Issues Relating to the Generation, Collection and Treatment of Building Product Waste in Western Australia

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Issues Relating to the Generation, Collection and Treatment of Building Product Waste in Western Australia

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EXECUTIVE SUMMARY

Cardno BSD was appointed by the Department of Environment (WA) to carry out general background research into issues relating to the generation, collection and treatment of building product waste from the construction and demolition industry. This research will be used to support policy and programme development within the Waste Management Branch and of the Waste Management Board

To achieve this objective Cardno BSD have competed a number of tasks including comprehensive data gathering relating to the manufacture, use and waste management practices for building products waste in Western Australia. Key stakeholders have been contacted to provide feedback on any barriers or issues associated with the safe disposal and recycling of building product wastes. This has provided a background picture of the current practices and issues.

A review of policies and programmes introduced by other geographic regions within Australia and overseas has been competed to research the range of measures that have been implemented outside Western Australia. The background data, consultation feedback and measures identified have been assessed to produce a series of options that could be introduced in Western Australia to improve the safe disposal and recycling of building product wastes.

Construction Industry & Waste Management Practices

The building and construction industry in Western Australia is experiencing significant levels of activity. 3,606,522 tonne of quarried building products were sold in 2004-05, with a value of $19,611,673 (DOIR, 2005). The value of manufactured building products sold in Western Australia in 1999 –2000 was $5,716,000,000 (ABS, 2001). During the construction and demolition of a building these materials frequently end their product life as waste. During 2003-04, 1,616,613 tonnes for building product waste was produced in the Perth Metropolitan region (WA DOE) this makes up 56% of the total waste stream. If Western Australia is going to reach the targets set out in the Waste 2020 Vision, building product waste is an important area to focus on and could achieve a rapid reduction in waste landfilled.

In Western Australia, normal practice at construction and demolition sites for wastes produced is to combine all the wastes together into mixed loads for disposal at inert (Class I) landfill sites. There are a number of reasons for these waste management practices, but the key factors are the low cost of disposal and an industry culture of ‘mixed load & disposal’ as the standard waste management practice.

Some operators in the industry take their wastes to one of the recycling facilities running is the Perth Metropolitan region, but this is generally when there is an economic advantage when compared with disposal. The recycled products sold by recycling and salvage yards have markets, as listed in **Table E1** below, but they require development.

Table E1: Building Product Wastes, Recycling Options and Markets

Materials	**Process**		**End Use**
Concrete	Crushed	Recycled	Fill, levelling, road base
Surplus Pour	Use up	Pavers, slabs	
Bricks	Cleaned	Reused	Construction
	Crushed	Recycled	Landscaping, driveways, drains
Roof Tiles	Cleaned	Reused	Roofing, landscaping
		Recycled	Landscaping, driveways, drains
Plasterboard (clean)	Reprocessed	Recycled	New plasterboard
Hardwood beams (denailed)	Reuse		Flooring, furniture, fencing, craft
Other Timber	Cleaned	Reuse	Formwork, bridging, propping
	Ground		Landscaping, woodflour (oil spills)
Doors, windows	Cleaned	Reuse	Second hand market
Fittings	Cleaned up	Reuse	Second hand market
Glass	Crushed	Recycled	Aggregate for concrete products
Unbroken Glass		Reuse	Repairs, glazing, glass houses
Carpet – wool		Reuse	Mulch, landscaping
Underfelt - natural	Reuse		Compost cover, mulch, landscaping
Synthetic Rubber (underlay)	Shredded	Recycled	Safety barriers, speed humps
Trees	Relocated	Reuse	Landscaping on or off-site
Greenwaste	Shredded	Recycled	Compost, mulch fertiliser
Soil	Screened	Reuse	Topsoil
Metals: aluminium, copper, lead, zinc, steel	Scrap metal	Recycled	Mew metal products
Packaging Cardboard		Recycled	New packaging
Plastic/steel drums	Cleaned		Reused
Metal scrapings	Reuse		Return to supplier
Paint tins		Recycled	Tine extracted

(Source: Inner City Waste Board, 1998)

Demolition Industry and Waste Management Practices

The Department of Housing and Works have undertaken research on the extent and trends and the spatial distribution of demolition activity between 1996/97 and 2003/04. The department has found that the number of demolition in Western Australia has more than doubled over this timeframe. Data indicated that demolitions have increase from 1,200 in 1996/97 to at least 2,500 in 2003/04 (Department of Housing and Works, 2004). The majority of demolitions occur in the Middle Sector making up 50-60% of all demolitions with the Inner Sector making up 30-40% of all demolitions. It is anticipated that the number of demolitions in Western Australia will continue to increase due to urban renewal and considering Western Australia's strong economy and growth within the construction industry.

During the demolition process, products and materials including scrap metal, timber, tiles flooring, doors and windows are salvaged. Approximately half of the demolition contractors have established their own salvage yards and sell material from the building they have demolished. Alternatively, these products are transported to the nearest salvage yard. The remainder of the waste consisting of concrete and rubble is collected into mixed loads and transported to the closest landfill. The majority of contractors in the demolition industry do not involve a waste management plan, which calls for the reuse, recycling and identification of disposal destinations well in advance to the demolition.

Building Product Waste Policy

Organisations from Australia and overseas were researched to determine the policies and measures they had implemented to promote the safe disposal and recycling of building product wastes. The measures ranged from 'waste bans' to stop the disposal of building product waste, through to education and communication programmes to encourage waste recycling. Most jurisdictional areas had a balance between discouraging waste disposal (with regulation to ban disposal or economic legislation e.g. landfill levies), and market development strategies. Most jurisdictions agreed that a comprehensive communication and education programme was key to the success of any strategies.

Issues

The issues relating to the safe disposal and recycling of building product wastes that have been identified during the project are:

- **Environmental impacts of raw materials and building products** – relating to the quarrying and manufacture of building products
- **Waste generation during construction** – specifically wastes generated from product packaging, 'over ordering' and off-cuts of materials.

- **Biodegradable Waste Contamination** – this has serious impact on the environment due to disposal in unlined landfills, and acts as an economic barrier for recycling operations due to cost of separation and residue disposal
- **Mixed wastes** – this is an economic barrier to recycling due to the cost of waste separation
- **Illegal dumping** – often caused by poor work practices, lack of appropriate infrastructure and lack of incentive or disincentives
- **Economics of disposal vs. recycling** – the low cost of landfill make disposal a more attractive waste management option than recycling
- **Economics of raw materials vs. recycled materials** – recycled materials are competing against low priced raw materials
- **Recycling infrastructure** – Is there sufficient infrastructure to process additional volumes of material?
- **Quality of recycled products** – the perception that recycled products are lower quality than raw materials or products
- **Markets for recycled materials** – lack of demand for the recycled materials
- **Education and Communication** – lack of awareness within the construction industry of the recycled materials available
- **Data and tracking of wastes** - to enable the monitoring of waste production, management options and recovery rates, also to provide an audit trail to combat illegal tipping

Options

The issues have been examined and using examples of programmes and measures from other geographic areas together with consideration of factors specific to Western Australia, the following options have been developed. These would require further analysis to identify the priority measures that could be implemented to achieve rapid improvement in terms of safe disposal and recycling of building product wastes.

Education and Communication

- To involve and engage industry stakeholders
- To communicate any programmes or regulatory measures
- To provide a free information service for stakeholders effected by the programmes
- To assist in the development of markets for recycled materials
- To provide funds for other programmes to increase the use of recycled building materials
- To allow the DoE to concentrate on regulatory enforcement and environmental protection

Waste separation and recycling as a condition for Demolition Approvals

- To ensure all demolition waste is separated at site and recycled or safely disposed

Incorporate Waste Management into Development Approval Process

- To ensure all approved developments prepare a waste management plan

Increased Enforcement of Landfill Waste Acceptance Criteria

- To protect groundwater and air quality from pollution by ensuring non-inert material is not disposed of at unlined Class I landfills
- Ensure the real disposal cost for biodegradable and hazardous wastes is realised by requiring their disposal at Class III facilities
- Removal of biodegradable contamination from 'inert' building product wastes, therefore improving the likelihood and economics of recycling the waste.

Ban on unsorted waste to inert landfills

- To improve the economic balance between C&D waste disposal and recycling and therefore facilitate recycling

Introduction of Waste Transfer Notes (WTN)

- To reduce the incidence of illegal dumping of waste
- To provide an audit trail for waste disposal and recycling
- To provide a mechanism to track waste production
- To provide a mechanism to recording levels of recycling for any potential 'recycling credit' system

Increase enforcement against illegal dumping

- To reduce the incidence of illegal dumping of construction and demolition waste.

Restriction on new quarries close to the Perth Metropolitan Region

- To increase the cost of raw (virgin) aggregates
- To reduce the availability of future inert landfill sites

Introduction of an Aggregate Tax on quarried (virgin) aggregates

- To increase the cost of raw (virgin) aggregates
- To include the 'environmental cost' of the extraction of raw materials

- To provide funds for other programme and measures introduced to increase the use of recycled building materials

Landfill Levy Escalator

- To increase the cost of disposal to landfill and make recycling more price competitive
- To provide a strong signal to the industry that waste disposal will only get more expensive

Development of C&D recycling infrastructure

- To ensure there is sufficient recycling infrastructure to process the additional material diverted from landfill

Market Development via procurement and tendering processes

- To create a demand for recycled materials
- For Government to lead by example

Once initial measures have been introduced to address the main areas relating to the safe disposal and recycling of building product waste; product manufacture, building design and packaging can be addressed. This includes issues such as:

- Ensuring all material packaging is reusable or easily recyclable
- Construction designs minimise the production of waste due to off-cuts, i.e. specifying standard sizes
- Reviewing manufacturing processes to minimise waste production and if possible recycle any reject product

These future options would require expanding (once the measures that will have a greater impact have been suitably implemented), and would achieve further improvement throughout the entire building product supply chain.

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Definitions

Building products: products created specifically to be used as components in the construction and built environment. These include products made to be used in construction (e.g. timber, bricks, concrete, steel trusses) and those products as they are recovered following demolition. It also includes whole Products designed to form part of a constructed building (e.g. doors, window frames plasterboard, roofing). Building Products may contain Packaging Products as a component and can be made up from any combination of the preceding Products (e.g. Organic, Elemental, Chemical, Synthetic, Paper).

C&D waste: waste from the C&D of households, council activities (e.g. roads and footpaths) and from Australian and New Zealand Standard Industrial Classification (ANZSIC) type facilities (**Appendix A**).

Class 1 clean recycled concrete aggregate: "Recycled concrete produced from a quality uniform stock of clean concrete containing no more than 2% of brick, stony material or other forms of contaminants, manufactured for use as coarse aggregate in the production of pre-mix concrete having characteristic strength up to and including Grade N40 concrete for use in non-structural concrete applications." (CSIRO, 1998: 5). Class 1 concrete must have a particle density greater than 2100kg/m³.

Contaminants: The impurities associated with C&D waste, such as crushed brick, glass, organic matter, plastics and timber.

House Construction: the class consists of units mainly engaged in the construction of houses (except semi detached houses) or in carrying out alterations, additions or renovations or general house repairs to houses, or in organising or managing these activities. Primary activities include garage and house construction in addition to prefabrication, assembly, erection or installation on site.

Inert Waste: Wastes that are largely non-biodegradable, non-flammable and not chemically reactive.

Non-Building Construction: otherwise classified as heavy and civil engineering construction (ANZIC, 2006). This includes **roads and bridge construction** and **other heavy and civil engineering construction**

Non Residential Building Construction: this class consists of units mainly engaged in the construction of non-residential buildings such as hotels, motels, hospitals, prisons or other institutional buildings, in carrying out alterations, additions, or renovation or general repairs to such buildings, or in organising or managing these activities. Primary activities include commercial building, industrial building, office building, prefabricated non-residential building assembly, erection and installation of site (except sheds, garages and carports), general repair or renovation of non-residential buildings.

Other Heavy and Civil Engineering Construction: this class consists of units mainly engaged in the construction of railway permanent way, dams, irrigation systems, harbour or river works, water or gas supply systems, oil refineries (except buildings), pipelines or construction projects, in on-site assembly of furnaces or heavy electrical machinery from pre-fabricated components, or general repair of such structures, machinery or equipment, or in organising or managing these activities. Primary functions include breakwater construction, cable laying, canal construction, dam construction, distribution lines, electricity or communication construction, dredging of harbours or rivers, electrical machinery, flood control system construction, golf course construction, harbour works construction, irrigation system construction, jetty construction, lake construction, mine site construction, oil refinery construction, pile driving, pipeline construction, railway permanent way construction, river works construction, sewerage treatment plant construction, sewerage or storm water drainage system construction, television or radio transmitting tower construction, tunnel construction, water tank construction.

Other Residential Building Construction: this class consists of units mainly engaged in the construction of residential building (except houses), or in carrying out alterations, additions or renovation or general repairs to such buildings, or in organising or managing these activities. Primary activities include Apartment, Duplex House, Flat, High Rise Flats and semi detached construction in addition to general repairs and renovations.

Recycled concrete: "Sorted and clean concrete generated from building rubble, demolished structures or service pavements, for the purpose of crushing and grading to produce uniform quality RCA." (CSIRO, 1998: 5)

Recycled Concrete Aggregate (RCA): "Uniformly graded coarse aggregate (4-32mm), produced by crushing waste concrete with total contaminant levels of all material other than concrete typically lower than 2% of the bulk mass. The material shall consist of gravel, crushed stone, hydraulic-cement concrete or a combination thereof." (CSIRO, 1998: 4)

Residential Building Construction: this included **house construction** and **other residential building construction**

Roads and Bridge Construction: this class consists of units mainly engaged in the construction or general repair of roads, bridges, aerodrome runways or parking lots, or in organising or managing these activities.

1. INTRODUCTION

1.1 STUDY OBJECTIVE

Cardno BSD was appointed by the Department of Environment (WA) to carry out general background research into issues relating to the generation, collection and treatment of building product waste from the construction and demolition industry. This research will be used to support policy and program development within the Waste Management Branch and of the Waste Management Board

1.2 STUDY METHODOLOGY

To achieve the above objective, the following tasks were performed:

1.2.1 Data Gathering & Consultation

Cardno BSD undertook a comprehensive review of readily available literature, completed web searches and held discussions with a range of stakeholders as listed in the references, in order to collect the following background data:

- Quantities of the key building materials sold in WA each year and the major manufacturers of these materials.
- The current status/characteristics and likely future trends and opportunities of the construction industry in WA as they relate to building product waste.
- A summary of common waste management practices within the demolition and construction industries.
- A summary of recovery and disposal options for building product waste.
- A summary of building products and construction and demolition materials recycled and disposed in WA.
- A summary of issues or barriers relating to the safe disposal and recycling of building product wastes.

1.2.2 Policy Review and Assessment

Policies and programmes implemented by other jurisdictions have been investigated as part of this project. This will ensure that, where practical, a best practice approach can be adopted in WA. These jurisdictions have included:

- New South Wales
- Victoria
- South Australia
- Australia – Commonwealth
- USA
- Canada
- European Union

1.2.3 Identification of Issues

Based upon consultation with the industry and other stakeholders a number of issues have been identified that are currently barriers to the safe disposal and recycling of building product wastes.

1.2.4 Recommendations

Based upon the activities in other jurisdictions, the issues highlighted by the industry and stakeholders together with factors specific to Western Australia, a number of options have been suggested in the report and include a discussion relating to implementation, potential impact and wider implications of each option.

1.3 HISTORY OF C&D WASTE STRATEGY IN WA

The historical policy context for a C&D waste strategy was established in 1989 when the Western Australian Government announced the policy of halving waste to landfill in ten years. This was later modified to halving per capita waste to landfill by the year 2000. The policy was confirmed in 1996 by the Government in its response to the Select Committee Report on Recycling and Waste Management. As roughly one half of the solid waste stream comprises C&D waste, reduction and recycling in this waste stream was considered essential.

In late 1994, a State Government, local government and industry C&D waste Recycling Taskforce was established and in March 1995 engaged Sinclair Knight Merz to produce a report. The report was used as a basis to develop "A Draft Strategy for the Management of Construction and Demolition Waste in Western Australia".

