cafes and Restaurants
I	Transport and Storage
J	Communication Services
K	Finance and Insurance
L	Property and Business Services
M	Government, Administration and Defence
N	Education
O	Health and Community Services
P	Cultural and Recreational Services
Q	Personal and Other
X[2]	Other commercial and industrial

[2] Code X is not an ANZSIC Industry Sector Code.

Mobile compactor vehicles regularly collect waste from a variety of industry sectors within a single load. When it was possible for the driver to identify one major industry sector, the load was classified according to the ANZSIC code for that industry. If it was not possible to identify one major industry sector, Code X was used. Code X generally represents a variety of small to medium enterprises.

As the B/D sector was not classified by ANZSIC in sufficient detail for this project, the following codes were allocated as per the Project Brief:

Code	Industry Sector
BD1	Residential building and development
BD11	Residential demolition
BD2	Commercial building and development
BD21	Commercial demolition
BD3	Institutional government building and development
BD31	Institutional government building demolition
BD4	Landscaping building and demolition
Other	Other building and demolition

4.3.3 Waste Type

Waste was classified into four major types as per the Project Brief requirements:

- building/demolition (B/D)
- commercial/industrial (C/I)
- special
- domestic.

The first three waste type loads were all logged through the weighbridge/gatehouse and visually audited.

Domestic waste was logged through the weighbridge/gatehouse, but was not visually audited.

For the purpose of this project, domestic waste was defined as kerbside collected material, transfer station waste, hard rubbish collections and bagmen. Domestic waste did not include cars/trailers.

4.3.4 Waste Category

The waste categories used for both the visual and physical audits were based on those developed in the Australian Waste Database (AWD).

A total of 25 categories were used, as listed next page, with definitions and examples of types of waste included.

Paper	all paper eg office, newsprint, liquid paperboard, glossy	**Clean fill**	indistinguishable mixture of clay, soil, crushed rock/ rubble up to 150 mm
Cardboard	all grades	**Rubble**	mixture of mineral materials >150 mm but not readily distinguishable as brick, concrete, etc, in significant quantity
Food/ kitchen	food scraps, fruit and vegetables, feathers, meat, fish, poultry	**Soil**	sandy loam, sand, mountain soil, considered to be of suitable quality to be used as a topsoil, either on its own or mixed with an organic amendment
Vegetation/ garden	garden waste, lawn clippings, trees	**Clay**	ranging from clayey sands and silts to firmer clays
Wood/ timber	sawdust, shavings, MDF, chipboard, timber	**Concrete**	footpaths, footings, slabs, posts, etc
Leather/ textile	footwear, carpet/ underlay, clothing, mattresses, curtains	**Rock/bricks**	Whole and large broken bricks and large rocks
Tyres/ rubber	shredded tyres, car tubes, offcuts, tubing	**Asphalt**	road paving
Glass	all	**Plasterboard**	all varieties
Bags, film, plastic	cling wrap, stretch wrap, shrink wrap, bags, PET bottles, HDPE bottles	**Garbags**	all black/grey/clear, etc garbage bags
Hard plastic	PVC pipe, vinyl flooring, milk crates, pails, plastic roofing	**Other CI**	non listed materials or indistinguishable materials
Polystyrene	sheeting, packaging, cups	**Other BD**	non listed materials or indistinguishable materials
Ferrous metal	spouting, strapping, drums, roof sheeting	**Specials**	all wastes requiring environmental consideration, including waste covered by transport certificate (eg asbestos and foundry sands)
Non-ferrous metal	aluminium cans/ extrusions, copper pipe		

Table 1: Definitions and examples of types of waste.

4.4 Physical Audit Process

This programme was primarily used to separate selected waste loads into predetermined categories, which were then weighed, and the volume/compaction rate measured. The information from this process was then used to calculate densities of the various categories of materials.

On-site physical auditing of such waste required close consideration of many factors, such as:

- type and quantity of wastes to be audited
- location of a suitable flat area of sufficient size
- maintenance of staff occupational health and safety
- awareness of normal on-site activities and equipment/vehicles used
- personnel protective equipment
- set-up of sorting and weighing equipment
- transfer of sorted and weighed materials to the disposal point
- provision of amenities for the large physical auditing team
- access to a weighbridge to provide net load weights for audited materials
- decontamination equipment and procedures.

The following process was used to conduct the physical audit programme.

4.4.1 Waste Categories

The categories into which the waste was separated were identical to those used for the visual audits.

4.4.2 Sample Selection

As part of the project requirements, a sample representing 1% of the total C/I and B/D waste movements for the six selected sites was to be physically audited.

The actual sample load numbers were calculated from the total number of movements for the sites covered by the Project Brief. These figures were obtained from several discussions with each of the site operators.

As it was agreed with EPA that there is little site-to-site variability in waste characteristics, the physical audits were conducted at the ACC Wingfield site.

The statistician employed for this project (Dr Rodney Carr, Deakin University), provided advice as to the methods of load selection.

The final indicative figures obtained for the total movements of C/I and B/D waste streams for the selected landfills were:

C/I – 1200 loads/week

B/D – 1800 loads/week.

The minimum physical audit target was then selected to be 1% of these figures, ie:

C/I – 12 loads

B/D – 18 loads.

Whilst the B/D waste stream is predominantly transported in open trucks/bins, it is divided into two main types, namely:

(a) General B/D (eg wood/timber, ferrous metal, plastic)

(b) Clean fill (eg soil, sand, rubble).

Based on predicted movements, the breakup of loads between general B/D and clean fill type material, was expected to be about 50:50.

Vehicles for physical audit were randomly selected on the basis that they were the 'next vehicle' containing the type of waste that was required for auditing (ie C/I or B/D) and the category of waste they contained (eg cleanfill). The variables affecting the selection of vehicles were:

- type of waste
- type of vehicle (open or compactor).

The physical audit targets were exceeded with the following numbers of loads being audited:

- **7** x C/I – compactors
- **7** x C/I – open vehicles
- **16** x B/D – general (eg timber, vegetation, plastic, metals)
- **14** x B/D – clean fill (eg clean fill, soil, clay, concrete and rubble).

The actual movements recorded during the audit are listed in the following table:

Waste Type	Total Movements	ACC Movements	
		No.	%
Commercial/Industrial	1037	746	72
Building/Demolition	1720	832	48
Special	129	64	50
Domestic	1384	442	32

Table 2: Movements recorded during the audit.

According to these figures, **11 C/I** and **18 B/D** loads should have been physically audited. Again it can be seen that these requirements were exceeded.

4.5 Visual Audit Programme (Week 1)

The visual audit programme during the first week of the project, was conducted at the ACC Wingfield landfill site. Operational hours at this site were 5am – 5pm weekdays, 6am – 5pm Saturdays, and 8am – 4pm Sundays.

This phase of the project involved auditors in liaison with the gatehouse auditor identifying that the vehicle depositing waste was carrying either C/I or B/D waste (if the auditor was not sure if the load was domestic waste, then data would be collected). The following methodology was employed.

All auditors wore white overalls with protective vests so they were highly visible. In addition each auditor was equipped with binoculars to enable them to visually assess loads if they could not get close to the

load being deposited. All auditors carried two-way radios to allow conversations between auditors and/or the gatehouse. The visual auditors had regular breaks so that they could obtain refreshments and the relief auditor replenished their drink containers on a regular schedule.

Categorisation of waste components was consistent between the physical and visual audit programmes.

4.5.1 Calibration of Auditors' Eyes

It was considered to be imperative that the visual audits were consistent as well as accurate. A number of steps were taken to ensure this consistency.