The WAste 2020 Taskforce work overtook the Draft Strategy, with the Towards Zero Waste Action Plans, including *Actions for the Construction and Demolition* Sector being made public in April 2001. At that time, the Department made a commitment to the stakeholders who had been involved in working on the Draft Strategy that the next moves would be towards industry prioritisation and implementation of actions, with measurable outcomes. The WAste 2020 *Actions for the Construction and Demolition Sector* report was more generalised in its approach and did not offer specific strategies for C&D waste recovery.

A C&D waste stakeholder workshop, held 23 January 2002, was attended by about 80 people, representing the construction, demolition, transport, reuse/recycling and landfill industry sectors, as well as relevant local and state government bodies. The purpose of the workshop was to:

- Integrate ideas from all sections of the industry
- Obtain up-to-date information on the sector's priority issues
- Begin thinking about solutions for the top priorities
- Form a small industry working group to further refine those ideas for industry to take action and inform the new WMB to ensure that the actions fall within the overall strategic direction for waste management, and how they can best be monitored

A summary of the issues identified in the workshop were:

- Landfill Levy (equitable; significant; incremental increase; to be used to improve the industry – not for Government coffers)
- Local Governments and State Governments to work together (guidelines for demolition, create viable markets, contract specifications, illegal dumping needs harsher penalties and better policing)
- Education
- Virgin Material (cost of virgin material too low and doesn't reflect real cost)
- Planning & Development (applications and tenders to incorporate resource recovery)
- Markets (innovation; MRWA to recognise product, engineering specification, for specific products)
- Cost Benefit analysis of disposal to landfill and other options (recognise cost implications of solutions)
- Weighbridges at all Landfill sites

After approximately nine months, the meetings of the working group were postponed pending the outcomes of the landfill levy review and the development of the Strategic Direction document. To date the working group has not been reconvened.

The *Strategic Direction for Waste Management* adopted by Government on advice from the Waste Management Board whilst maintaining the waste hierarchy, shifts the focus from "disposal" of wastes to "prevention" of waste. The *Statement of Strategic Direction for Waste Management in Western Australia: Vision and Priorities* outlines the broad strategic framework and the fundamental principles that guide the Waste Management Board's perspective on the *Towards Zero Waste* vision. The *Strategic Direction for Waste Management in Western Australia* sets out three principles:

Principle 1: Prevention – To avoid the creation of waste
Principle 2: Recovery – To efficiently recover, retreat and reuse all waste
Principle 3: Disposal – To responsibly manage waste into the environment

A key feature of the *Strategic Direction* is the focus on "products" rather than "waste streams". Wastes streams are classified as sub-sets within the product categories. This allows a priority waste type to be specifically identified. For example, Building Products encompasses all the individual construction and demolition wastes components and enables each to be assessed at the product lifecycle level.

The Western Australian State Sustainability Strategy also sets down principles to be considered when developing policy. These are:

- Precautionary Principle
- Intergenerational equity
- Biodiversity
- Polluter pays

1.4 BUILDING PRODUCT LIFE CYCLE

The Department of Environment have adopted a strategic approach to shift away from the sole focus on reducing the amount of waste disposed to landfill towards the management of the whole lifecycle of every product and its wastes, from creation to disposal.

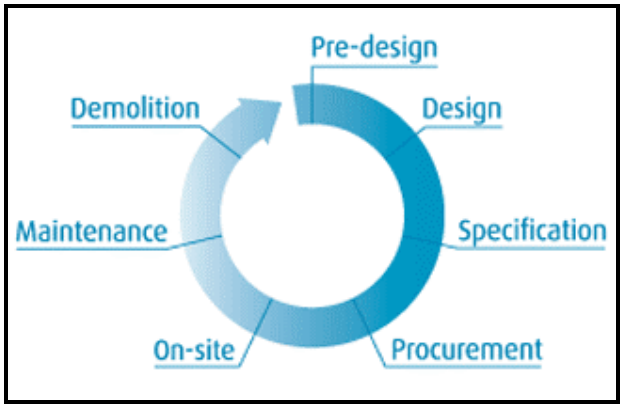
This report adopts the Product Life Cycle strategic approach. Instead of concentrating on Construction and Demolition waste generation and disposal, this report presents background information regarding the following industries:

- Building material extraction industry
- Building products manufacturing industry
- Construction industry
- Demolition industry

This report presents the issues relating to the generation, collection and treatment of building product waste within the construction and demolition industry. Building products are defined by the Department of Environment as products created specifically to be used as components in the construction and built environment. These include products made for use in construction (e.g. timber, bricks, concrete, steel trusses) and those products as they are recovered following demolition. It also includes whole products designed to form part of a constructed building (e.g. doors, window frames plasterboard, roofing). Building Products may contain Packaging Products as a component and can be made up from any combination of the preceding Products (e.g. Organic, Elemental, Chemical, Synthetic, Paper).

This report provides background information on each industry associated with the Building Products, from the manufacturing of the products to the use of building products in the construction to demolition, disposal and possible recycling. **Figure 1.1** outlines the construction process life cycle.

Figure 1.1: The Construction Process (Building Lifecycle)



Although this report reviewed the whole building lifecycle, it concentrates on the waste produced during the on-site construction and demolition stages, as the greatest impact is possible during these stages.

2. CONSTRUCTION MATERIALS (QUARRIED)

This section of the report examines the use of quarried materials used in the building industry and indicates the major suppliers, annual quantities used (tonnes per year) and the value of the materials sold ($ per year). Companies were directly contacted for this information but the information was considered commercial confidential. Therefore the information was gathered from the Department of Industry and Resources.

Construction materials or extractive resources are used in large quantities in any modern community. They include fine and coarse aggregate used in concrete, clay/shale used in brick, tiles and pipes, and a range of unprocessed materials used for fill and general construction purposes.

The key building materials used within the construction industry include aggregate, gravel, rock, sand and sandstone. They have a variety of uses including road base, concrete, asphalt and railway ballast. Major sources for these materials within Western Australia are outlined in **Table 2.1** below.

Table 2.1: Major Building Material Suppliers in Western Australia

Name	Material
The Ready Mix Group	Aggregate, Sand
Boral Resources (WA) Ltd	Gravel, Sand
WA Limestone Co.	Gravel
Rocla Quarry Products	Sand
Tuma Holdings Pty Ltd	Sand

Source: Department of Industry and Resources, 2004

2.1 BUILDING MATERIAL QUANTITIES AND VALUES FOR WESTERN AUSTRALIA

The Department of Industry and Resources compiles annual data for the quantity and value of construction materials but only for quarries that operate on mining tenements under the Western Australian Mining Act. Extractive materials that occur on privately owned land are not included. Local government under extractive quarry licenses administers these commodities and recording of quarry output is sporadic. There is no current data source for construction materials produced on privately held land. **Table 2.2** below outlines the quantity (tonnes) of Construction Materials Sold in Western Australia (2001 – 2005) as published by the Department of Industry and Resources. **Figure 2.1** shows that quantity of building materials sold in Western Australia is increasing over time with the majority of the material being sand. There was a decrease in building materials sold in 2002-2003. **Table 2.3** below outlines the dollar value of Construction Materials sold in Western Australia (2001-2005).

Figure 2.2 shows that value of material extracted is increasing over time. In summary approximately 3.6 million tonnes of quarried building materials were sold in Western Australia in 2004 –05 with a combined value of $19.6M.

Table 2.2: Quantity of Construction Material Sold in Western Australia (tonnes) (DOIR, 2005)

	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
Aggregate	284,164	650,749	477,673	461,384	423,539
Gravel	161,947	353,191	154,806	136,627	198,199
Rock	251,360	249,449	350,834	364,612	408,723
Sand	1,174,861	1,544,804	1,436,049	2,239,611	2,576,091
Sandstone	1,100	300	568	0	0
Total	1,873,432	2,798,493	2,419,930	3,202,235	3,606,552

Source: Department of Industry and Resources, 2005

Figure 2.1: A graph showing the quantity of construction materials sold in Western Australia (2000-2005)

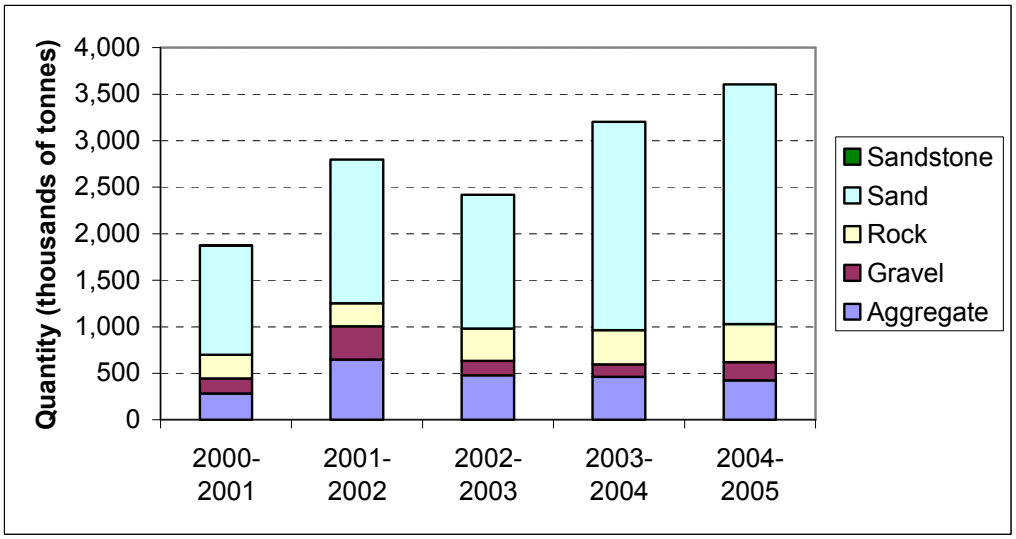
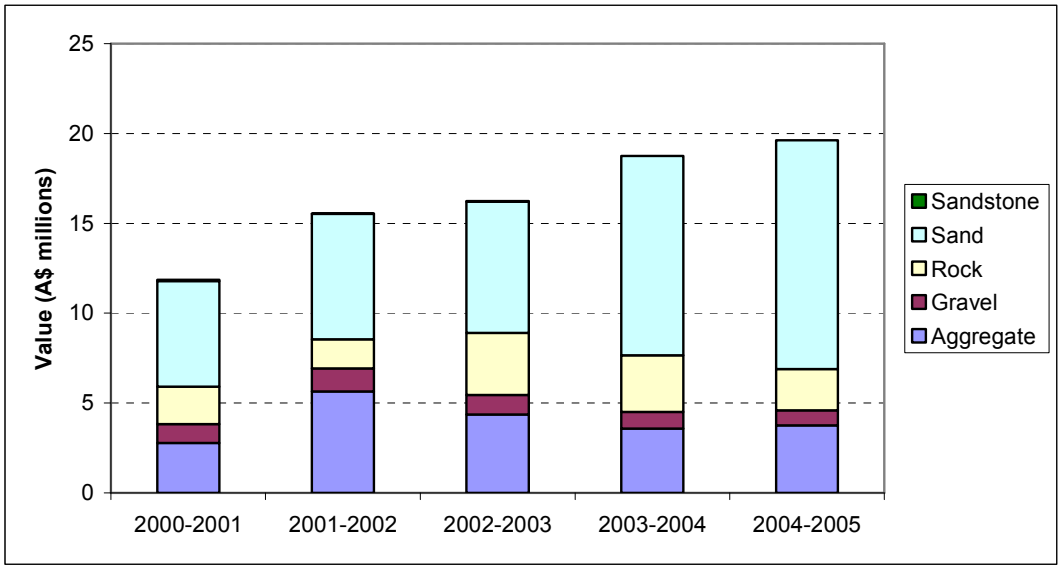


Table 2.3: Dollar value of construction materials sold in Western Australia (2000-2005)

	2000-2001	2001-2002	2002-2003	2003-2004	2004-2005
Aggregate	2,776,441	5,631,178	4,354,630	3,576,082	3,747,930
Gravel	1,059,089	1,300,475	1,088,798	933,421	844,655
Rock	2,074,419	1,625,004	3,465,632	3,129,658	2,303,186
Sand	5,874,215	6,964,844	7,291,151	11,095,274	12,715,902
Sandstone	55,000	16,500	31,240	0	0
Total	11,839,164	15,538,001	16,231,451	18,734,434	19,611,673

Source: Department of Industry and Resources, 2005

Figure 2.2: Graph showing the value of construction materials sold in Western Australia (2000-2005)



Source: Department of Industry and Resources, 2005

3. BUILDING PRODUCT MANUFACTURING

This section of the report summarises the Building Product Manufacturing Industry who provide goods to Western Australia's building industry. Western Australia's dynamic building industries are well serviced by the State's building product manufacturers. The building product manufacturing industry provides materials to support the construction of the State's houses and other residential buildings, commercial buildings, public facilities and engineering works such as roads, bridges and ports.

The type of building products used within the industry differs when considering building construction and non-building construction. A summary of the building products is outlined below:

Building Construction Materials

- Timber
- Bricks
- Concrete
- Steel trusses and building framework
- PVS or steel pipe work
- Roofing i.e. tiles
- Doors
- Window frames
- Plasterboard
- Plaster
- Composite boards or other partitions
- Carpet
- Paints
- Glass

Non-Building Construction Materials

Roads

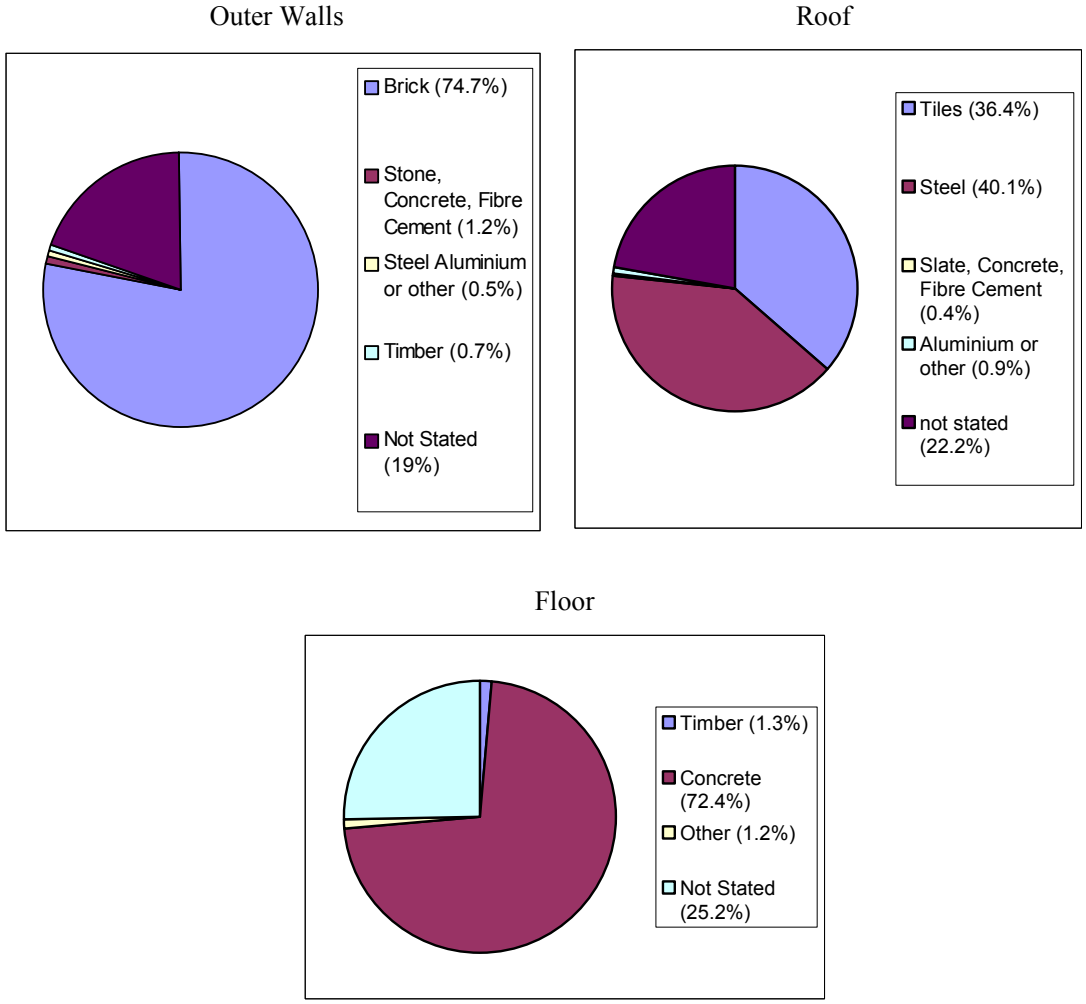
- Limestone
- Crushed Rock
- Asphalt
- Pavers
- Concrete
- Reinforced concrete
- Concrete/ Bitumen

Railways

- Aggregate
- Metal
- Steel ties (spikes or nails)
- Concrete
- Timber

The products used in residential construction differ from house to house. **Figure 3.1** displays the proportion of products used in the construction of outer wall, roof and floors of private sector houses in Western Australia during September Quarter 2005. In general, the majority of products used in the construction of a house consist of bricks for outer walls, tiles or steel for roofing and concrete for flooring

Figure3.1 Products used in the construction of Private Sector Houses – Western Australia September Quarter 2005



Source: ABS unpublished building approvals data, cited in HIA Economics Group, 2005a, pC-14

3.1 BUILDING MATERIAL QUANTITIES SOLD IN WESTERN AUSTRALIA

A number of companies and government departments were contacted to find the total quantity of building products sold in Western Australia. These included:

- Department of Industry and Resources
- Chamber of Commerce and Industry
- Australian Bureau of Statistics
- Housing Industry Association
- Master Builders Association

The only statistical information regarding the quantity and dollar value of building material sold in Western Australia was with the Australian Bureau of Statistics. Please note that a portion of these products may not be specifically used in construction. The following manufacturers have been isolated for the ABS survey with their associated annual turnover ($million).

- The Value of Building Products sold in Western Australia – 1999 / 2000, is shown in the table on the next page. -

Table 3.1: Value of Building Products sold in Western Australia – 1999 / 2000

Manufactured Product	**Annual Turnover A$ million (1999-2000)**
Paint	94.7
Glass and Glass Product	58.7
Ceramic Products (including Clay Brick, Ceramic Product, Ceramic Tile and Pipe)	307.6
Cement, Lime and Plaster Product	294.1
Concrete Slurry	247.2
Concrete Pipe and Box Culvert	28.3
Concrete Product	167.7
Iron and Steel	Not provided
Basic non-ferrous metal	3160.7
Non-ferrous basic metal product	Not provided
Structural steel fabricating	526.4
Architectural aluminium product	225.7
Structural metal product	42.7
Metal Container	56.8
Sheet metal product	151.4
Hand Tool and general Hardware	Not Provided
Spring and wire product	38.4
Nut, bolt, screw and rivet	4.4 [1]
Metal coating and finishing	67.8
Non-ferrous pipe fitting	Not provided
Fabricated metal product	140.8
Electric Cable and wire	Not provided
Prefabricated metal building	83.1
Prefabricated building	19.5
TOTAL BUILDING PRODUCT MANUFACTURING	**$5.716 billion**

Source: (Australian Bureau of Statistics, 2001)

[1] (estimation has an error between 25% and 50%)

4. CONSTRUCTION INDUSTRY IN WESTERN AUSTRALIA

This section of the report examines the three sectors of the construction industry and the likely future trends for each category of the industry. The three categories are:

- Residential Building Construction
- Non-residential Building Construction
- Non-Building / Engineering Construction

The Western Australian Economy continues to be strong and, as the rest of this section shows, all sectors of the construction industry in Western Australia have experienced significant growth in the last few years. It is forecasted to peak around 2006 and then experienced a slight decline in growth, but still maintains high levels of construction activity into 2008 (HIA Economics Group, 2005a). Therefore waste production from the construction industry is likely to reflect the industry activity and peak around 2006 and then experience a slight decline.

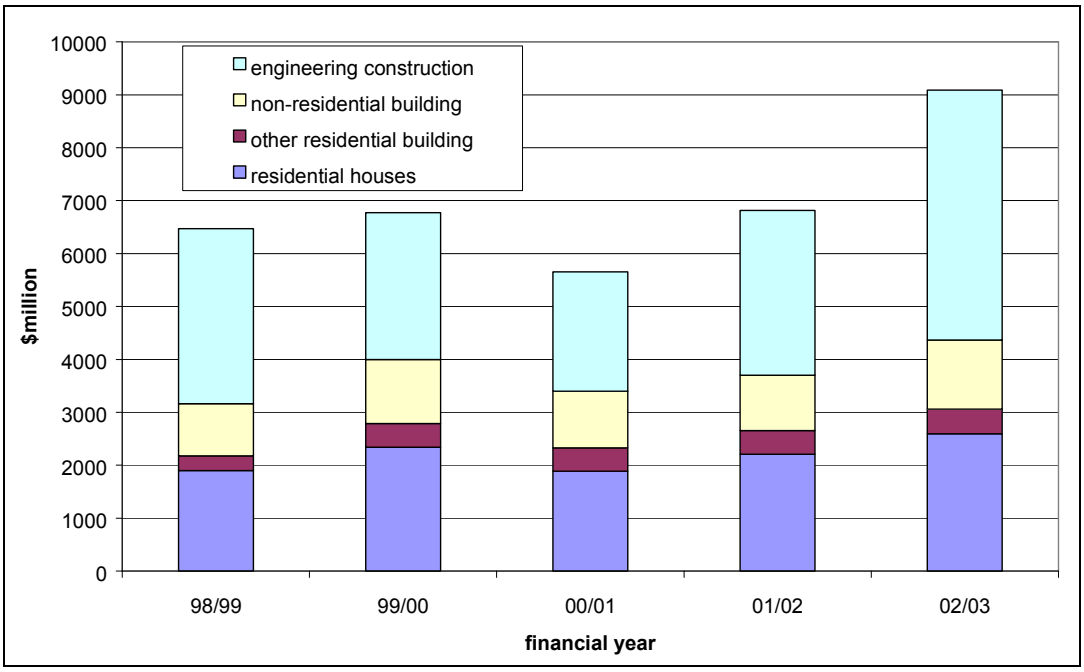
4.1 CURRENT STATUS AND LIKELY FUTURE TRENDS

The construction industry is a significant part of the Western Australian economy. In 2003/04, the construction industry contributed an estimated $6,659 million (8.1%) to Gross State Product and employed 77,900 people (approximately 8.1% of the state's workforce) (Australian Bureau of Statistics, 2003). **Figure 4.1** shows the value of construction work completed over a five-year period from June 1998.

The construction division comprises of the following market segments:

- **Residential Building Construction:** which combines the sectors of house construction and other residential construction (apartments, duplex house, flats, high rise flats and semi detached construction).
- **Non-Residential Building Construction:** this class consists of units mainly engaged in the construction of non-residential buildings such as hotels, motels, hospitals, prisons or other institutional buildings.
- **Non-Building construction:** otherwise classified as Heavy and civil engineering construction (ANZIC, 2006). This includes roads and bridge construction, including the general repair of roads, bridges, aerodrome runways or parking lots and in organising and managing these activities.

Figure4.1: Value of work done in the construction industry in Western Australia



Source: (ABS, 2003a)

4.1.1 Residential Building Construction

After three near record years, the Australian residential building industry experienced tougher times in 2004/05 (HIA Economics Group, 2005a). Household consumption has grown at a pace greater than 3.5% per annum for nine consecutive quarters up until 2004 (HIA Economics Group, 2005a). Housing demand decreased during 2005 due to nerves over interest rates and a general lack of urgency among buyers while on the supply side, a lack a good quality trades and spiralling land costs made it difficult to keep new homes within an achievable range (HIA Economics Group, 2005b).

However, residential construction in Western Australia continues to be the strongest in Australia. Western Australia holds the largest residential construction market share in Australia (68%) with the value of work done within industry totalling over $3.44 billion (HIA Economics Group, 2005b). BGC (who also trade under the brands BGC Residential, J-Corp and Ventura Homes) are the biggest residential builder in Australia for the third consecutive year and hold 19.6% of the Australian market (HIA Economics Group, 2005b). The company had 4,535 housing starts (3,656 detached houses and 879 units). The biggest increase in starts was recorded by JWH Group up by 487 starts or 33% higher than the previous year (HIA Economics Group, 2005b).

Table 4.1 below outlines Western Australia's top 20 Residential Construction Companies based on new dwelling starts and market share. New dwelling starts increased in 2004/05 by 3% to 23,180 in 2004/05 Starts of houses decreased by 1% and starts of multi-units increased by 20% The market share of the largest 20 builders fell from 71% to 68.9% over 2004/05 (HIA Economics Group, 2005b).

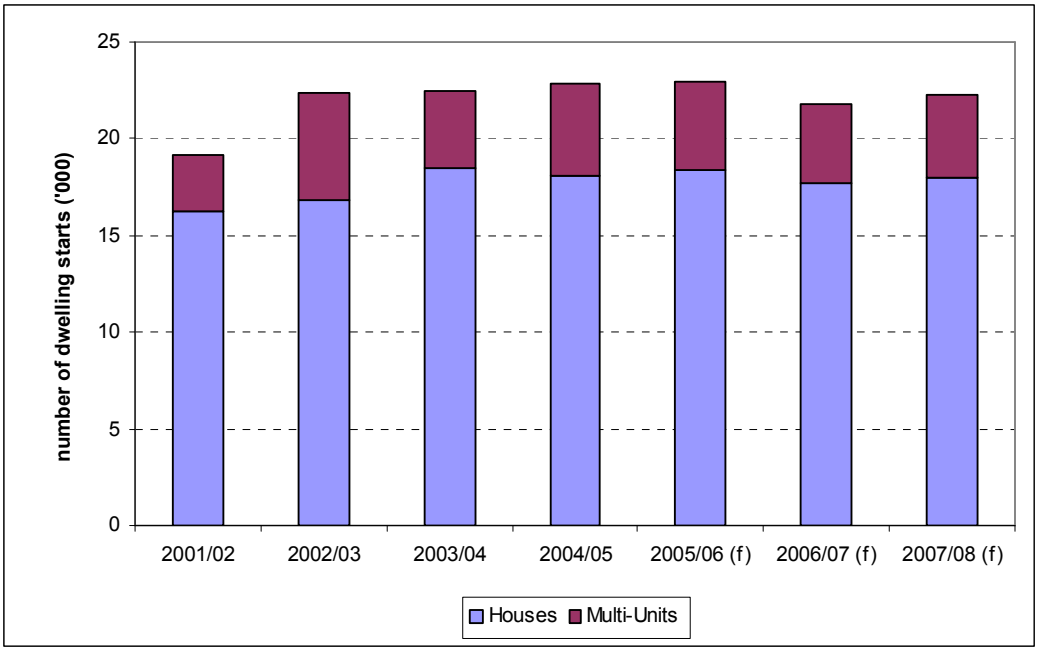
Table 4.1: Top 20 Western Australian Residential Construction Companies based on new dwelling starts and market share 2004/05.

Rank		Company	Starts		Market Share (%)	
04/05	**03/04**		**04/05**	**03/04**	**04/05**	**03/04**
1	1	BGC (Australia)	4,535	5,137	19.6	22.9
2	2	Alcock/Brown-Neaves Group	3,402	3,496	14.7	15.6
3	4	JWH Group	1,455	968	6.3	4.3
4	3	Content Living	942	982	4.1	4.4
5	7	Summit Homes Group	900	781	3.9	3.5
6	5	Scott Park Homes	820	875	3.5	3.9
7	6	Pindan	708	846	3.1	3.8
8	8	The Ross North Group	593	587	2.6	2.6
9	9	Westcourt LTD	508	461	2.2	2.1
10	11	Mirac Group	432	205	1.9	0.9
11	10	Jaxon Constructions	330	296	1.4	1.3
12	12	Peter Stannard Homes	213	200	0.9	0.9
13	-	Joyce Property Investments	204	-	0.9	0.0
14	14	McGrath Homes	196	185	0.8	0.8
15	16	Tilli P Group of Companies	178	157	0.8	0.7
16	17	Don Russell Homes	124	131	0.5	0.6
17	-	Belvista Homes	117	57	0.5	0.3
18	13	Trlin Developments	109	185	0.5	0.8
19	-	Beaumonde Homes	105	-	0.5	0.0
20	15	Home Australia	102	178	0.4	0.8
		Total	**15,973**	**15,727**	**68.9**	**70.0**

Source: HIA Economics Group, 2005b

Residential housing starts increased from 19,140 in 2001/02 to 22,880 in 2004/05. It is forecasted that dwelling starts will continue to slightly increase in 2005/06 (22,960) but then drop by 5% in 2006/07 but then rise by 2% in 2007/08 (HIA Economics Group, 2005a).

Figure 4.2: Dwelling Statistics Forecast - Western Australia



Source: HIA Economics Group, 2005a

Residential Building Construction also includes the carrying out of alterations, addition or renovations. The alterations and addition market is difficult to measure due to the large amount of unreported owner/builder activity and reporting arrangements of the Australian Bureau of Statistics Currently only alterations and additions exceeding $10,000 in value require a permit and are reported (HIA Economics Group, 2005a). It has been estimated that there are over 5 million alterations or additions with an average value of $2,500) every year (HIA Economics Group, 2005a). **Table 4.2** outlines the official measures of alterations and addition from the ABS who report jobs valued over $10,000.

Table 4.2: Number and Value of Residential Alterations and Additions – Western Australia

	Number of Jobs	**Value ($m)**
Jul 2005	713	32
Aug 2005	780	35
Sept 2005	773	31
Total Sep Quarter	**2,266**	**97**

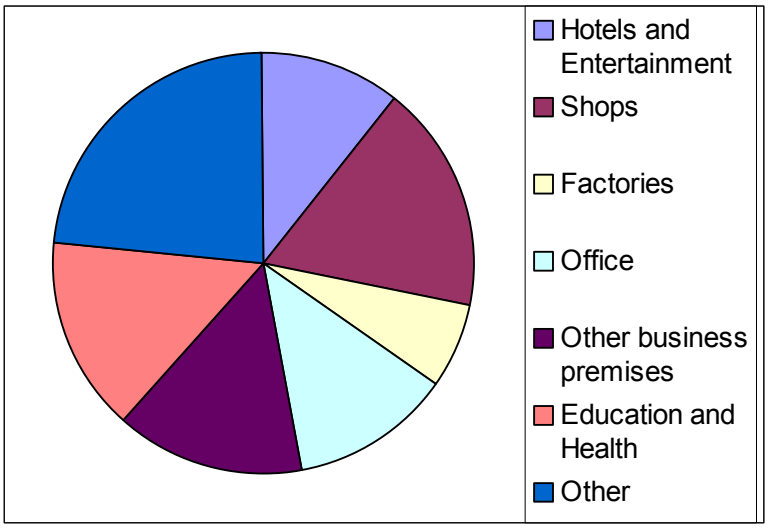
Source: Australian Bureau of Statistics cat no. 560908 cited in HIA Economics Group 2005a

The Economics group of the Housing Industry Association predicted that renovation expenditure increased by 7% in 2004/05, and due to the strong economy in the state, they have predicted these activities to increase a further 2% in 2005/06. Overall the HIA state outlook reports that spending of renovations in 2004/05 reached over $2 billion. The growth in alterations and addition are due to wealth gains in the house price growth. The Economic group predict that this housing investment will drop by 8% over 2006-2008.

4.2 NON-RESIDENTIAL CONSTRUCTION

Non-residential construction is associated with the building of various types of infrastructure. **Figure 4.3** shows the breakdown and proportion of each type of building that is defined as non-residential.