- Only experienced senior personnel were used for the visual audits.
- Visual auditors received theoretical and practical pre-training at the actual physical auditing site.
- All visual and physical auditing activities were concentrated on one site during the first seven days of auditing.
- Visual auditors were rotated on the main site during the first seven days of the audit.
- Two-way radio communication was used between gatehouse observer and visual auditors.
- Loads were more closely inspected during times when compactor/dozer machinery was not in operation.
- Loads where inspected while being 'pushed over' by machinery, whenever possible.
- Independent multiple visual assessments were conducted on individual loads with a comparison of results immediately on completion.
- Auditors were paired whenever possible to assess loads and then compare results.

All auditors involved in visual audits were required to attend training periods of visual auditing to enable calibration of auditors' 'eyes'. This process ensured consistency of estimations of composition of the waste. Mandatory training and calibration sessions were conducted for all auditors before the auditing programme began and at the beginning

of each day of the Week 1 programme (before physical audit activities began).

4.5.2 Viewing Positions

Visual auditors selected vantage points on each site that gave them a clear view of the waste as it was discharged from the vehicle, but did not place them in a potentially hazardous situation.

If possible, viewing was conducted from an elevated position. Viewing positions were shifted to accommodate changes in the active tip face. If possible, positions downwind of the working face were avoided. During strong wind conditions, viewing downwind of the tip face was prohibited.

4.5.3 Waste Composition Assessment

Visual audits were made of loads as they discharged from the truck, and whilst they lay on the ground. Binoculars were used to assist in the identification of registration numbers, and in categorisation of the load.

A mark was placed on the audit sheet for each waste category identified as being present in the load. On further consideration, a percentage figure was given to any category deemed to be present at 5% or more of the load into “V1” (Visual 1), column of the audit sheet.

If time permitted, a second audit was made and the figures logged in the “V2” (Visual 2), column with the “V1” figures being crossed out.

4.5.4 Compaction Estimation

In addition to the assessment of the make-up of the waste, an estimation of the degree of compaction (DOC) was also made to assist in the estimation of waste densities under different compaction conditions.

The main waste categories that were considered to be significantly compactable were:

- paper
- food/kitchen
- cardboard
- garden/vegetation
- polystyrene
- bags/film/plastic
- garbags.

The DOC was determined by visually assessing the compaction state of these materials.

Three levels of compaction were set as 'loose', 'medium' and 'compacted'.

The following guidelines were used for DOC estimates:

- **Loose** – waste carried in bulk bins and open trucks
- **Medium** – waste carried in only partially full stationary compactors or heavily packed waste in an open truck or bin
- **Compacted** – all waste carried in mobile compactors and most waste carried in stationary compactors.

4.6 Visual Audit Programme (Week 2)

Visual audits were conducted during the second week of the project at the following sites:

- RAR, Nuriootpa
- IWS, Wingfield
- WRWMA, Garden Island
- SRWRA, Pedler Creek
- Lucas, Maslins Beach.

The methodology employed to conduct these audits was identical to that used during the Week 1 programme. Except for the RAR Nurioopta site, where only one senior auditor was required to conduct both the gatehouse data logging and visual audits, due to the small number of movements at the site.

5. RESULTS

5.1 Waste Volume to Weight Relationships

5.1.1 Density Estimates

The density of the various waste category materials, in conjunction with the degree of compaction (DOC), was used to determine:

- estimated net weight of loads entering the two landfills not equipped with weighbridges
- a waste based percentage of visual audit data converted from a volume based percentage.

Densities for each of the waste category materials were determined from the physical auditing activities. These estimates were for loosely compacted material.

Loose densities as determined from the physical audit are listed in the following table, as are the estimates used in the 1997 NSW EPA Census[3].

[3] Unpublished work from NSW EPA

SA EPA Audit			NSW EPA Census
Waste category	Average density (kg/m³)	Number of measurements	Average density (kg/m³)
Paper	76	45	59
Cardboard	53	78	
Food/kitchen	343	13	383
Vegetation/garden	91	25	117
Wood/timber	156	70	178
Leather/textile	91	58	118
Tyres/rubber	263	4	116
Glass	411	10	288
Bags/film plastic	39	71	39
Hard plastic	72	24	87
Polystyrene	14	26	19
Ferrous metal	120	32	141
Non-ferrous metal	139	5	170
Clean Fill < 150mm	1175	8	
Rubble > 150mm	1048	18	
Soil	1259	7	1179
Clay	1150	2	1120
Concrete	830	10	1066
Rock/bricks	828	8	1352
Asphalt [4]	310		310
Plasterboard	227	7	
Garbags	87	11	
Other CI	170		
Other BD	1160		

Table 3: Loose densities for each waste category.

[4] The small number of 'clean' asphalt loads that entered the ACC Wingfield site during the auditing period, made physical auditing of this material impossible. A density figure obtained from the NSW Landfill Census has been used as a default in this case.

5.1.2 Degree of Compaction Estimates

A number of waste materials were considered to have their densities significantly affected by compaction within a vehicle. These were:

- paper
- cardboard
- food/kitchen
- polystyrene
- garden/vegetation
- garbags
- bags, film and plastic.

It could be argued that other wastes could be partially compacted, but no significant level of compaction in materials other than the above showed in the audit.

Density figures for medium and compacted materials were derived using a multiple approach comprising:

- use of loosely compacted density figures derived from the physical audit data
- estimation of compaction ratios of targeted materials from industry knowledge and from liaison with waste management companies and computer manufacturers
- review of actual 'in-truck' densities of loads carrying more than 90% of a targeted waste under various compaction conditions
- experience gained in physically compacting materials during the physical audit.

The following DOC values were assigned to the compactable wastes.

Material	Degrees of Compaction		
	Loose	Medium	Compacted
Paper	1	2	3
Cardboard	1	1	3
Food/kitchen	1	1.5	3
Vegetation/garden	1	2.5	5
Bags/film plastic	1	2	4
Polystyrene	1	1.5	2
Garbags	1	2	4

Table 4: Degree of compaction values.

These compaction ratios were then used to estimate densities for the materials, under different degrees of compaction.

5.1.3 Validation of Density/Compaction Estimates

A check of the database during the first seven days of the audit revealed that many compacted loads containing primarily cardboard had densities of 200–250 kg/m^3.

This was greater than the densities calculated from the physical audit data and compaction ratios.

It was suspected that the cause of the discrepancy was the tendency for cardboard to act as a sponge for liquid contained in the load. It was evident that many loads contained wet compacted cardboard with the most likely source of liquid being from food waste.

A field experiment was conducted using bales of cardboard that had been compacted by an elephant foot press. This would be considered to be highly compacted material. The bales were measured and weighed and then one was broken and loaded into a 1.75 m^3 weighing skip and soaked overnight with water. Another was soaked overnight in water in its baled form.

The following information was gained from the experiment.

density	loose dry cardboard	»	55 kg/m^3
	compacted dry cardboard	»	130 kg/m^3
	loose wet cardboard*	»	190 kg/m^3
	compacted wet cardboard	»	260 kg/m^3

* wetting of loose cardboard actually leads to some compaction, hence this figure is not a true loose DOC value.

Hence, the moisture content of cardboard is likely to be responsible for the higher density readings.

Whilst some food waste in loads is evident by visual audit, a major portion is 'hidden' in the liquid that drains from compactors, and in the moisture in the cardboard.

If a high density figure was used for cardboard, it would lead to an overestimation of the weight of cardboard in a load.

The liquid in question has a density of about 1000 kg/m^3 and should be attributed to the food content of the load.

Hence, the estimated compacted density figure for cardboard (159 kg/m^3) has been validated when an allowance is made for a small amount of moisture in the material.

This did not, however, overcome the problem with the 'hidden' portion of food waste in compacted loads. If this problem was not addressed it would have led to an underestimation of the food waste stream, and to a shortfall in load weights as calculated from visual audit data.

The problem was overcome or minimised by intentionally over-estimating the compaction ratio for food type wastes, to take into account the liquid (density 1000 kg/m^3) that is squeezed out of the food during compaction.

A check of 16 compactor loads selected at random showed that the difference between actual net weight and that calculated from visual audit/density/compaction data, was within an acceptable level and approximated a normal distribution.