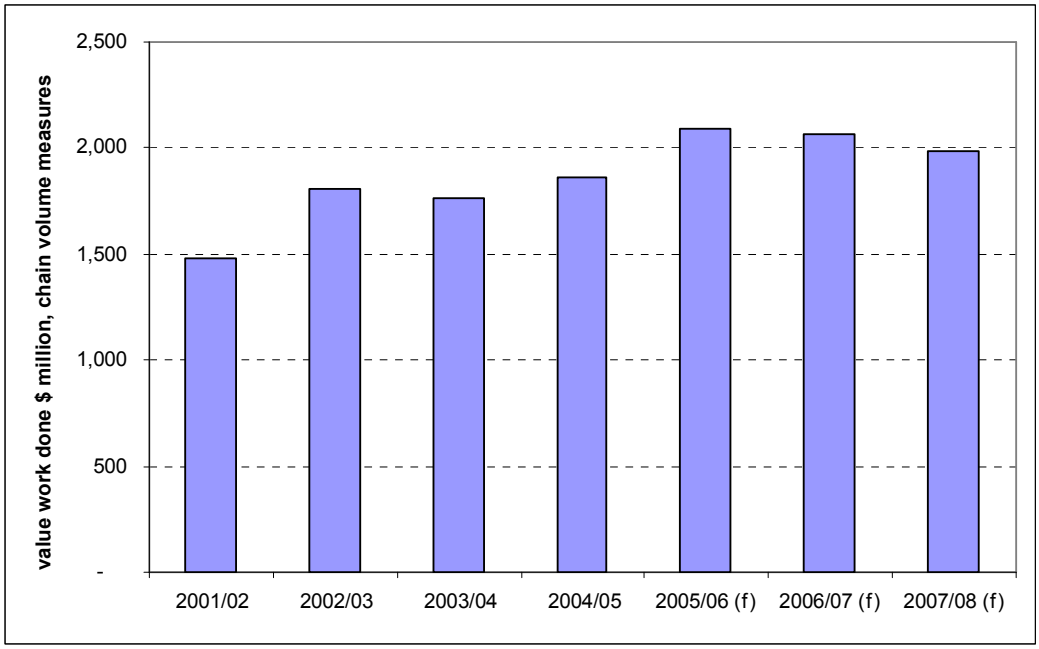
Figure 4.3: Non-Residential Construction broken down by Building Type



(Source: HIA Economics Group, 2005a)

Non-residential Construction in 2006 is not as strong as residential and engineering construction but it is still remaining at high levels and should continue (HIA Economics Group, 2005a). In 2004/05 the value of work done was $1865 million. It is expected that the value of work done will increase by 12% in 2005/06 before dropping by 1% and 4% in 2006/07 and 2007/08 respectively (HIA Economics Group, 2005a).

Figure 4.4 Value of work done by the Non-residential Construction Industry in Western Australia ($ million) 2001-2008

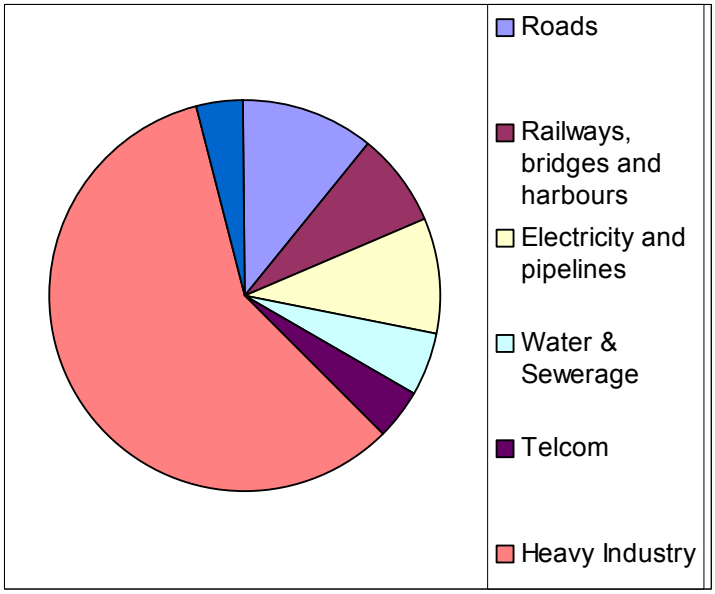


(Source: HIA Economics Group, 2005a)

4.2.1 Engineering Construction

Engineering construction is associated with the building of various types of infrastructure, but this sector is dominated by heavy industry as shown in **Figure 4.5.**

Figure 4.5: Engineering Construction broken down by Type

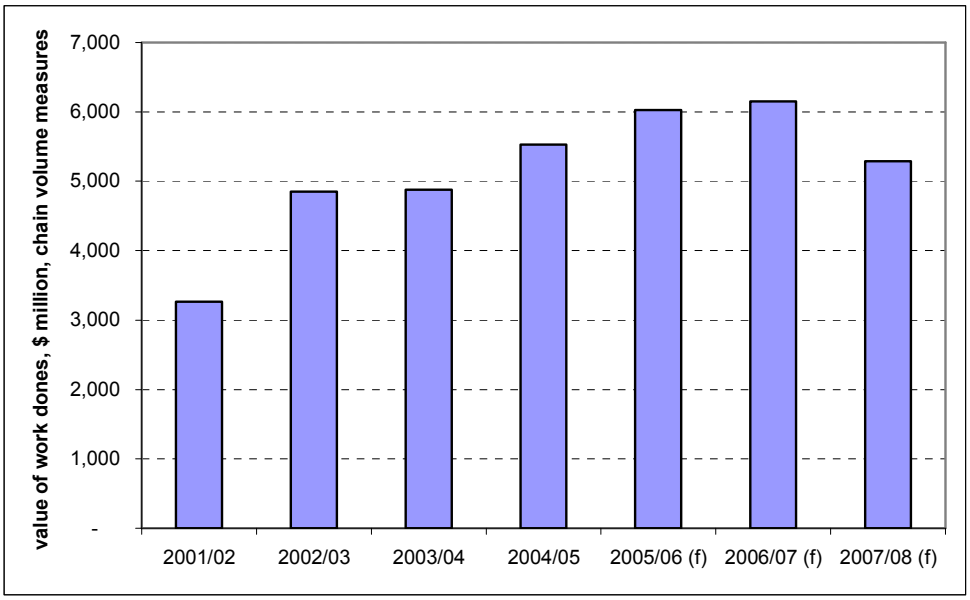


(Source: HIA Economics Group, 2005a)

Engineering construction within Western Australia is rising given the mining boom. The strong activity is aided by plant and equipment investment within the industry and the strong Australian dollar. At September 2004, engineering construction within Western Australia grew at 22% per annum this continues until to the present day (HIA Economics Group, 2005a).

Figure 4.6 displays the value of work done by the Engineering Construction Industry in Western Australia. It is forecasted that non-building construction work will continue to rise into 2005/06 and 2006/07, followed by a decrease in 2007/08.

Figure 4.6: Value of work done by the Engineering Construction Industry in Western Australia ($ million) 2001-2008



Source: HIA Economics Group, 2005a

5. DEMOLITION INDUSTRY IN WESTERN AUSTRALIA

5.1 CURRENT STATUS AND FUTURE TRENDS

Demolition specifications such as *AS 2601-1991 The demolition of structures* allows the choice of sequential demolition (the reverse order to construction) or induced collapse. Preferred methods such as deconstruction, which involved the manual sequential demolition (deconstruction) of a building are not specified but should be left to the contractor. The standard requires submission of a demolition work plan for approval by the local authority, but does not require details of how the material is to be disposed of.

The majority (50-60%) of buildings are demolished using the sequential demolition practice. Sequential demolition involves gradually reducing the structure height by demolishing the structures component (in reverse order to construction) by use a mechanical means. Methods of mechanical demolition include:

- The use of plant (e.g. Excavators, cranes, demolition balls and bulldozers)
- Impact hammers to break up mass structures (e.g. Rocks, bricks and concrete)
- Wire and chain pulling down parts of structures
- Drilling and sawing to product a fracture zone
- Power shears cutting through material (structural steel)
- Pusher arms, which exert a horizontal force (e.g. Pushing over walls)
- Expansion bursters which make use of expansion (of gas or hydraulic device in a crack of a mass) to break it into fragments
- Thermal reaction and thermic lance, using heat to weaken or sever the structure in order to remove it. This is usually used in conjunction with other methods.

(Worksafe Australia, 2006)

Around 40% of buildings in Perth are deconstructed. The deconstruction practice involves the use of hand held tools to gradually reduce the height of the structure. Lifting appliances may be required to lower structures members or to dispose of debris.

A small number of buildings are demolished using explosives. Induced collapse requires a specialist who is competent in the application of explosives. Local legislative requirements in relation to the use of explosives and demolition work must always be followed.

The majority of the demolition contractors in Perth listed in **Table 5.1** have established salvage yards that sell the marketable waste from the buildings they have demolished. This includes products such as timber, tiles, doors, metal fittings and windows.

Table 5.1: Major Demolition Contractor in Perth – Names and Locations

Contractor Name	Suburb	Street
Contractors north of the river		
Coda Contracting	Balcatta	Fontaine Street
Moltoni Adams	Belmont	Abernethy Road
Mainline Demolition	Belmont	Abernethy Road
Murphy Demolition	Wanneroo	Bamboore Crescent
Demolition Works	Woodvale	Parkwood Avenue
Highway Demolition	Marangaroo	Duvall Court
Contractors east of the river		
Diacon Demolitions	Bayswater	Colwyn Road
Diangelo Contracting	Bayswater	Colwyn Road
Vinsan Contracting	Bayswater	Katanning Street (cnr Colwyn Road)
Capital Demolition	Bayswater	Duffy Road
Midland Demolition	Midvale	Gallant Crescent
Groundworks Demolition	Swan View	Pagnell Way
Brajkovich and Son Demolition	Upper Swan	Great Northern Highway
Vic Park Salvage	Welshpool	Briggs Street
Contractors south of the river		
R H Demolition Services	Kenwick	
Statewide Demolition	Bassendean	Wood Street
Raptor Commercial Demolition	Jandakot	Spencer Road
Swift Demolition	Victoria Park	
Hatton Deconstruction	Brookdale	Wollaston Avenue
P&P Contractors	Safety Bay	
Projec Demolition	Wattleup	Pavlovich Court

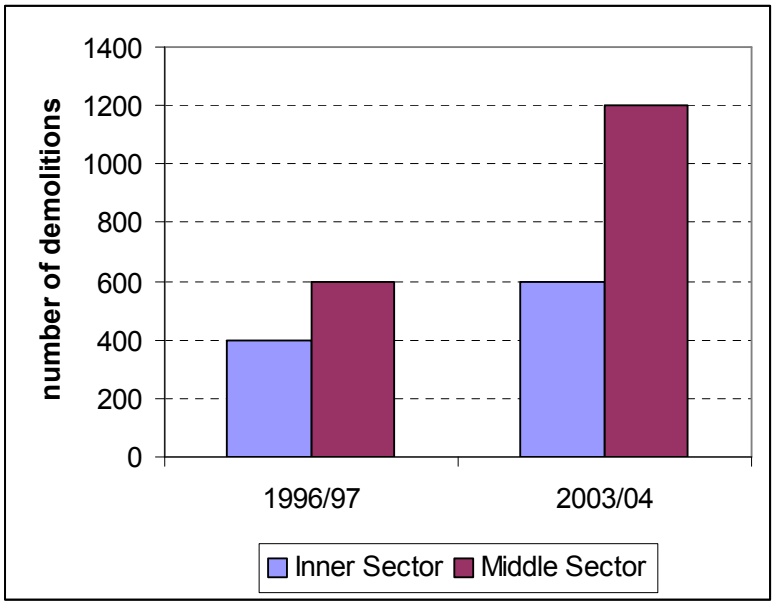
The Australian Bureau of Statistics has ceased the official collection of residential demolition statistics in 1996. Since then, there has been a rapid increase in the number of demolitions in Western Australia due to:

- The Infill Sewerage Program initiated across WA in 1994
- Amendments to the Strata Titles Act in 1996 to create survey strata lots
- The New Living Urban Renewal Program
- Land economics – older houses at the end of their economic life located on larger lots that provide redevelopment potential to create smaller lots

The Department of Housing and Works have undertaken some research on the extent and trends and the spatial distribution of demolition activity between 1996/97 and 2003/04. The department has found that the number of demolitions in Western Australia has more than doubled over this timeframe (Department of Housing and Works, 2004). Data collected excludes several outer metropolitan and small local authorities in regional WA, however the split between Perth and the rest of Western Australia is consistently 90:10 (Department of Housing and Works, 2004).

Data indicated that demolitions have increased from 1,200 in 1996/97 to at least 2,500 in 2003/04. The majority of demolitions occur in the Middle Sectors (Stirling: 400-600, Melville: 200, Canning: 120, Belmont: 70) making up 50-60% of all demolitions. The Inner Sector (South Perth: 120, Nedlands: 70, Cambridge: 70) making up 30-40% of all demolitions (Department of Housing and Works, 2004).

Figure 5.1: Demolition in the Inner (South Perth, Nedlands and Cambridge) and Middle (Stirling, Melville, Canning and Belmont) Sectors of Perth 1996/97 and 2003/04



Source: Department of Housing and Works, 2004

Ongoing improved data capture indicated that demolitions across Western Australia were in the order of 2,800 but this figure was skewed by a demolition licence issued by the City of Cockburn for 270 dwellings in Hope Valley as part of improving the buffer requirements around the Kwinana Industrial Area (Western Australian Housing Industry Forecasting Group, 2005).

It is anticipated that number of buildings demolished will continue to increase each year due the Western Australia's strong economy and growth within the construction sector.

6. BUILDING PRODUCT WASTE IN WESTERN AUSTRALIA

Previously described as Construction and Demolition (C&D) waste, building product waste is generated from a variety of sources. Typically, the main sources of building product waste can be divided as follows:

- The construction of new houses/housing subdivisions and major road networks. These materials include unsuitable, poor-compacting or clay soils that cannot be used onsite
- The preparation of the site, when the unsuitable materials are removed. These materials include sand, limestone and/or trees
- Waste and reject material from the manufacture of building products
- The wastes produced during the construction process
- The demolition of residential buildings, offices and industrial buildings

Building Product waste forms a disproportionately large share of the total waste stream in the Perth metropolitan area. A February 2003 study by the Waste Management Board indicated that C&D waste has consistently accounted for around 50 percent of the total waste stream deposited to landfill since 1998 (Waste Management Board, 2003). This is compared to approximately 15 percent for the commercial and industrial sector and 30-35 percent for the municipal sector over the same time period.

6.1 BUILDING WASTE GENERATED

In 2004, the Perth Metropolitan waste stream to landfill was 2,886,900 tonnes, of which 1,619,613 tonnes (56%) was classified as C&D waste (Waste Management Board, 2004). There is currently no data on the amount of individual building products disposed to landfill.

Table 6.1: Tonnages/Percentage of Waste Streams to Landfill by weight – Perth Metropolitan Region 2001-2004. (WA DOE)

Year	2001/2002	2002/2003	2003/2004
Total waste to landfill (tonnes)	2,342,516	2,695,616	2,886,900
C&D waste component (tonnes)	1,171,258	1,534,679	1,616,613
% C&D waste component	50%	57%	56%

Figure 6.1 illustrates the amount of C&D waste produced between 1998 and 2004, which is mostly Class I or inert material, and contrasts this against the commercial and industrial sector and the municipal sector (Waste Management Board, 2005).

Figure 6.1: Quantity of Waste Landfilled in the Perth Metropolitan Region, 1999 –2004 (Zerowaste, 2004)

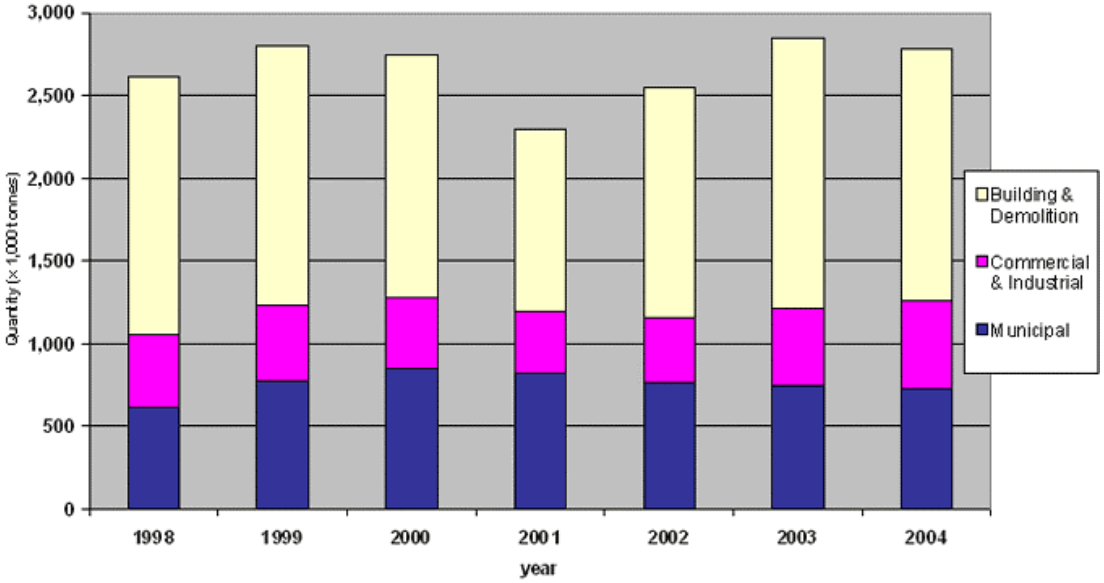


Figure 6.1 shows that the quantity of C&D waste that was disposed to landfill notably declined in 2000/2001 and 2001/2002. The amount of C&D waste disposed to landfill in 2003/2004 is more than the 1998/1999 figure (Waste Management Board, 2005).