5.1.4 Calculation of Load Weights at Non-Weighbridge Sites

Two of the audit sites (RAR at Nuriootpa, and IWS at Wingfield) did not have weighbridge facilities.

Net weights of individual loads entering these sites were estimated using the following strategy:

- The actual volume of vehicles was determined from the 'class of vehicle' and from discussions with vehicle manufacturers and transport operators.
- The 'fullness' of a load was estimated as a part of the visual assessment programme.
- From the above information and from the assessment of waste categories, the volume of individual waste categories was estimated.
- The density of each waste material under the compaction conditions was then used to calculate individual weights and net weight of the total load.

The database was configured such that net weight values were used as a priority in calculations. Where a net weight was not available however, (non-weighbridge sites), the calculation was based on the load volume estimate.

Average net weights of particular classes of vehicles at weighbridge sites was compared to the estimates for non-weighbridge sites to ensure that no significant anomalies occurred.

Although domestic loads were not included in the visual audit programme, total weight estimates for household collections and transfer station loads were desired as a matter of completeness. These estimates were obtained using actual truck volumes, and average densities of the materials as calculated at weighbridge sites.

5.1.5 Calculation of Weights of Waste Categories

Visual audit data was used as the basis to estimate the weights of the various categories of waste identified within a load.

The following equation was used within the Microsoft Access program to automatically calculate the result:

Let:

$\mathbf{d_i}$	be the density of waste material **i (i = 1 to N)**
N	be the number of waste components
$\mathbf{f_i}$	be the visual audit fraction for waste material **i**
NW	be the net weight of the waste load
$\mathbf{w_i}$	be the weight of waste component **i**

Then:

$$w_i = NW \quad \text{x} \quad \frac{f_i \; x \; d_i}{\sum_{i=1}^{N} f_i \; x \; d_i}$$

5.1.6 Garbage Bag (Garbags) Composition

Garbags were separately audited during the physical audit programme, due to their significant presence in the overall waste stream.

Classification of the contents of the garbags into their respective categories enabled the identification of a significant portion of the waste stream, that would otherwise have remained unknown.

On average, the main contents of garbags were paper (31.4%), food and kitchen (31.14%), and soft plastic (20.5%).

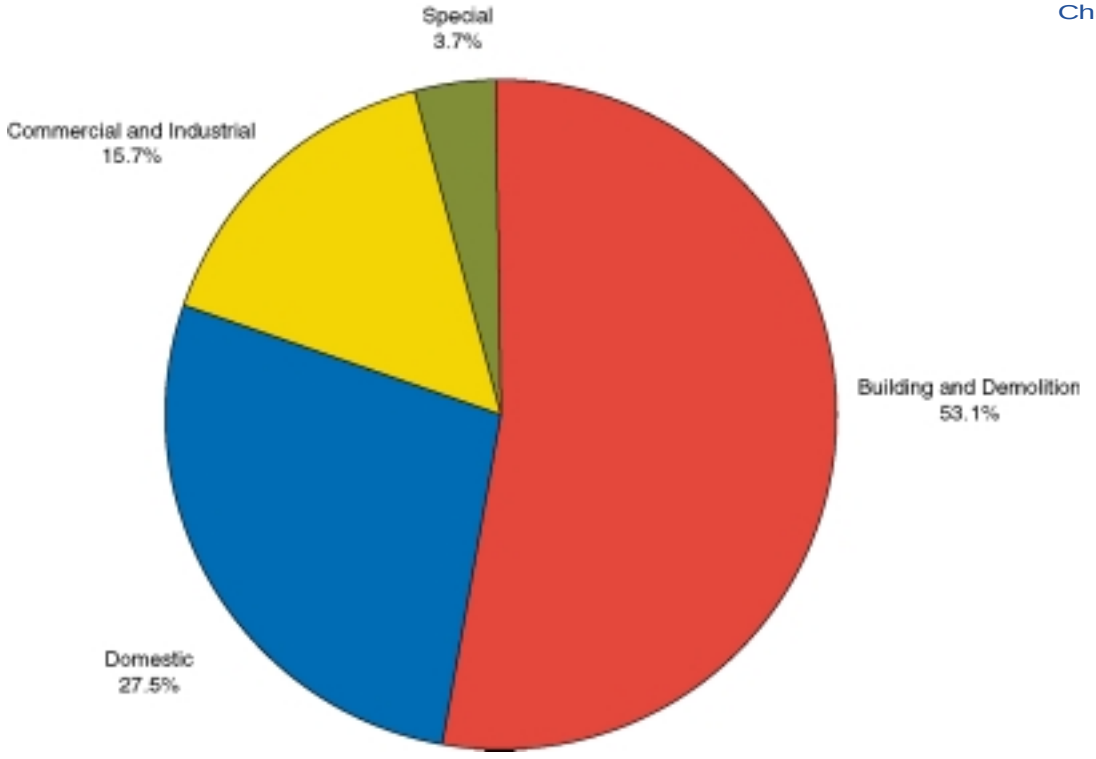
9.2 Landfill Waste Data Analysis

9.2.1 Total Waste Stream by Type

Waste Type	Weight (t)	% (w/w)
Building and Demolition	19704.3	53.1
Commercial and Industrial	5830.5	15.7
Domestic	10196.3	27.5
Special	1368.2	3.7
SITE TOTAL (t):	37099.3	100

Table 5: All sites - see chart 1.