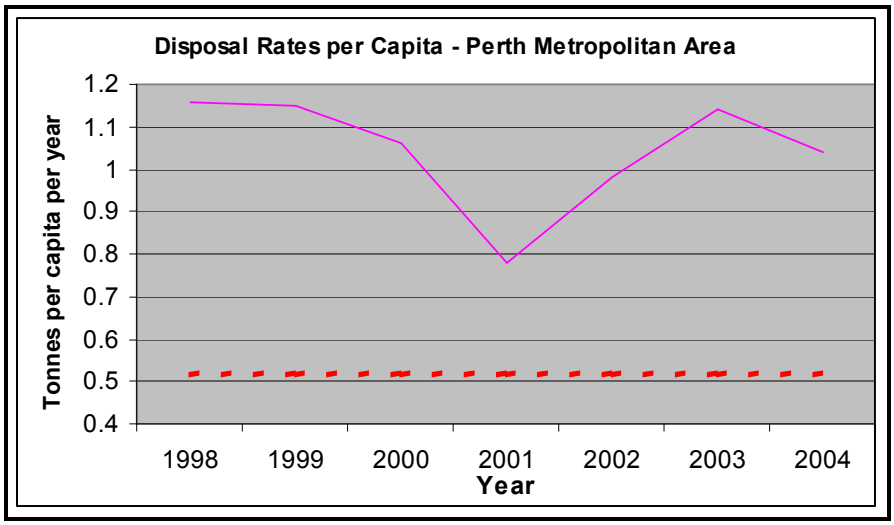
There are potentially a number of reasons that account for the relative increase in C&D waste in 2003/2004 compared to 2001/2002:

1. An increase in the amount of C&D work in Perth
2. A reduction in illegal dumping of C&D and a corresponding rise in the amount of C&D waste that is disposed to landfill
3. A greater proportion of the C&D waste has been recorded at the disposal sites
4. The introduction of Goods and Services Tax (GST)

6.1.1 C&D Waste per Capita

The waste per capita figure is used to compare the C&D waste generated by each person in the Perth Metropolitan Region. The information in **Figure 6.2** has been included because a waste reduction target previously agreed by the Western Australian Government in 1996 was to reduce the C&D waste stream per capita by 50%, this was to be achieved by 2000. Based upon 2004 figure the target would be at a level of 520kg per person (shown as a dotted red line on the graph), or the equivalent of reducing or recycling 808,300 tonnes of C&D waste per year.

Figure 6.2: C&D Disposal rates per capita (WMB, 2004)



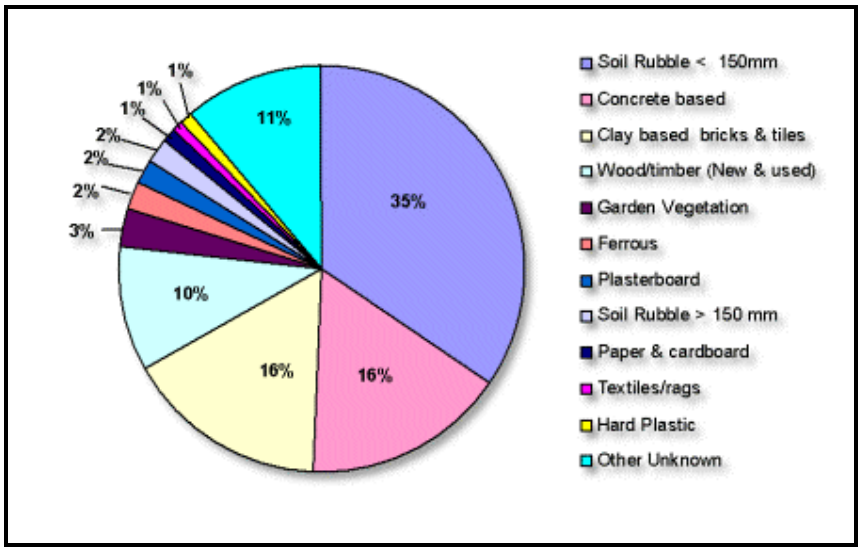
6.2 BUILDING PRODUCT WASTE COMPOSITION

The Building / Construction and Demolition (C&D) waste stream mostly consists of inert material made-up of concrete, soil, rubble and bricks (Waste Management Board, 2003).

When considering the composition of the C&D waste stream, it is important to distinguish whether composition is measured by volume or weight. The NSW Wasteboards puts forward:

> *The largest [C&D waste] contributor, over 50% by weight, to landfill is soil, rubble, concrete-based and clay-based materials. However, by volume it is generally timber, closely followed by plasterboard, which together contribute the majority of waste in residential construction. Paints and carpet often contribute a significant amount to the waste stream* (NSW Wasteboards, 2003).

Figure 6.3: A Summary of the C&D Waste Composition in New South Wales (NSW Wasteboards, 2003)



Source: NSW Wasteboards web site, Construction and Demolition Waste Stream

Based upon the NSW Wasteboard C&D waste composition data, the relative tonnes of material groups produced in WA (using 2004 data) are show in **Table 6.2** below.

Table 6.2: Approximate Tonnage of Materials Produced from C&D Waste in WA, 2004 (based on NSW compositional data)

Material Type	NSW Percentage Composition[2]	WA Equivalent 2004 (1000's tonnes)
Soil Rubble	35	566
Bricks / tiles (clay based)	16	259
Concrete	16	259
Other Unknown	11	178
Timber	10	162
Trees	3	48
Ferrous	2	32
Ceiling/wall plaster	2	32
Soil Rubble > 150mm	2	32
Paper / Cardboard	1	16
Rags / Textiles	1	16
Hard Plastics	1	16
TOTAL	**100**	**1616.613**

[2] Source: Nolan ITU (November, 1999)

A focus on only the demolition waste (as opposed to construction *and* demolition waste) provides a different composition. It has been estimated that residential demolition accounts for approximately 44% of the total demolition waste, with non-residential demolition account for the other 56% (Environmental Protection Agency Qld, 2002). Work undertaken by the demolition industry association estimates the following breakdown for residential and non-residential building demolition is shown in **Table 6.3.**

Table 6.3: The Approximate Breakdown of Residential and Non-Residential Demolition Waste in Western Australia

Waste	Components	Percentage by Volume
Concrete	Concrete, reinforcement	20%
Masonary	Bricks, tiles, blocks	45%
Timber	Treated and untreated wood, pallets, trees etc.	10%
Others	Plasterboard, glass, metals, plastic, floor covering, dirt etc.	25%

Source: Construction and Demolition Waste – Waste Management and Resource use Opportunities

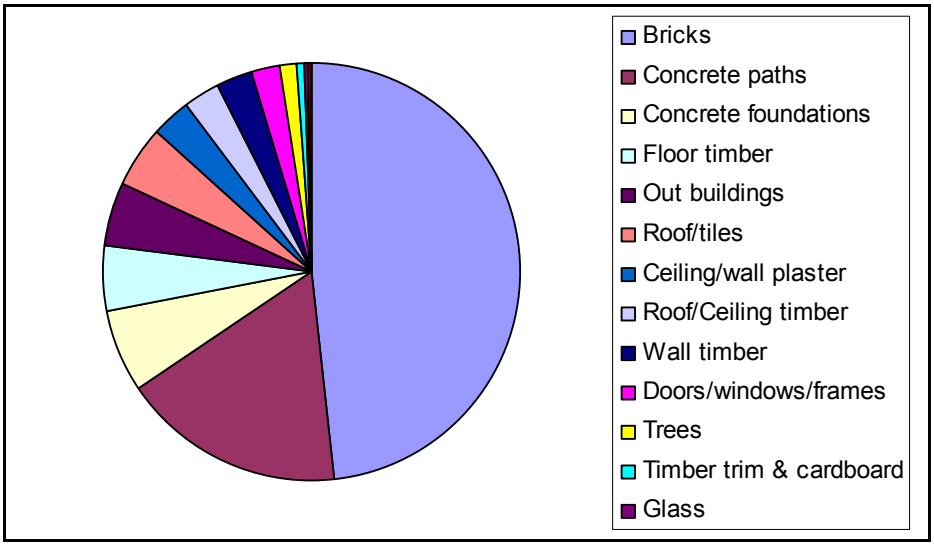
Ecorecycle Victoria monitored the demolition of 15 houses and then examined the demolition waste composition as shown in **Table 6.3** and **Figure 6.4.**

Table 6.4: Waste Composition During House Demolitions

Material	Total Weight (tonnes)	Percentage of recovered materials	Average quantity per household (tonnes)
Roof/tiles	91.3	4.6	5.7
Roof/Ceiling timber	55.4	2.8	3.5
Bricks	967.8	48.4	60.5
Ceiling/wall plaster	62.0	3.1	3.9
Floor timber	102.0	5.1	6.4
Wall timber	56.0	2.8	3.5
Timber trim & cardboard	11.8	0.6	0.7
Doors/windows/frames	43.6	2.2	2.7
Glass	5.1	0.3	0.3
Plumbing fixtures	4.8	0.2	0.3
Stove/heater	2.2	0.1	0.1
Concrete foundations	125.2	6.3	7.8
Concrete paths	346.5	17.3	21.7
Out buildings	100.4	5.0	6.3
Trees	26.8	1.3	1.7
Total	**2,000.96**		

Source: Nolan ITU (November, 1999)

Figure 6.4:Waste Composition During House Demolitions



Source: Nolan ITU (November, 1999)

The largest contributor by weight is bricks (967.8 tonnes). Concrete paths (346.2 tonnes) and concrete foundations (125.2 tonnes) also contribute a large amount of demolition waste. Non-building materials can account for a significant amount of the demolition waste composition. These can include trees, shrubs, driveways, paths, garages and sheds (Nolan ITU, 1999).

6.3 BUILDING PRODUCT WASTE TRENDLINES

Generally speaking, building product waste follows a trendline based on economic indicators. Construction activity, and thus the quantity of building product waste that is produced, has cyclical links to business activity, interest rates and changes in the tax levels. The buoyant economic situation in recent years combined with the low interest rates has stimulated building construction and resulted in increased building product waste quantities.

Therefore, ignoring any reduction relating to waste minimisation or increased recycling, the production of building product waste in Western Australia in likely to mirror the forecast trends for the construction industry. The building product waste generated is likely to peak around 2006 and slightly reduce by 2008, but stay at high levels of about 1,500,000 tonnes per year.

7. WASTE MANAGEMENT PRACTICES IN THE CONSTRUCTION AND DEMOLITION INDUSTRY

7.1 CONSTRUCTION

7.1.1 Building Construction - Normal Operations

The Centre of Excellence in Cleaner Production, in collaboration with Homeswest (Department of Housing and Works), undertook a project entitled *Industry Best Practice for Cleaner Production in the Building Industry* (Brereton, 2001). Waste management practices and the type of wastes generated during residential construction were examined in detail and documented in a Waste Inventory. Eight Homeswest Construction companies participated in the study and a total of 18 houses /units were observed from January to August 2001. The waste inventories started with extensive interviews with the building managers and supervisors to gain an insight into the major types and quantities of wastes expects and the understanding of perceptions of the personnel. In addition, observations of waste materials were noted.

The report summarised the activities involved during residential building construction and identifies the wastes generated during the stages as outlines in **Table 7.1.**

Table 7.1: Construction Activity/Stage and the associated waste management practice and types of waste generated

Construction Activity / Stage	Waste Management Practice and Waste Generation
Building Design	Lack of consideration for standard materials sizes and complexity of building design contribute to substantial construction wastes.
Site Works	Many people contribute to small wastes specific to their trade. Concrete retaining often damaged after installation. Buried waste a problem if left insitu.
Slabs and underground plumbing	Water used excessively when digging trenches because of poor stability of dry sand. Concrete waste can be avoided. Polystyrene is used on all sites. Damp proof HDPE plastic offcuts always present. One third of a sheet of mesh reinforcing wasted. Short lengths of formwork are often discarded. Replacement of 'unclean' sand/fill with 'clean', for better compaction is common.
Bricklaying	Brick wastage results from a wide range of causes. Bricklaying practices and damage to face bricks are key aspects of brick waste generation. Over-ordering is not uncommon. Bricklayers are penalised by current payment systems for using less bricks. Brick packaging creates a significant volume of waste. Packaging materials and quantities vary considerably between brick companies. Some brick companies are being innovative in reducing their packaging. Site separation of strapping and cement bags from other wastes is

Construction Activity / Stage	Waste Management Practice and Waste Generation
	not uncommon.
Roofs and Gutters	Wood and tiles are both huge wastes both by volume and weight. Timber wastes are generated from a variety of causes. Design plays a significant role in the amount of timber waste generated. Estimates for ordering purposes are difficult. Substantial lengths of timber are commonly discarded. Tile waste is also substantial and arises mainly from design and site practices. Leftovers frequently discarded. High potential for secondary use of both timber and tile wastes. Quantity of packaging of tiles is highly variable. Some companies do get it right and promote principles of cleaner production e.g. conservative use of tiles, reuse or recycling of unused tiles and reusable packaging through pallet return system.
Plumbing	Cardboard boxes and PVC offcuts are the most obvious and largest waste. Plumbers also generate small quantities of waste from a wide variety of materials e.g. plastics, mortar, brick, foam sheaths, and metal. Copper wastes are recycled.
Electrical Installations	Excessive waste is generated from packaging of electrical fittings i.e. cardboard boxes, plastic bags and reels. Cable off-cuts have no value at present. Some opportunities are available for minimising length of cable used for internal wiring. Connection of main power box to mains and making it live early in the construction process provides mains power during construction and avoids the hire of temporary power or use of generators or petrol powered equipment.
Walls and Ceilings	Plasterboard waste is the largest volume of waste and the quantity of waste can be considerable. Considerable lengths of cornice were also waste on some sites. Lots of different products used all requiring separate packaging. Excess materials both unmixed and mixed is another main contributor of waste generation. Supply of labour only by trades people does not encourage use of leftovers.
Cabinets and Carpentry	Quantity of wood offcuts varies considerably. Builders commonly supply timber and no incentive for carpenter to conserve material. External cladding introduces new materials and wastes and is fiddly, also requires painting. Prefabricated cabinets reduce site waste. Protection of benchtops is important to avoid replacement. Excessive packaging for some items.
Wet Areas and Tiling	Ceramic and vinyl cardboard packaging are both large wastes (by volume). Ceramic tile wastes (mainly cutting wastes) is largest by weight. A variety of materials are used and a variety of wastes created especially resulting from the packaging of these materials and also high percentage waste as opposed to applied because it is used in small quantities. ‘Labour hire’ contracts are a disincentive to trades people saving materials. Also having two bathrooms /toilet homes doubles the amount of material used and wastes generated.

Construction Activity / Stage	Waste Management Practice and Waste Generation
Painting and Finishing	Paint tins (plastic or metal) are high quality waste that are sometimes used for a range of purposes but often only single use. Unused paint is problematic to reuse or dispose of. Cleaning of equipment in a non-control environment is also a concern
External Finishing	Paving offcuts and leftovers are the most substantial waste, even small curved sections create substantial waste. Straps from pavers also contribute to a large volume of waste. Offcuts of fencing cut to size on site.
Site Management	Management of food scraps and food and beverage packaging waste and impact of building site of the community are issues e.g. untidy sites, sand on road. Neighbourhood dumping is also a common occurrence.