Chart 1

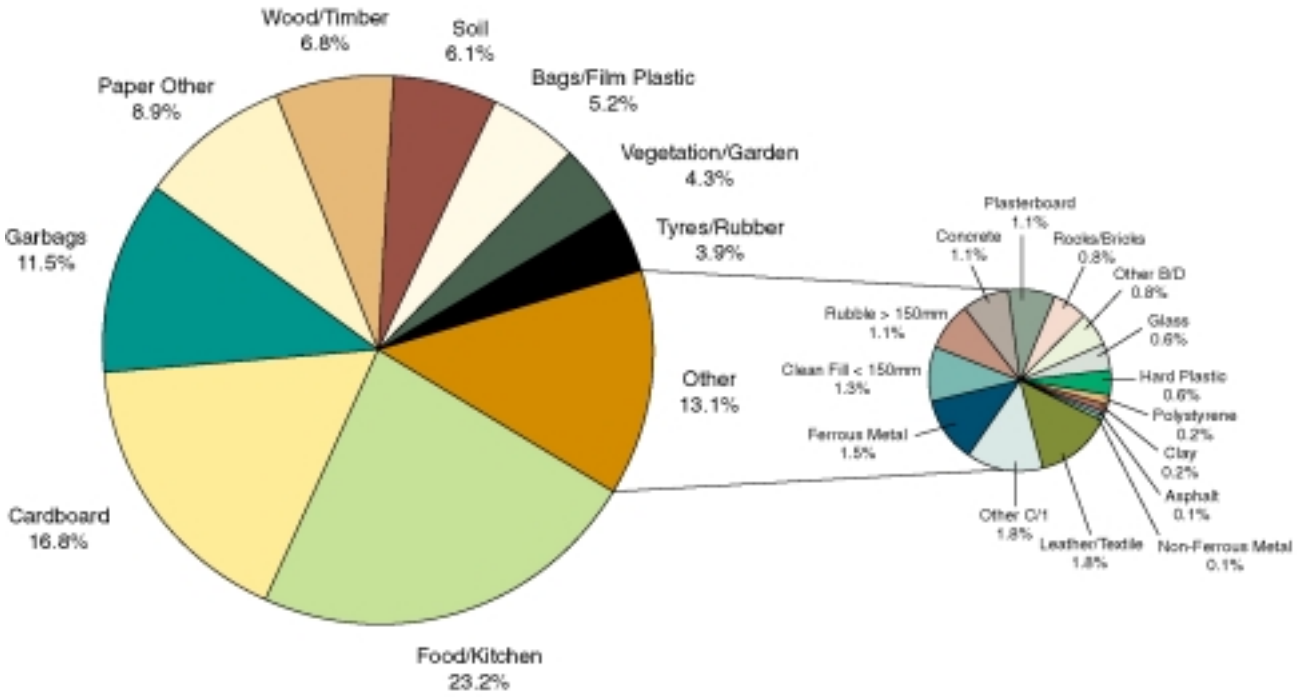


5.2.2 Total C/I Waste Stream by Category

Commercial / Industrial	Weight (t)	% w/w
Food / kitchen	1352.50	23.2
Cardboard	980.79	16.8
Garbags	671.03	11.5
Paper	516.22	8.9
Wood / timber	397.55	6.8
Soil	356.45	6.1
Bags & film - plastic	306.10	5.2
Vegetation / garden	249.35	4.3
Tyres / rubber	228.77	3.9
Leather / textile	106.74	1.8
Other C/I	104.05	1.8
Ferrous metal	90.02	1.5
Clean fill < 150 mm	76.76	1.3
Plasterboard	66.36	1.1
Concrete	64.92	1.1
Rubble > 150 mm	62.13	1.1
Other B/D	48.89	0.8
Rocks / bricks	48.06	0.8
Glass	35.63	0.6
Hard plastic	35.43	0.6
Polystyrene	11.59	0.2
Clay	10.92	0.2
Non ferrous metal	6.76	0.1
Asphalt	3.46	0.1
Category total (t):	5830.49	100

Table 6: All sites - see chart 2.

Chart 2

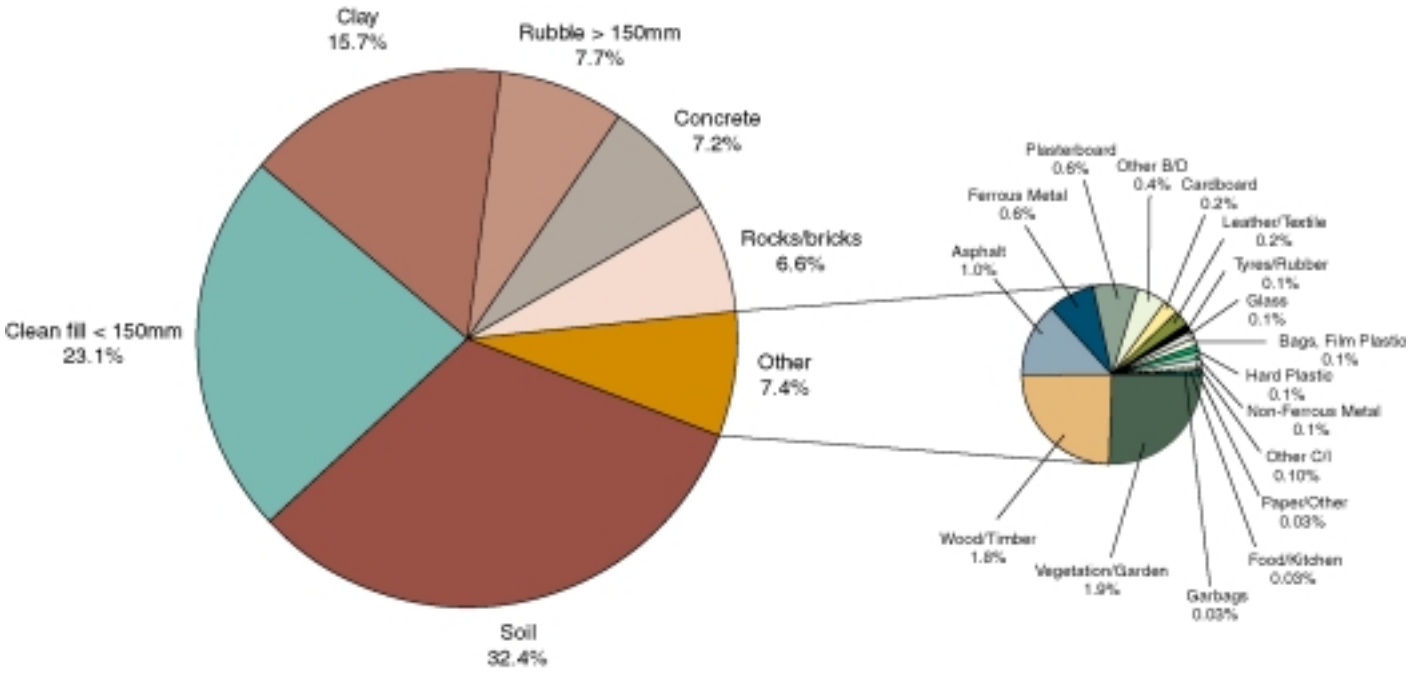


5.2.3 Total B/D Waste Stream by Category

Building / Demolition	Weight (t)	% w/w
Soil	6405.78	32.5
Clean fill < 150 mm	4550.22	23.1
Clay	3102.48	15.7
Rubble > 150 mm	1517.07	7.7
Concrete	1424.80	7.2
Rocks / bricks	1307.12	6.6
Vegetation / garden	366.17	1.9
Wood / timber	353.85	1.8
Asphalt	200.13	1.0
Ferrous metal	118.77	0.6
Plasterboard	109.69	0.6
Other B/D	87.40	0.4
Cardboard	39.72	0.2
Leather / textile	32.98	0.2
Bags & film - plastic	12.38	0.1
Tyres / rubber	11.87	0.1
Non ferrous metal	11.75	0.1
Glass	11.60	0.1
Hard plastic	10.70	0.1
Other C/I	10.42	0.1
Paper	6.74	0.0
Garbags	5.62	0.0
Food / kitchen	5.32	0.0
Polystyrene	1.75	0.0
Category total (t):	19704.31	100

Table 7: All sites - see chart 3.