Source: (Brereton, 2001)

In summary, the construction industries in Western Australia collect and remove waste during all stages of construction. When preparing the site, wastes collected during this stage include sand, limestone and trees. These are disposed of in a skip bin and transported to landfill. Some companies may store sand for other construction purposes and translocate trees. During and after construction materials such as offcuts, excess building product, packaging material and litter are also collected in a mixed loads and disposed of to landfill. The majority of companies do not sort waste streams into separate bins.

As represented in **Figure 7.1**, construction companies have four options when transporting the waste. Contractors can transport:

- Sorted concrete waste to a concrete reprocessor to be crushed into aggregate
- Mixed waste to a MRF for sorting which can be sent to a reprocessor to be reprocessed
- Mixed waste to a Transfer station which sort the waste and transports recyclable waste to a reprocessor and other waste to landfill
- Mixed waste to landfill

Contractors can choose either of the above and usually opt for the most cost effective option which is generally the disposal of mixed waste to landfill.

7.1.2 Building Construction Programs in Western Australia

Clean Site

The Clean Site programme was an education and training programme that aimed to reduce the environmental impact in the development and construction industry. The programme was coordinated

by Keep Australia Beautiful Council WA, Department of Environment, builders, traders and industry associations including the Master Builders Association and the Housing Industry Association.

Clean Site concentrated on improving construction management practices, one being waste management / resource recovery. Using a coordinated approach, the programme aimed to reduce litter and wastes produced on site while encouraging recycling initiatives across Western Australia. In addition, the programme conducted training sessions, demonstration events while providing information resources for developers, builders, tradespeople, home renovators and Local Government.

HIA GreenSmart

The HIA GreenSmart programme is a national, industry based building programme run by the Housing Industry Association within each state. The programme was launched in Western Australia in 2001 aimed to encourage responsible environmental management at each stage of the manufacturing, design and construction of housing and land development. It also aims to encourage customers to adopt practices that contribute to sustainable development.

One of the main focuses of the programme is to educate builders and designers to minimise construction waste. It was intended that a series of activities would promote this including training, information packages and demonstration projects. HIA's objectives in becoming a signatory to the WA Cleaner Production Statement is to improve awareness and understanding of cleaner production and eco-efficiency principles and practices within the building industry.

Bunbury ecoHOME

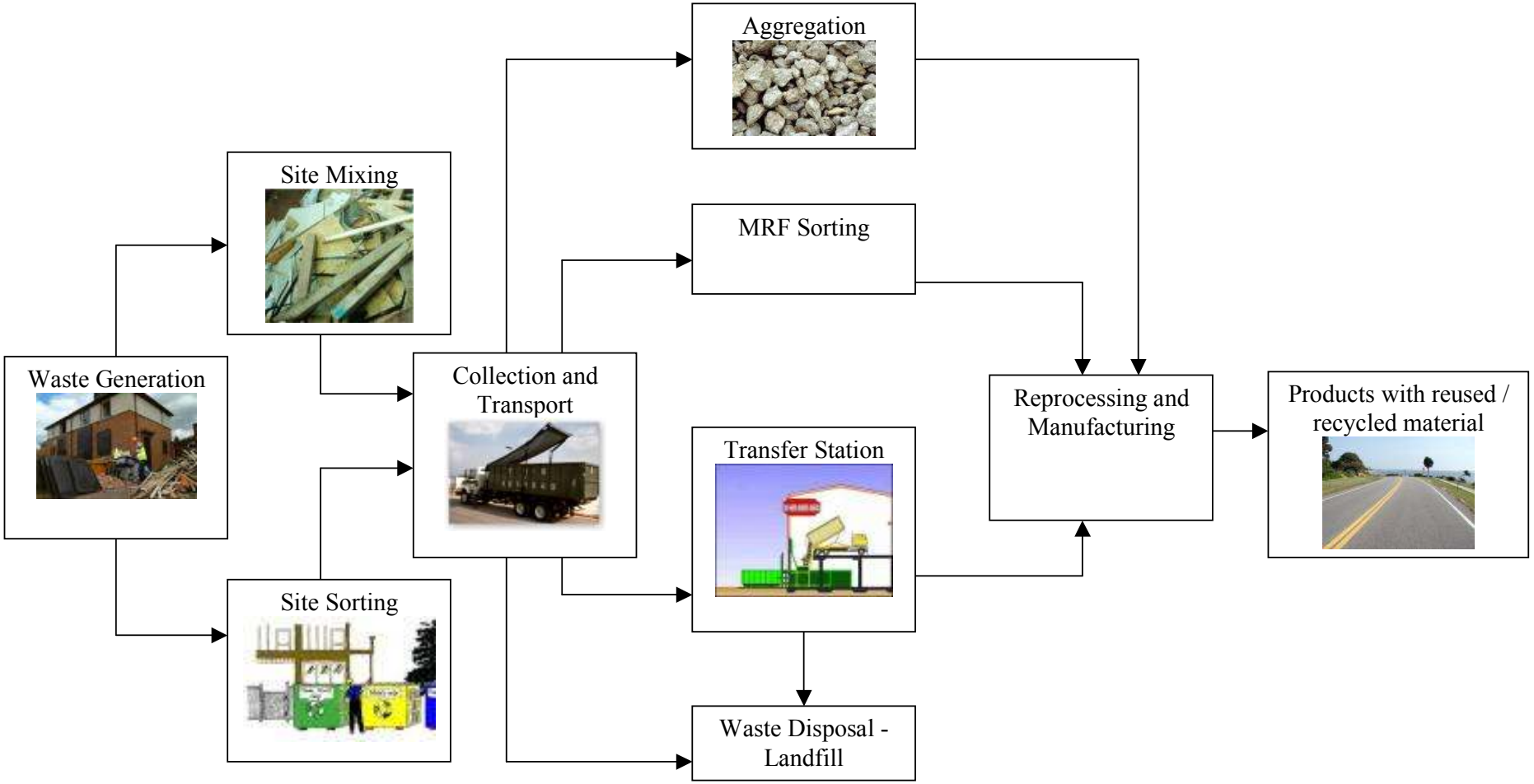
The Bunbury ecoHOME project has designed, constructed and will now monitor a house that demonstrates ecologically sustainable design and high-energy efficiency standards. During the construction phase of the project, the site was used as a demonstration and research model for the 'Clean Site' programme. All the waste produced was been separated and each waste stream has been recorded and measured. The results are to be supplied to the Waste Management Board.

During a meeting with Sandii Roger (Project Manager), she reported that it took a lot of effort to get the Tradesmen on site to put their different wastes into separate bins and skips. Finally this requirement was added to their contracts with $100 penalties for any infringement, this resulted in improved segregation of the waste streams.

7.1.3 Non-Building Construction Normal Operations

BGC construction was contacted to represent the non-building / engineering construction sector. BGC construction indicated that they sort their waste before, during and after construction practices. Waste material such as reinforced steel, timber, polystyrene and oil are sorted into specialised bins and sent to companies to be recycled. The rest of the waste is sent to landfill. It can be assumed that not all non-building construction companies sort their wastes like BGC construction. Non-building disposal options are also represented by **Figure 7.1**. Generally, non-building construction companies are not involved in any programs, which promote responsible waste management practice or aim to minimise non-building construction waste.

Figure 7.1 Construction and Demolition Waste Management and Recycling Flows



Source: Report of the Alternative Waste Management Technologies and Practices Enquiries

7.2 DEMOLITION

7.2.1 Normal Operations

During the demolition process, products and materials including scrap metal, timber, tiles flooring, doors and windows are salvaged. Approximately half of the demolition contractors have established their own salvage yards and sell the salvaged material from the buildings they have demolished. Alternatively, these products are transported to the nearest salvage yard. The remainder of the waste consisting of concrete and rubble is generally collected into trucks and transported to the closest landfill.

The majority of contractors in the demolition industry do not produce a waste management plan which calls for the reuse, recycling and disposal destinations well in advance to the demolition (M Harper 2006, personal communication). However a number of companies (around 40%) undertake deconstruction, which is complimentary to resource recovery. The disadvantage to this manual process is that it is labour intensive. Older houses are easier to deconstruct due to simpler building techniques of that time. Older buildings are easily 'mined' for reusable materials and components, which are usually of higher value in the salvage yard. Many building techniques today include the use of composite materials (e.g. reinforced concrete), which restrict the deconstruction practice.

8. RECOVERY AND DISPOSAL OPTIONS FOR BUILDING PRODUCT WASTE

Building product waste is currently received by a number of landfill facilities and private companies. The price of disposing building product waste at these operations varies substantially, with the transfer stations charging the highest rate per tonne. The Class II landfill sites such as Tamala Park that are licensed to accept putrescible or organic wastes, do not offer a discounted disposal cost for inert wastes. Inert wastes are disposed in the same cells as the organic wastes and the disposal costs are therefore the same. Similarly a number of the transfer stations operated by local councils such as Brockway or Balcatta have high waste disposal costs and are not likely to attract large quantities of waste from contractors. They are primarily operated for residents to take trailer loads to a nearby waste disposal facility. **Table 8.1** summarises the cost for disposing building product waste at the major facilities and identifies their locations.

Table 8.1: The Cost of Disposing Building Product Waste in Perth

Facility Name	Location	Road	Disposal price (per tonne)
Facilities north of the river			
City of Stirling Transfer Station	Balcatta	Balcatta Road	$46.80
Eclipse Resources	Wanneroo	Flynn Drive	$14.00
Mindarie Regional Council	Tamala Park	Marmion Avenue	$51.00
Capital Demolition	Bayswater	Duffy Road	$6.00 clean concrete
RCG Pty Ltd	Neerabup	Quinns Road	$8.80
Atlas	Noranda	Alexander Drive	$43.90
Non-Organic Disposals	Landsdale	Furniss Road	$14.85
Cleanaway Transfer Station	Bayswater	Collier Road	$55.00
Facilities south of the river			
City of Canning	Canningvale	Ranford Road	Accepts car-trailer loads only - $16.00
Collex	Jandakot	Marriot Road	$8m³ clean rubble $14m³ general rubble $20m³ oversize (i.e. >1m²) rubble or steel reinforced
Waste Stream Management	Medina	Thomas Road	$9.25 (min $79.27)
Western Metropolitan Regional Council	Shenton Park	Brockway Road	$59.00
AAA Bulk Haulage	Wellard	Mortimer Road	Unknown
Eastern Metropolitan Regional Council	Red Hill	Toodyay Road	$46.20
City of Cockburn	Henderson	Rockingham Road	$11.00 clean rubble $39.00 mixed waste
City of South Perth	Como	Hayman Road	$66.00
City of Rockingham	Baldivis	Millar Road	$33.62
City of Armadale	Forrestdale	Hopkinson Road	$18.00 per 1.3 m³ clean rubble $30.00 per 1.3 m³ mixed waste
Pioneer-Sita Waste Services	South Cardup	Shale Road	$33.00
Pioneer-Sita Waste Services	Welshpool	Kurnall Street	$56.00
Eclipse Resources	Kwinana	Abercrombie Road	$9.32 m³ clean rubble $55 m³ mixed waste
Steg Pty Ltd	Bedfordale	Canns Road	Unknown

The waste is split evenly between north and south of the river. The three main building product recycling operations north of the river are the RCG facility on Quinns Road, the Non-Organic Disposal facility in Landsdale and the Eclipse Resources facility on Flynn Drive. The disposal costs confirm that the majority of the building product waste would be disposed to these three sites.

The main building product recycling operations south of the river are the Eclipse Resources facility (the Class I Abercrombie Road Landfill Site), Collex (Jandakot Recycling), the Waste Stream Management facility on Ratcliffe Road and the Capital Demolition facility on Duffy Road.

The DoE were unable to provide details on where the building product waste is disposed because it is commercially sensitive. It is known that their published waste disposal figures come from reports provided by the Class I landfill sites. It is therefore estimated that there is in the order of 200,000 tonnes per annum of C&D waste disposed to the larger Class 1 inert landfill sites such as Eclipse Resources, RCG, Non-organic Disposals and Waste Stream Management.

It should be noted that a number of the facilities are operating as inert landfill sites and do not attempt to recycle incoming waste. Inert sites operated by RCG and Eclipse Resources for example are accepting C&D waste in order to supplement their income from their sand, limestone or rock extraction activities or to rehabilitate sites that have been previously used for these activities.

8.1.1 Operating Companies

Capital Demolition is perhaps the closest and largest C&D waste recycling facility near to the Perth central business district. Their operations are carried-out in the open in an area surrounded by other industrial premises, particularly salvage yards and scrap recycling facilities. The incoming waste is sorted into different piles according to its contaminant content. A crane feeds the crusher that deposits the waste into different piles according to the concrete size and contaminant level. It is understood that Capital Demolition also has a screener and a front-end loader. They have one industrial shed that is used mainly to store the equipment when it is not operational. Capital offers a relatively cheap rate to dispose of concrete waste but is not licensed as an inert landfill

Waste Stream Management is located in Kwinana and commenced operation recycling building product waste in 2000. Through its relationship with the Town of Kwinana, Waste Stream Management has constructed a ‘test’ road using Reprocess Concrete Aggregate (RCA) for road-base and has received significant assistance from the Waste Management Recycling Fund. The building product waste received at Waste Stream Management is understood to be processed through a screen and crusher, and treated with electromagnetic, dry and airflow separators. The process is undertaken

in the open and the product is generally sold for road-base, drainage aggregate and general purpose aggregate.

Eclipse Resources has operations in both Kwinana and Neerabup. Their facilities only accept inert waste, which is landfilled. Similarly, the RCG facility is a quarry site that landfills inert waste. RCG does not recycle building product waste. The majority of inert waste that is sent to RCG and Eclipse Resources is from large companies, as opposed to householders wishing to dispose of small amounts of rubbish.

9. MARKETS FOR C&D RECYCLED MATERIALS AND PRODUCTS

This section of the report provides a brief summary of potential markets or uses for the wastes streams produced by building product wastes. Market identification and development is a key issue that would need to be addressed to stimulate the demand for recycled materials. This list below is not intended to be an exhaustive list of markets, simply an indication that available markets already exist for most sections of the building product waste stream, but the markets do need to be developed.

9.1 SOIL & RUBBLE (566,000 TPA)

This material can be screened to produce a recycled soil for landscaping and the oversize material can be reprocessed to produce variation qualities of general fill material. This material produces lower value products but includes a very high proportion of the waste generated.

9.2 BRICKS / TILES (CLAY BASED) (260,000TPA)

These can be reclaimed (salvaged) whole for resale, or crushed to be used as raw material for re-firing into bricks or used as general fill, drainage, road pavement, structural concrete or pavement concrete as shown in **Table 9.1.**

9.3 CONCRETE (260,000TPA)

Concrete can be reprocessed to produce a specified RCA product. This product must comply with certain criteria and be suitable for specific applications if it is to be accepted in the recycled product market. **Table 9.1** summarises the suitability of RCA according to its classification. The classification system for RCA is based on nominal material parameters including grading, impurity concentration and quality (Sagoe-Crentsil, 1997).

Table 9.1: Classification and Uses of RCA

RCA classification	Bulk fill[3]	Drainage/filter	Road pavement	Structural concrete	Pavement concrete[4]
Crushed demolition debris	Suitable	Usually suitable	Not suitable	Not suitable	Not suitable
Graded mixed debris	Suitable	Usually suitable	Suitable in some cases	Not suitable	Suitable in some cases
Clean graded bricks	Highly suitable	Suitable	Usually suitable when blended with RCA	Suitable in some cases	Usually suitable
Clean graded concrete	Highly suitable	Highly suitable	Suitable	Usually suitable	Suitable

Source: Sagoe-Crentsil *et al.*

9.4 TIMBER (160,000TPA)

Treated timber can be used for new construction or for the manufacture of particle/fibre board.

9.5 GREENWASTE (48,000TPA)

Greenwaste can be used to produce mulch or compost for landscaping or soil conditioning.

9.6 METALS (32,000TPA)

Ferrous-based metals have an existing and viable market with metal reprocessers. The scrap metal reprocessor will collect loads of scrap metal produced in WA.

9.7 CEILING /WALL PLASTER (32,000TPA)

There is no obvious market for this material. However plasterboard can be taken back by some manufacturers to produce new plasterboard.

9.8 SOIL RUBBLE > 150MM (32,000TPA)

This material can be screened to produce a recycled soil for landscaping and the oversize material can be reprocessed to produce variation qualities of general fill material. This material produces lower value products but includes a very high proportion of the waste generated.

[3] The use of RCA for an acoustic barrier has comparable suitability characteristics. See Krezel, 2002.

[4] Suitable for sub-base, base, kerbs, car park and footpath slabs.

9.9 PAPER / CARDBOARD (16,000TPA)

Paper and cardboard can be recycled into other paper-based products provided the levels of contamination are acceptable. Alternatively 'contaminated' paper and cardboard may be suitable for composting to product a soil conditioner.

9.10 RAGS / TEXTILES (16,000TPA)

Natural fibre material can be composted, synthetic rubber used in carpet underlay can be used to produce safety barriers and speed humps.

9.11 HARD PLASTICS (16,000TPA)

Some types of plastics are suitable for recycling to product new 'recycled' plastics.

10. NATIONAL AND INTERNATIONAL POLICY EXAMPLES

10.1 AUSTRALIA – COMMONWEALTH

Waste management arrangements through policy and legislation, are the joint responsibility of State and Territory Governments. The Commonwealth's main role is to establish and promote cohesive national waste reduction arrangements through the Environment Protection and Heritage Council (EPHC). The following waste initiatives are through Environment Australia's administration of the National Heritage Trust.

Natural Heritage Trust – Waste Management Awareness Program (WMAP)- Waste Wise Construction Programme

Waste Wise Construction is a national programme, established in 1995, to pioneer industry best practice in waste reduction in the construction and demolition industry. The programme was investigated by the Australian and New Zealand Conservation Council (ANZECC), the predecessor to the EPHC, and aimed to significantly reduce material going to landfill. ANZECC approached five major Australian construction companies to pioneer best practice waste reduction in the industry by reducing and recycling valuable materials such as concrete and steel, paying less to dispose of materials, and using energy more efficiently.

It also raised issues of better waste management practices for a wide range of stakeholders including developers, design professionals, suppliers, waste contractors and collectors. It intended to give both practical guidelines and greater understanding of waste management and reduction practices.
(Department of Environment and Heritage, 2000a)

A guide to the use of Recycled Concrete and Masonry Material

The Commonwealth Government has provided a guide to the use of Recycled Concrete and Masonry Material. The publication states material specifications for recycled concrete and masonry. The Commonwealth Government identified that the growth in the use of recycled material can be constrained by specifier's limited knowledge about the performance of recycled materials in addition to the low awareness of the benefits and perceived risks. The guide was created to provide information for engineers on the tools required for conventional design with graded recycled construction and demolition waste and specific product information.

The guide provided information on material properties and performance in a single document with the aim to facilitate decision on product specification, use and marketing. The guide is also useful for:

- Specifiers of road construction
- Local council engineers
- Concrete subcontractors
- Specifiers of civil works
- Demolition contractors
- Recovered material processors

(Department of Environment and Heritage, 2006c)

Commonwealth C&D waste reduction guidelines for the Construction and Demolition Industry

The booklet, published by the Department of Environment and Heritage, aimed to facilitate national waste reduction processes through practical guidelines to assist the construction and demolition industry. It aimed to develop notions of best practice waste reduction in projects at all scales of operations. It also raises better waste management practices for a wide range of stakeholders including developers, design professionals, suppliers, waste contractors and collectors. Overall the booklet intends to give both practical guidelines and a greater understanding of waste management and waste reduction practices.

(Department of Environment and Heritage, 200c)

10.2 NEW SOUTH WALES

Department of Environment and Conservation (DEC)

The Department of Environment and Conservation (DEC) incorporates Resource NSW (which is no longer considered a separate entity). The functions of the department are to develop, coordinate and evaluate the implementation of strategies and programmes for the statewide achievement of government policy objectives in respect of:

- Resource conservation and waste reduction including municipal, commercial and industrial, and C&D waste
- Resource conservation and waste reduction and management in relation to identified regions, industry sectors or material types
- Market development for recovered resources and recycled materials
- Community education and awareness in relation to resource efficiency and waste reduction and management
- Programmes for preventing and controlling litter and illegal dumping
- Information dissemination

The Department of Environment and Conservation are successfully managing the construction and demolition waste sector in New South Wales as recycling of building product waste is on the increase. The department has reported that approximately 70% of construction and demolition waste is currently being recovered in the Sydney Metropolitan Area (S Mitchell, 2006, personal communication).

The NSW Government funds about a third of all construction activities in the state including roads, schools and hospitals. Recently the state government has used its purchasing power to change industry practice by implementing a number of policies.

WRAPP – Waste Reduction and Purchasing Policy

The Premier announced the NSW government's Waste Reduction and Purchasing Policy (WRAPP) in 1997. This policy requires all state government agencies and state owned corporations to develop and implement a WRAPP plan to reduce waste. The policy specifically identified the C&D industry as a sector that can improve its practices to reduce waste.

WRAPP requires that each government agency and state owned corporation must collect and periodically report data on:

- Total quantities of scheduled wastes being generated and recycled.
- Total quantities of scheduled materials being purchased, which contained recycled content.

All agencies and corporations must submit a progress report every two years that must contain the following information:

- General information about the agency
- Progress in implementing strategies identified by WRAPP
- Information on barrier on implement strategies
- Waste data on the quantities of materials being disposed of through regular waste audits
- Purchasing data on the quantities of certain types of materials purchased including quantities of materials and products with recycled content.

The WRAPP policy ensures that the state has an up to date record of all material and products purchased and also waste disposed of by any construction and demolition undertaken for the NSW state government.
(Department of Environment and Conservation, 2005a)

Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage

The *Specification for Supply of Recycled Material for Pavements, Earthworks and Drainage* was the first industry wide specification for the use of recycled materials in local roads, pavements and other civil construction works. It was a joint initiative between Resource NSW, the Institute of Public Works Engineering Australia (IPWEA) and the C&D Division of the Waste Management Association of Australia (WMAA). The specification outlined:

- Road base material suitable for a range of traffic conditions
- Select fill for improving sub grade performance and also for raising site levels
- Bedding material suitable for use as a base layer for pavers
- Drainage medium for backfilling structures

The specification provided standards, which were performance based. Traditionally standards have specified virgin materials and have therefore restricted the use of recycled materials. It has been discovered that recycled products can deliver the same and even better performance requirements. The specification set the standard for the recovery industry to supply quality, recycled materials. The document also provided confidence in the marketplace for designers, specifiers, councils and contractors. In addition the document outlined the following benefits of using recovered concrete, brick and asphalt materials:

- Protecting stocks of natural resources
- Protecting the environment from further degradation
- Potential cost savings
- Ensuring local government works towards international best practice
- Assisting local government and industry to ensure development is ecologically sustainable
- Recycled materials are capable of being worked in wetter conditions, resulting in less down time in wet weather
- Recycled materials bind together well which reduce potholes and scouring and also require less brooming to finish

The initiative is in accordance with the Government's policy for the recovery and use of secondary materials so as to minimise the consumption of natural resources. It has made a positive contribution as the specification has increased the acceptance and use of recycled materials within the public works sector and provides a base on which other specifications can be created. Overall it has improved the quality of recycled materials as the variability of the level of contaminant was previously high.
(Resource NSW, 2003)

After the success of the above specification, the department is now developing a Recycled Glass specification for use as drainage material.

IPWEA Professional Development Program

The Institute of Public Works Engineering Australia (IPWEA) has introduced training on the use of the above specification, recycled materials and pavement technologies. *The Fundamentals of Flexible Pavements* is an interactive workshop, which provides personnel with, and encourage the adoption of, practical engineering practices in the design, specification, construction and maintenance of flexible pavements.

Case Study - Christo Road, Georgetown

During 2001 the pavement of Christ Road in Georgetown, NSW was reconstructed using recycled materials. The works used recycled asphalt and recycled concrete as the recycled products are assigned the same strength as conventional base and sub base materials for roads with these traffic loadings. Boral supplied the recycled concrete to the site and 40% was saved on material costs of those for conventional products. To date there have been no construction problems associated with the recycled material.

Construction and Demolition Recycling Directory

This directory lists contact details of where to recycle and purchase aggregates, concrete, brick, asphalt, soil, second hand building materials. There are available in two versions: Sydney Metropolitan Area and the Illawarra/Shoalhaven Edition.

IPWEA Recycling Directory

In addition the IPWEA have supplied a list of suppliers of recycled aggregate and materials on their website. These companies meet the requirements of the "draft Specification for Supply of Recycled Materials for Road Drainage and Fill". The directory and website have been successful and the construction industry are currently utilising recycling companies.

Development Control Plans (Waste Management Plans)

In 1995 a *Waste Not…* Guideline was introduced into the Sydney Metropolitan Region that applied to development and building applications. These guidelines ensured that every company, which applied to build, erect, demolish, refurbish or develop piece of property in the Sydney metropolitan area, would be required to think about what steps they could take to reduce waste and to produce a Waste Management Plan (WMP). This plan would document the steps they would take to carry out these actions.

In 1994/1995 the combined Sydney Regional Organisation of Councils (ROCs) obtained funding from the Commonwealth Government's Local Government Development programme to develop a model Development Control Plan (DCP) for waste minimisation that could be used by all Local Government in the Sydney metropolitan area. The DCP was seen to be a step towards minimising waste through regulating recycled materials and products usage through Development Approvals.

A number of workshops were undertaken to educate personnel within local government in the use of Development Control Plans. The training programme was undertaken to introduce staff to the requirements for adapting the model guidelines to their own Council and adopting them in their own area.

Waste Management Plans

The Waste Management Plan asks the applicants of the development approval to predict what waste they are going to produce, what management steps they are going to undertake to re-use and recycle materials and how they are going to dispose of any waste product that can be re-used or recycled.
In general, the Waste Management Plan provides the Council with the following data:

- The volume and type of waste that will be generated
- How waste will be stored and treated on site
- How residual waste is going to be disposed of
- How ongoing management is going to address the issues of waste minimisation and management

The Waste Management Plans are now operating in all Councils across Sydney and were based on the Waste Wise Construction Program implemented the Commonwealth's Natural Heritage Trust.

Waste Planning Guide for Development Applications Brochure

The New South Wales Waste Boards developed a brochure, which was designed to assist builders, architects, demolishers and owner/builders to meet these new Council requirements. Its main aim was to assist the personnel preparing Waste Management Plans as a part of their development applications. It also helps identify and estimate quantities of waste and provides guidance on how to reduce and manage waste.

Waste Planning Guide for Development Applications Booklet

This booklet was produced by the Inner Sydney Waste Board on Behalf of all Regional Waste Boards. The 28 page booklet identifies that a Waste Management Plan is now needed as part of development applications or applications to council to erect or demolish a building. In addition, the information

booklet outlines what the waste management plan looks like and how to complete one. In addition the booklet also provides information on how to:

- Predict quantities of waste
- Manage waste on site
- Minimise waste produce
- How to dispose of waste that can not be re-used of recycled

Education and Information

The C&D Industry in NSW have now adopted reuse and recycling of building products as normal practice. Outlined below are exampled of previous information and education tools that were used to educate the industry in the principles of responsible waste management. The majority of the information tools are no longer printed in New South Wales.

Posters on waste management at domestic building sites – Smart Building 2

Master Builders Association of NSW Pty Ltd

The aim of this project was to develop a waste management guide for the use in the residential building industry. A working party was established to represent the residential building industry. Parties included builders, subcontractors, suppliers and waste boards. Through this project, a guide was developed for the distribution to the residential building industry and associated trades. The guide was developed as an easy to use, practical poster.

The outcome was the enhancement and promotion of waste management techniques, principles and practices in the building industry. The project was successful as the industry was willing to recognise the importance of waste management, and to address associated issues

Measure twice, cut once! – A guide to minimising waste on construction and demolition projects

This is a pocket size handbook that provides an easy-to-read guide to minimising waste on construction and demolition projects. The booklet is an inexpensive, compact and appealing handbook that can be distributed to every construction worker (from designer through to developer) in New South Wales.

Leaders in the construction and demolition industry are generally aware of the need to improve the environmental impact of their operations. What is not well understood is what can be achieved and how. This handbook aimed to provide a basis for understanding the issues and giving practical ways of taking action to meet these objectives.

Through consultation with important stakeholders in the building construction industry, the handbook introduces readers to issues and discusses the current impact the industry has on the environment. It then moves through examples of what can be done to reduce waste and then into specific strategies for each of the major waste streams. The handbook also includes a deliberately simple and concise strategy for those readers who wish to take the first steps towards reducing waste in their activities.

Overall, the handbook has been well received with encouraging feedback. A survey sample of industry workers indicated that there was an overall positive result. The distribution has been channelled through large companies and industry bodies such as the Master Builders Association.

onSITE: a website on Waste avoidance, Resource Recovery and Recycling in the Construction and Demolition Industries

National Centre for Designs at RMIT University

The onSITE website was conceived, designed and developed following consultation with a wide range of industry stakeholders including the Commonwealth, State and Local Government, waste boards, designers such as engineers and architects and industry associations.

The website contained:

- Information on key organisations for construction and demolition waste management
- Guidelines, policies, handbooks and other relevant publications
- Case studies
- Links to related sites
- Online discussion forums

The project recognised that information availability and sharing is crucial to achieve waste minimisation in a large and diverse industry such as the construction industry.

10.3 VICTORIA

EcoRecycle Victoria

During late 2005, Sustainability Energy Authority of Victoria and EcoRecycle Victoria joined forces to become Sustainability Victoria. Sustainability Victoria continues to provide advice and leadership on waste management issues. The agency has made major advances regarding construction and demolition waste. A number of programmes have been implemented which aim to change the industry's mindset.

Towards Zero Waste

Through strategic planning and the WasteWise approach, EcoRecycle assists business, the community and government to reduce waste, use resources more efficiently and send waste to landfill only as a last resort. The *Towards Zero Waste Strategy* establishes goals and directions for Victoria's solid waste management and resource recovery framework.

The Strategy's vision is for the state to become a low waste society by 2014. The strategy sets specific targets for waste streams. By 2014, 80% (by weight) of the C&D waste stream should be re-used or recovered. An interim target of 65% has been set for 2008/09.

To achieve these aims, Sustainability Victoria has implemented a number polices and programmes as outlined below.

Funding for Recycling Industries

Sustainability Victoria provides funds to businesses that are involved in the recycling industry. Within the construction and demolition industry, reprocessors are provided finance for infrastructure. The programme has been extremely successful and the initiative has substantially increased the quantities of C&D waste recovered. By 2003, Victoria recovered and reprocessed over 50% of its C&Dwaste, which equates to over 4.5 million tonnes of resource from landfill. The state has 112 reprocessors of steel, paper, concrete, asphalt, brick, cardboard, glass, rubber and plastic. In total $50 million was spent on capital investment, research and development and the sector employed over 1600 people. In the last 10 years, the reprocessing industry has contributed to over quarter billion dollars to the Victorian economy (Annual Report 2003-04)

Project Planning – Waste Wise Construction and Demolition Kit

Sustainability Victoria aim is to assist developers, project managers and builders to minimise waste during construction and demolition projects. A kit has been produced which has been supplied to companies who take place in the Waste Wise program. The kits contains the following practical tools:

- **Guidelines for preparing a Waste Reduction Strategy for Construction –** helps construction companies to identify where waste may be generated in the design, specification and purchasing phase as well as on site
- **Construction Waste Minimisation Plan –** sets priorities for construction companies in regards to waste minimisation and identifies ways of measuring success
- **Demolition Waste Minimisation Plan –** sets waste recovery targets for demolition companies
- **Model Contract Clause –** these clauses have been designed to be readily inserted into any formal agreement between contractors who will be made responsible for developing a waste minimisation plan for a construction and/or demolition project

Case Study - Kensington Development

Waste reduction strategies were adopted during a $60 million public housing renewal at Kensington, Victoria. During the construction project the builder, Becton, embraced guidelines, which aimed to reduce waste during construction project. These included:

- Establish systems and contracts to separate waste on site for ease of recycling
- Engage Collex to provide a number of skips for cardboard, concrete, bricks, steel, timber and general waste

The result was that 76% of construction waste was diverted from landfill. In addition, the builder saved 10% on waste management costs.