Chart 3

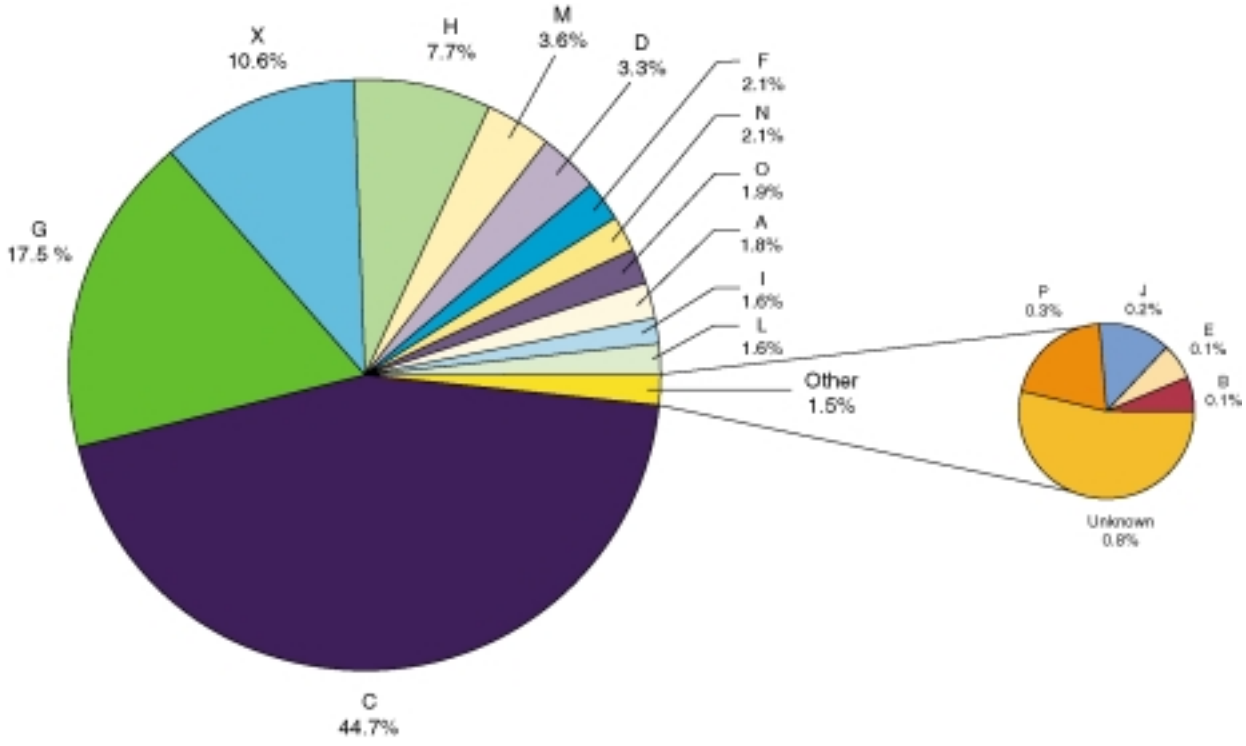


5.2.4 C/I Waste Stream by Industry Sector

Industry Code	Description	Weight(t)	% w/w
C	Manufacturing	2605.16	44.7
G	Retail trade	1020.39	17.5
X	Mixed small to medium enterprise	616.05	10.6
H	Hospitality	446.76	7.7
M	Government/admin/defence	212.77	3.6
D	Services supply	194.25	3.3
F	Wholesale trade	123.13	2.1
N	Education	120.12	2.1
O	Health and community services	113.05	1.9
A	Agriculture/forestry/fishing	105.71	1.8
I	Transport and storage	95.50	1.6
L	Property and business services	91.26	1.6
Unknown	Unknown	46.88	0.8
P	Cultural and entertainment	18.18	0.3
J	Communication services	11.08	0.2
E	Construction	5.69	0.1
B	Mining	4.50	0.1
Category total (t):		5830.50	100

Table 8: All sites - see chart 4.

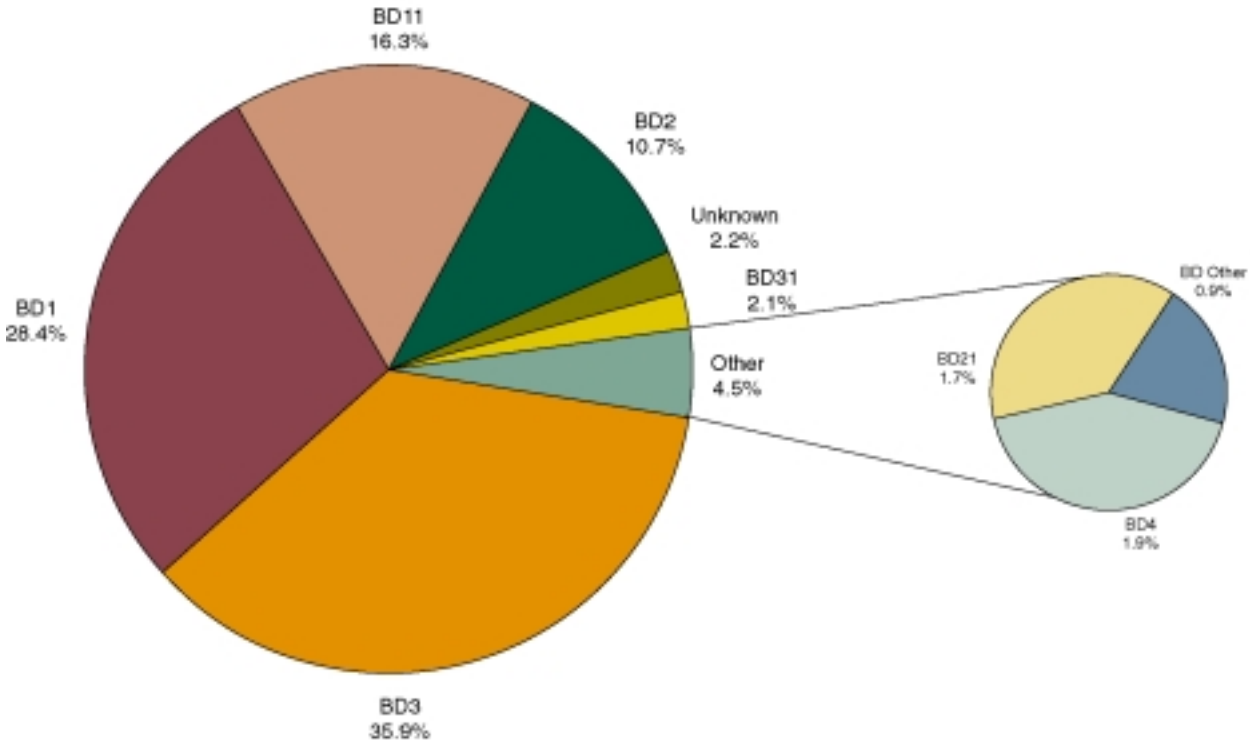
Chart 4



5.2.5 B/D Waste Stream by Industry Sector

Industry Code	Description	Weight(t)	% w/w
BD3	Institutional/Govt building and development	7066.83	35.9
BD1	Residential building and development	5601.04	28.4
BD11	Residential demolition	3215.96	16.3
BD2	Commercial building and development	2098.55	10.7
Unknown	Unknown	428.01	2.2
BD31	Institutional/Govt building demolition	408.83	2.1
BD4	Landscaping building and demolition	373.64	1.9
BD21	Commercial demolition	329.65	1.7
BD Other	Other building & demolition	181.80	0.9
Category total (t):		19704.31	100

Table 9: All sites - see chart 5.

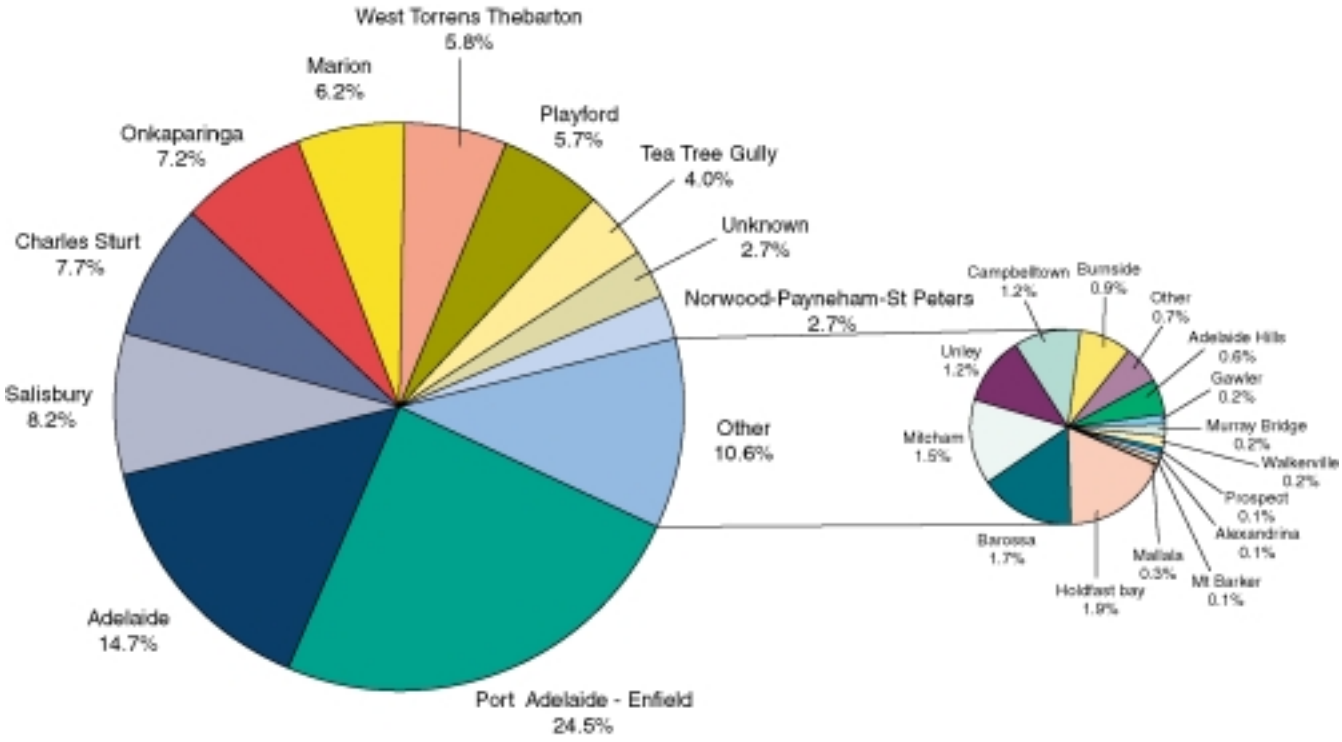


5.2.6 C/I Waste Stream by LGA

LGA	Weight (t)	% w/w
Port Adelaide-Enfield	1427.41	24.5
Adelaide	858.51	14.7
Salisbury	479.54	8.2
Charles Sturt	450.92	7.7
Onkaparinga	418.51	7.2
Marion	362.67	6.2
West Torrens Thebarton	338.86	5.8
Playford	334.82	5.7
Tea Tree Gully	231.16	4.0
Unknown	157.28	2.7
Norwood-Payneham -St Peters	156.77	2.7
Holdfast Bay	108.08	1.9
Barossa	96.97	1.7
Mitcham	87.66	1.5
Unley	71.32	1.2
Campbelltown	69.55	1.2
Burnside	51.23	0.9
Other	38.73	0.7
Adelaide Hills	32.48	0.6
Gawler	13.42	0.2
Murray Bridge	12.04	0.2
Walkerville	9.48	0.2
Prospect	8.56	0.1
Alexandrina	6.88	0.1
Mt Barker	6.00	0.1
Mallala	1.66	0.0
Category total (t):	5830.49	100

Table 10: All sites - see chart 6.

Chart 6

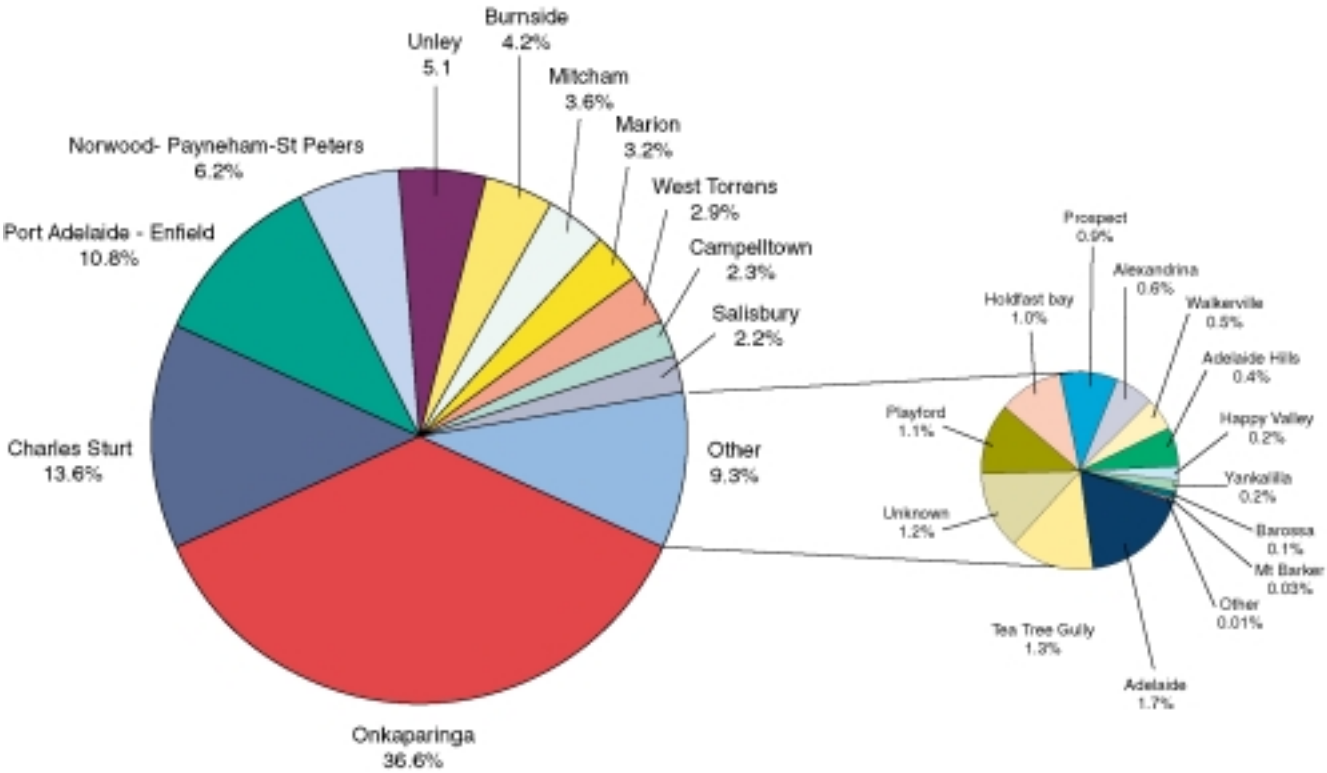


5.2.7 B/D Waste Stream by LGA

LGA	Weight (t)	% w/w
Onkaparinga	7201.67	36.5
Charles Sturt	2686.95	13.6
Port Adelaide-Enfield	2118.43	10.8
Norwood-Payneham -St Peters	1220.91	6.2
Unley	1013.97	5.1
Burnside	820.12	4.2
Mitcham	718.57	3.6
Marion	633.17	3.2
West Torrens Thebarton	574.58	2.9
Campbelltown	458.91	2.3
Salisbury	437.09	2.2
Adelaide	326.32	1.7
Tea Tree Gully	246.44	1.3
Unknown	233.10	1.2
Playford	217.04	1.1
Holdfast Bay	196.11	1.0
Prospect	183.00	0.9
Alexandrina	118.62	0.6
Walkerville	105.88	0.5
Adelaide Hills	82.98	0.4
Yankalilla	47.88	0.2
Happy V-Noarlunga -Willunga	33.46	0.2
Barossa	21.04	0.1
Mt Barker	5.44	0.0
Other	2.65	0.0
Category total (t):	19704.31	100

Table 11: All sites - see chart 7.

Chart 7

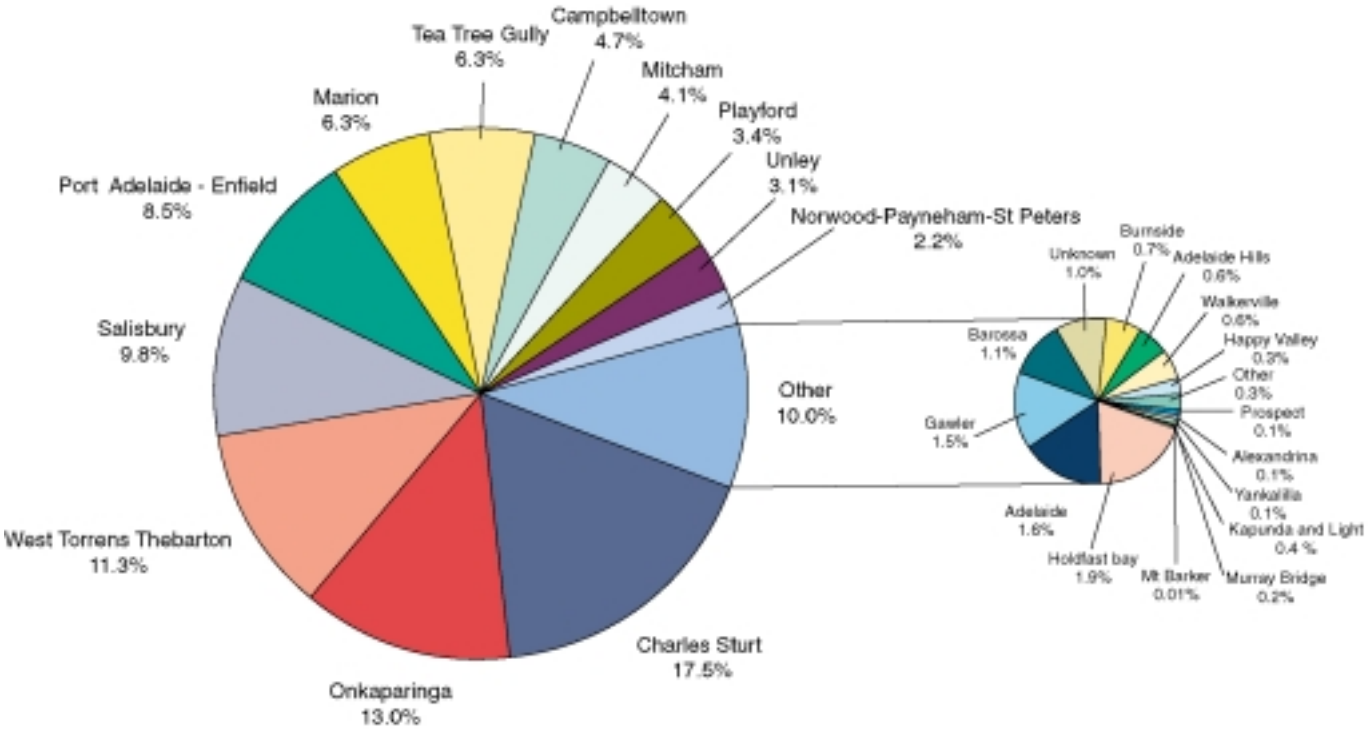


5.2.8 Domestic Waste Stream by LGA

LGA	Weight (t)	% w/w
Charles Sturt	1789.10	17.5
Onkaparinga	1321.17	13.0
West Torrens Thebarton	1154.08	11.3
Salisbury	1004.10	9.8
Port Adelaide-Enfield	869.55	8.5
Tea Tree Gully	645.28	6.3
Marion	637.91	6.3
Campbelltown	481.69	4.7
Mitcham	416.23	4.1
Playford	345.85	3.4
Unley	314.05	3.1
Norwood-Payneham -St Peters	226.88	2.2
Holdfast Bay	193.25	1.9
Adelaide	158.46	1.6
Gawler	151.04	1.5
Barossa	108.20	1.1
Unknown	98.34	1.0
Burnside	66.66	0.7
Walkerville	66.20	0.6
Adelaide Hills	65.40	0.6
Happy V-Noarlunga -Willunga	31.36	0.3
Other	26.00	0.3
Prospect	6.88	0.1
Yankalilla	6.00	0.1
Alexandrina	5.18	0.1
Kapunda and Light	4.00	0.0
Murray Bridge	2.00	0.0
Mt Barker	1.44	0.0
Category total (t):	10196.30	100

Chart 8

Table 12: All sites - see chart 8.



6. CONCLUSIONS

The information gained from the detailed disposal based audit will enable EPA to target specific materials, as well as to prioritise strategies that will minimise the total amount of materials generated and currently disposed of to landfill.

The data generated by this project indicates that there are significant quantities of materials in the C/I and B/D waste streams that have the potential to be diverted from landfill. This does not imply that suitable recycling facilities currently exist in South Australia to receive these materials, as this issue was not within the scope of the current project.

During the seven-day audit period, the following quantities of materials were identified in the overall waste stream landfilled:

- 1020 tonnes cardboard
- 1350 tonnes food/kitchen wastes
- 750 tonnes wood and timber
- 520 tonnes paper
- 320 tonnes plastic bags and plastic film.

This is a significant percentage of the overall waste stream. Should appropriate facilities be available, these materials should be immediately targeted for either reuse, recycling or composting.

The data generated during this project could be used by the recycling industry to conduct feasibility studies into the potential to increase the diversion of these materials from landfill.

During the audit period approximately 14,500 tonnes of 'cover' material (eg soil, clay and clean fill) was landfilled. Whilst this type of material is invaluable to the landfill operators(s) for daily covering operations and litter control, there are likely to be times when more

than the required amounts are received at individual sites. This could result in the material not being used effectively and simply consuming valuable airspace.

A small, but significant portion of this cover material appeared to be of such quality that it could be better used in blending with organic amendments such as compost.

There were inconsistencies in the manner in which some materials were managed at the different sites, for example cover material and green waste.

A concern of the auditors was that of management of asbestos cement wastes, which varied during the audit period from site to site, and within particular sites.

It is recommended that EPA reviews guidelines for the management of materials being deposited in landfills and ensures that all site operators use consistent management approaches.

It is important that the data generated during this project is used as a baseline measurement, and that this auditing exercise be conducted on a regular basis (suggested on a 3-yearly basis as a minimum) to measure the progress and success of waste minimisation and diversion strategies.

APPENDIX 1

The following photos have been selected for their relevance to the project.

Adelaide City Council Wingfield – Physical Audit

Photograph 1
The site used to conduct the physical audit. Blue skip bins are located around the outside of the load of waste to be sorted. Each bin was designated a waste category and material was sorted and deposited accordingly. Physical auditors involved in this activity were required to wear the standard personal protective equipment shown.

Photograph 2
This load of waste contained a considerable amount of cardboard, much of which was not compacted. The right hand side of the photograph shows food wastes deposited inside cardboard boxes before being placed into the waste container. This material and all physically audited loads were sorted, deposited in the appropriate bins and weighed.

Photograph 3
The food residue of the load physically audited in photograph 2. Note the amount of food which was not visible to a visual auditor.

Photograph 4
Illustrates a load of tyre waste from a retread company. Loads such as this which appeared to consist of predominantly one waste type were also sorted and weighed. This photograph also shows how bins were weighed – lifted by a truck and placed onto a set of platform scales. Individual bin weights were recorded before the physical audit began.

Photographs 5 and 6
This load of waste is from the manufacturing sector, contained and transported in a stationary packer. Note the quantity of cardboard throughout this load. There was also a significant quantity of garbage bags and plastic film wrap.

Photograph 7
Tools such as rakes and shovels were used to assist auditors separate waste into individual categories. 55 litre crates were also used to temporarily store material, before transfer to the appropriate bin.

Adelaide City Council Wingfield – Visual Audit

Photograph 8
A load of wood being dumped at the 'face'. A significant proportion of this material is new, unused wood still bound together. The other significant quantity of material is wooden pallets and wood offcuts.

APPENDIX 2

The following information provides an overview of the structure and operating systems used at each of the six individual landfill sites.

ACC Wingfield Waste Management Facility, Wingfield

The ACC Wingfield Waste Management Facility is owned and operated by Adelaide City Council with the majority of site operations carried out under contract. The site is an above ground landfill.

All vehicles entering the site pass over a weighbridge adjacent to the gatehouse control centre. A computer generated receival docket is signed by the driver prior to proceeding to the disposal / recycling areas.

The site accepts a full range of non-hazardous waste including putrescible (domestic and commercial), industrial, building and demolition (B/D), green waste and clean fill. The site also accepts loads that are classified as 'special and or difficult' and these include asbestos, sheep skins, food industry slurries (eg potato starch), grain dusts, cement dust, lime dust.

All waste containing putrescible materials together with C/I waste are directed to the general face for compaction and disposal. Some mixed B/D material is also directed to this area for either compaction and disposal or for the construction of batter walls used in the formation of disposal cells. B/D waste is also directed to a separate face for later compaction and disposal. Suitable loads of rubble are directed to different areas of the site in preparation for various road making activities.

In mid -1998 a recycling area was established on the site to recover reusable / saleable components of the B/D waste stream. Some 'clean' green waste loads are also accepted in this area. Green waste / wood and timber waste is mulched regularly by an external contractor and used for on-site projects and offsite Adelaide City Council use. Other materials that are recovered from the recycling area include ferrous metals that are sold offsite. Crushed rock and concrete is directed back to the onsite road making activities.

Tare weights of regular transport clients are held in the gatehouse data-base. When a truck arrives at the gatehouse entry of the registration number calls up the relevant database details for the vehicle. The relevant details of the particular load are then entered and a weighbridge docket produced in duplicate. One copy is retained by ACC Wingfield for invoicing purposes and one is given to the transporter as a receipt.

Hours of operation for the site are 5am – 5pm weekdays, 6am – 5pm Saturdays and 8am – 4pm Sundays.

Integrated Waste Services, Wingfield

Integrated Waste Services Pty Ltd is a privately operated landfill. The site is an above ground landfill. The site operates under two licenses, 25 acres under landfill and 5 acres as transfer station.

All vehicles are required to stop at the gatehouse to verify loads, sign accounts or pay for disposal before proceeding to the specified disposal point.

The site accepts non-hazardous solid waste from a variety of sources, including putrescible waste from the commercial sector, industrial waste, B/D waste, green waste and clean fill. No hazardous or special wastes are accepted.

All C/I waste vehicles are directed to the face for compaction and disposal. Some B/D wastes are also directed to the face but most is placed in the recycle area. Clean fill is sent either to the face to be used for cover or a designated area for stockpiling.

Vehicles containing green waste, wood and rubble are sent to the recycle area where they are stockpiled for further processing either on site or transported off site to an appropriate facility. Mulched green waste is transported off site.

Domestic cars and trailers are required to deposit their loads at the transfer station opposite the gate house. This waste is piled up using a front-end loader and subsequently moved to the face every few days. Metal is separated from this area by landfill staff and placed into skips for recycling.

The facility does not have a weighbridge and therefore cannot record weights of vehicles entering the premises, but the numbers and types of vehicles are recorded. Regular C/I and B/D clients have an account which is signed by the driver whenever a vehicle passes the gatehouse. Clients that do not have an account pay at the gatehouse and a receipt is issued.

Hours of operation for the site are 7am – 4.45pm seven days per week.

Lucas Earthmovers Southern Waste Depot, Maslins Beach

The Southern Waste Depot is leased and operated by Lucas Earthmoving Pty Ltd. Landfill operations have been carried out at the site for five years. Before that time it was operated for sand and soil extraction.

All vehicles entering the site pass over a weighbridge adjacent to the gatehouse control centre. The drivers for companies with an account sign a hand written receipt.

The site accepts a full range of non-hazardous waste including putrescible (domestic and commercial), industrial, B/D and green waste. Clean fill is not accepted on the site. The site also accepts loads that are classified as hazardous / EPA categorised and these include asbestos, waste treatment slurries, 'remediated wastes', contaminated materials.

There are four main waste tipping areas:

- Area 1 receives cars and trailers, compactors (domestic and commercial) other open bins / trucks of dry and wet waste.
- Area 2 is the newly prepared pit. Approximately 35% of the floor of this pit has been prepared with rubble filter base and has now been covered with mixed waste.
- Area 3 receives relatively 'clean' green waste for stockpiling for a period of months prior to being shredded on site for later sale as a mulch.
- Area 4 receives 'inert construction and demolition waste' as well as 'non-friable asbestos' and shredded tyres.

The landfill also operates an asbestos disposal area for 'friable and non-friable' asbestos. This is situated east of the inert construction and demolition waste area.

There is also a designated 'bioremediation area' and adjacent leachate lagoon at the eastern boundary of the site.

Tare weights of regular transport clients are held in the gatehouse tare database. When a truck owned by an account customer arrives at the gatehouse the relevant details of the particular load are then recorded manually and produced in duplicate.

A daily report is prepared manually for record purposes. An EPA return data sheet is generated daily by Lucas displaying the tonnage of each waste type per vehicle class

Hours of operation for the site are 7am – 5pm weekdays, 8am – 4.30pm Saturdays and 8am – 4pm Sundays.

Remove All Rubbish, Nurioopta

The Remove All Rubbish site located at Nurioopta is owned and operated by Remove All Rubbish Company (RAR). The site is a trench and fill landfill operation.

This landfill does not have a weighbridge for measuring waste loads. The site accepts a full range of non-hazardous waste including putrescible (domestic and commercial), industrial, B/D, green waste and clean fill.

All waste is directed to a nominated section of the working face (trench) for disposal and compaction. Loads of rubble and bricks/concrete are directed to a different area of the site for use in various road making activities. As the site is constructed by digging trenches, no clean fill is accepted on-site.

Waste from residential sources transported by members of the public is directed to a specific ramp for disposal into the trench. This ensures that the vehicles do not become 'bogged' and remain away from compactors. This ramp is also used by commercial vehicles during wet periods.

Hours of operation for the site are 7am – 5pm weekdays, closed – Saturdays and Sundays.

Southern Region Waste Resource Authority, Pedler Creek

The Southern Region Waste Resource Authority Waste Depot—Pedler Creek—is owned by member councils and is currently operated by Cleanaway, under a contract that will be re-tendered in 1999. The site is an above ground gully fill.

All vehicles entering the site pass over a weighbridge adjacent to the gatehouse control centre. A computer generated receival docket is signed by the driver prior to proceeding to the disposal / recycling areas.

The site accepts a full range of non-hazardous waste to include putrescible (domestic and commercial), industrial, B/D, green waste and clean fill. The site also accepts waste foundry sand, although EPA is currently reviewing this arrangement.

There are three main disposal areas at the SROC landfill, namely, the putrescible face, the B/D area, and the cleanfill area where cars and trailers also deposit their waste.

A pit is located below the putrescible level where asbestos is landfilled and covered.

The top level of the landfill is also used for the storage of clean fill brought to the site in larger tippers. An adjacent area is used for the storage of foundry sand.

Tare weights of regular transport clients are held in the gatehouse tare database. When a truck owned by an account customer arrives at the gatehouse the relevant details of the particular load are then recorded manually and produced in duplicate. A weekly computer generated report is prepared to summarise disposal activities.

Hours of operation for the site are 6.30am – 5pm weekdays, 6.30am – 4pm Saturdays and 8am – 4pm Sundays.

Western Region Waste Management Authority, Garden Island

The Western Region Waste Management Authority is the licensee of the Garden Island landfill site. The member councils are the Cities of Holdfast Bay, Charles Sturt, Port Adelaide Enfield and West Torrens.

All vehicles entering the site pass over a weighbridge adjacent to the gatehouse control centre. The drivers enter the gatehouse office and swipe an identity card that has a barcode attached. This brings up the truck and company details on the central database. Those drivers who do not have a card manually complete an invoice and retain a copy. For EPA categorised wastes the necessary documentation is completed by the gatehouse personnel.

Tare weights of regular transport clients are held in the gatehouse tare database. When a regular customer arrives at the gatehouse the driver gets out of the truck and scans their card. The driver takes a printed docket as a record of entry to the landfill. WRWMA retains a copy of the entry on computer file for invoicing purposes. A daily report is printed out at the end of each day and forwarded to the WRWMA head office for review and accounting purposes.

The main waste types accepted at this site are domestic putrescible, B/D, clean fill and green waste.

There are two main waste tipping areas:

- Area 1 receives all waste as outlined above, except garden waste
- Area 2 receives garden waste.

Hours of operation for the site are normally 6am – 4.10pm weekdays, 7am – 3.00pm Saturdays.