Information on Recycled Materials

ECO-Buy

ECO-Buy, formerly known as the Local Government Buy Recycled Alliance, is a local government green purchasing program. The programme is a joint initiative of the Municipal Association of Victoria and aims to work with Victorian Local Governments to increased their purchasing of recycled products. Specifically the programme promotes the use of recycled materials and products in the construction industry.

Members of ECO-Buy receive a Buy Recycled Resource Kit in addition to regular information updates and support services. The kit is a comprehensive guide to develop and implement a buy / purchasing programme in local government.

When considering the construction and demolition industry, ECO-buy aims to:

- Increase awareness of the range and quality of green products
- Support and stimulate sustainable long-term markets for green products
- Create a business and local government networks committed to green purchasing

(Eco-Buy, 2006)

Ecospecifier

Ecospecifier is a knowledge base of over 1000 environmentally preferred products, materials and resources. The programme was created by RMIT University and is a joint effort of a number of businesses and industry associations including the Green Building Council of Australia, Australia Green Development Forum and the HIA (Housing Industry Association) GreenSmart programme. The website specifies used materials or materials with recycled content supports the waste minimisation process. It links independent information with a powerful web search interface and is designed to help designers, builders, consultants and those looking to deliver best practice design. In summary, Ecospecifier helps reduce the amount of C&D waste going to landfill by promoting the use of recycled products. (Ecospecifier, 2006)

Outreach Officer

Ecorecycle has employed an Outreach Officer who now works with the Masters Building Association of Victoria to minimise waste and reduce environmental impacts of buildings. The officer is providing advice to building sector groups in addition to preparing waste minimisation guidelines to improve onsite waste management. In conjunction with training and promotional events, such as forums and workshops, networks have been fostered between builders, recyclers and the waste management industry.

The Outreach Officer has been working in conjunction with the Master Building Association for 2 years. It is anticipated that this will be an ongoing initiative with education and relationships within the industry improving over time (J Vandergraaff 2006, personal communication).

Housing Industry Association - GreenSmart Builders Program

The programme provides information about practical, affordable environmental measures in relation to construction a home. GreenSmart is a practical approach to building that focuses on educating builders, designers, product manufacturers and consumers about the benefits of environmentally responsible housing. It is an industry driven initiative that aims to reduce the waste from the building process.

The programme provides a comprehensive on-site waste management strategy. It attempts to optimise recycling opportunities and the use of recycled product or product with a recycled content in the construction of houses. It also promotes waste collection areas, which are used during construction and suitable facilities, which are incorporated in the fit out of all homes.

Specifying the use of Recycled Materials

Currently the Office of Housing recommends to contractors that they should take into consideration, the use of recycled or reused products. A company who specify that they promote the use of recycled products and materials will be favoured. The Department of Education also specifies that the recycled products and material be used in construction of school buildings. At a local government level, councils do not specify that recycled materials and products should be used in civil construction, however some local government in the state have recognised this and introduce it in to their specifications (J Vandergraaff 2006, personal communication).

Concrete, brick rubble, rock and excavated stone are processed and separately by crushing and screening into a range of products into a range of products. Aggregates and structural fill are used in many civil construction projects, and road base is utilised in the road construction sector (EcoRecycle, 2005). Recycled asphalt are used in road and pavement construction and maintenance (EcoRecycle, 2005)

Landfill Levy

The landfill levy in Victoria stands at $11/tonne. The waste levy has been a stimulus for recycling, reprocessing, and improved the viability of recycling materials, especially when considering building product waste. In addition, levy supplied funding for the above programmes.

10.4 SOUTH AUSTRALIA

Zero Waste South Australia

Zero Waste SA is a statutory authority that started in mid 2004. The objective of Zero Waste South Australia is to promote waste management practices that, as far as possible, eliminate waste or its contingent to landfill. In addition their aim is to advance the development of resource recovery and recycling and are based on an integrated strategy for the state.

Recently Zero Waste SA released their first statewide strategy. State and Local Government agencies, the waste management industry, business and the community have been involved in helping Zero Waste SA to develop the waste strategy and guide the way in which waste is managed in South Australia.

The strategy establishes waste reduction goals and targets for South Australia and sets out steps to achieve these goals and targets. The following targets have been set for the building product waste stream:

- By 2006 there would be a 20% increase in recovery and use of C&D materials
- By 2008 there would be a 35% increase in recovery and use of C&D materials
- By 2010 there would be a 50% increase in recovery and use of C&D materials

(Zero Waste SA, 2006)

In South Australia, the C&D industry contributes about 40% of the wastes going to landfill.

Waste Audits

In June 2004 Zero Waste SA commissioned Waste Audit Consultancy Services (Aust) Pty Ltd to undertake disposal audit of the waste disposed of to landfills within the Adelaide metropolitan area. The aim of the project was to estimate the quantity, source and composition of C&Dwaste entering 5 landfill sites.

It was found that the Adelaide C&D waste stream was dominated by 'Soil / Clean Fill' which represented 78.48% by weight of the total stream.

Landfill Levy and Licensing

The revenue raised from licenses is divided equally between the EPA and Zero Waste SA. The EPA uses the revenue to regulate the facilities while Zero Waste SA uses revenue to fund their Research and Development programmes. In 2004, Zero Waste SA increased the landfill levy of inert landfills from $5.50 to $10.50. The proceeds from the levy have financed a number of policies and programmes.

Infrastructure Program for Industry

Zero Waste SA provides financial assistance for projects that support the waste reduction goals and targets of *South Australia's Waste Strategy 2005-2010*. The building and demolition industry can apply for these grants to upgrade their recycling or re-use infrastructure. These may include crushing or treatment technologies and other recovery initiatives.

Research and Market Development Incentives

Zero Waste recognises the need for sustainable markets for recycled materials and for the research into avoidance/reuse and recycling alternatives for problematic waste streams. Zero Waste SA is currently providing financial assistance for a project, which investigates the potential for recycled carpets. The project is investigating the use of this fibrous material in road and building construction.

Industry Education – 'Be Waste Wise'

Discrete education packages have been developed for industry to adopt in formal training courses through TAFE colleges and other accredited training institutions. These will be coordinated with industry associations, training institutions (Zero Waste Business Plan, 2004-05).

These courses will concentrate increased awareness of waste issues, awareness of waste hierarchy and the importance of waste reduction and identification of waste as resources. (Zero Waste Business Plan, 2004-05)

Future Projects

Currently the inert landfill levy sits at $5 in rural areas while metropolitan inert landfill levy is $10.50. A number of construction and demolition companies have been transporting their waste to rural areas to decrease the levy paid. Zero Waste SA is planning to implement new legislation that restricts this practice. In addition Zero SA is preparing to target illegal dumping of C&D waste

Tender Specifications - Use of Recycled Materials

State and Local Government tenders now specify that 30-50% of materials and products with recycled content must be used in construction.

Case Study - Port River Expressway

The Port River Expressway (PRExy) links South Australia's major port and rail terminals at the Port of Adelaide directly with the National Highways to Perth, Darwin, Sydney and Melbourne. The Port River Expressway is therefore a key transport route within the state.

Transport SA is taking a leading role to promote resource recovery and reuse in the construction industry. A series of new material specification released in 2001 included the use of building and demolition waste. Transport SA and ResourceCo took upon the challenge to manage existing waste and fill materials located on site in an environmentally sustainable way.


Figure 10.1 (Left) Breaking up recycled concrete (Right) View of Stage 1 of the Port River Expressway

The Port River Expressway was in close proximity to a number of recycling industries which enabled the contractor to use recycled materials for 1.7 million tonnes of fill required for the project (equivalent to 75,000 loaded semi trailers). The amount of fill was used to raise the road level 3 metres above sea level, which was a requirement of the Coast Protection Board. Much of this fill consisted of demolition material such as bricks, concrete and rubble.

A significant amount of resources were recovered from 94,000 tonnes during the construction of stage 1 of the Port River Expressway, which would have otherwise been landfilled. This waste was processed and combined with better quality recycled material to build the base of this major road. In addition, other waste such as tyres were removed by machinery and timber, plastics, rubber and metal were removed by hand so it could be taken to the appropriate recycling depot.

Clean fill from the Torrens Road upgrade and City West Connector project in Adelaide, which would have otherwise been landfilled, were also used in the Port River Project. Recycled, broken down concrete and bricks were used as a working platform for overpasses for the expressway.

Traditionally, virgin fill material would have been sourced from quarries or borrow pits. This would have introduced a substantial cost to the project, as the nearest quarry is located 10 kilometres from the site. The Port River Expressway project was therefore heavily reliant on the availability of cost effective sources of fill material due to the large volumes required.

(Transport SA, 2006)

10.5 UNITED STATES OF AMERICA

The U.S. Environmental Protection Agency has estimated that the nation generates more than 135 million tons of building-related construction waste and demolition (C&D) debris annually. This represents the second largest component of the nation's waste stream, just behind municipal solid waste. This figure does not include the material generated in transportation related projects such as highway, airport, and transit construction.

Construction waste and demolition debris are solid waste and therefore governed under the Commerce Clause of the U.S. Constitution. The U.S. Supreme Court has ruled that C&D debris enjoys the same protections as other elements of the nation's waste stream. Therefore, attempts to limit its movement across state boundaries or institute flow control to limit the importation of debris from one state to another are prohibited.

The U.S. Environmental Protection Agency has a number of goals relating to C&D waste, these include to:

- Characterise, measure, and increase knowledge and understanding of the C&D waste stream
- Promote research and development on best practices for C&D debris reduction and recovery
- Foster markets for construction materials and other recycled materials that can be incorporated into building products
- Work with key players in the construction, remodelling, and demolition industries to implement more resource-efficient practices
- Incorporate C&D debris issues and projects into broader "green building" programs

There appears to be little Federal legislation relating to building product waste. However, there are different regulations within each of the states that promote (or in some cases prevent) building product waste recycling. The areas of New England and California have been examined closely to determine the policies that have been implemented or are being considered to increase the use of recycled building products.

10.5.1 Massachusetts

The information provided below has been sourced from the Massachusetts Department of Environmental Protection (DEP) website and other journals and reports.

To encourage the recycling of building product waste the Massachusetts DEP have taken the approach of; banning the disposal of a range of building waste products, expanding Extended Producer Responsibility with manufacturers, market development and capital grants for increasing the recycling

industries infrastructure. This is all backed up with a communication programme and stakeholder meetings (Alison et al, 2002). The information below summarises the initiatives detailed in the Massachusetts DEP Construction and Demolition Debris Waste Reduction Strategy (2005).

The C&D recycling rate in Massachusetts is already high. In 2003, 4.7 million tons of C&D were generated in Massachusetts, down from 4.8 million tons in 2002. Of the amount generated, 71% was recycled, down from 75% recycled in 2002. **Table 10.1** shows how C&D was managed in 2003 compared with 2002.

Table 10.1: C&D Management in 2002 and 2003

	2001	2002	2003
Generated	**4,550,000**	**4,750,000**	**4,720,000**
Disposed	**890,000**	**620,000**	**720,000**
• **In-State**	620,000	520,000	370,000
• **Out-of-State**	270,000	100,000	350,000
Diverted	**3,660,000**	**4,130,000**	**3,990,000**
• **Recycled**	**3,200,000**	**3,540,000**	**3,360,000**
o ***Asphalt, Brick, and Concrete (ABC)***	2,830,000	3,280,000	3,200,000
o ***Metal***	80,000	50,000	80,000
o ***C&D wood***	40,000	40,000	20,000
o ***Wood Waste***	180,000	110,000	40,000
o ***Other****	60,000	60,000	20,000
• **C&D Other Diversion**	**520,000**	**590,000**	**630,000**
o **C&D Fines**	380,000	400,000	430,000
o **C&D Wood for Fuel**	140,000	130,000	90,000
o **C&D Residuals**	0	60,000	110,000

*Other materials include ceiling tiles, carpet, gypsum wallboard, and asphalt roofing shingles.

Materials produced by C&D processors in Massachusetts are primarily reused at landfills as alternative daily cover (ADC). The strategies that have been developed to further reduce the disposal of C&D waste materials that could be followed in Western Australia are:

- **Build C&D Product Stewardship Initiatives:** The Massachusetts DEP is working with manufacturers of construction materials to develop and build product stewardship initiatives being Extended Producer Responsibility (EPR) where possible. This will include supporting the implementation of existing manufacturer commitments for carpet and wallboard and exploring product stewardship initiatives for other materials. When voluntary product stewardship initiatives are not successful, DEP will pursue regulatory controls such as waste bans more aggressively.

- **Implement C&D Waste Ban:** The Massachusetts DEP will introduce a C&D waste disposal ban that include will include asphalt, bricks, concrete (ABC), wood and metal. The Massachusetts DEP expect this ban to have the greatest effect on increasing diversion of wood, since ABC and metal are already recycled at high rates. To support the ban, DEP will revise its waste ban guidance, hold trainings on the ban, and review and approve revised waste ban plans. Over time, DEP will explore adding other C&D materials to the list of banned materials as markets for those materials develop and grow. Potential additional banned materials include asphalt shingles, gypsum wallboard, and carpet. Any extension of the waste bans would require a regulatory change with public hearing and comment.

- **Promote C&D Market Development:** The Massachusetts DEP will continue to use financial incentives such as Recycling Industry Reimbursement Credit grants and Recycling Loan Fund loans to promote development of new processing outlets and end markets for C&D materials.

- **C&D Waste Reduction Outreach:** The Massachusetts DEP will continue outreach on C&D waste reduction for the construction and demolition industries by distributing information via DEP's new C&D web page and by speaking at conferences and workshops.

- **SWAC C&D Subcommittee and Workgroups:** The Massachusetts DEP will continue to hold meetings of its SWAC C&D Subcommittee and Subcommittee workgroups on an as-needed basis.

10.5.2 California

Regulations to Recycle Building Product Waste

The information provided below is based upon a review of the California Integrated Waste Management Board (CIWMB) website and a telephone conversation with Clark Williams, from the CIWMB Sustainable Building Programme.

The main driver to encourage the recycling of building product waste in California is the 1989 Assemble Bill Legislation that set a target to reduce waste production to 50% of the existing levels by 2000. California achieved a state wide average of 48% reduction by 2002 (Williams, 2006. personal communication). The responsibility of hitting these targets lies with each local Government. Failure to reach the waste diversion target can result in fines of up to $10,000 per day for any offending local government. As the building product waste stream makes up 22% of the complete Californian waste stream this was considered a key area to focus on.

To assist in the reduction of building product waste the California Integrated Waste Management Board have initiated a number of programmes and schemes as outlined below.

The CIWMB developed a model construction and demolition (C&D) diversion ordinance (CIWMB, 2004), as required by Senate Bill 1374 (Kuehl, Chapter 501, Statutes of 2002), to assist jurisdictions with diverting their C&D waste material. Specifically, the Board was directed to:

> *"...Adopt one or more model ordinances, suitable for modification by a local agency, that the local agency may adopt that will require a range of diversion rates of construction and demolition waste materials from 50 to 75 percent, as determined by the Board, and as measured by weight."*

Jurisdictions are not required to adopt their own C&D ordinance, nor are they required to adopt the Board's model ordinance as their own by default. However, SB 1374 also added a new set of circumstances (related to C&D waste diversion) to those previously included in Public Resources Code section 41850 that the Board shall consider when determining whether to impose a fine on a jurisdiction that has failed to implement its Source Reduction and Recycling Element (SRRE).

The ordnance includes clauses to ***enforce the recycling of between 50% - 75% of wastes produced during construction and demolition projects***. The projects must provide a Waste Management Plan together with their development application. This is accompanied with a deposit relating to the size of the development or likely tonnes of waste to be produced. The deposit is only returned when the contractor provides a completed Waste Management Plan (WMP) at the end of the project

The documentation shall consist of a final completed WMP showing actual waste tonnage data, supported by original or certified photocopies of receipts and weight tags or other records of measurement from recycling companies, deconstruction contractors, and/or landfill and disposal companies. Receipts and weight tags will be used to verify whether waste generated from the covered project has been or are to be recycled, reused, salvaged or disposed. The applicant shall make reasonable efforts to ensure that all designated recyclable and reuse waste salvaged or disposed are measured and recorded using the most accurate method of measurement available. In the case of an infringement of the WMP fines must be paid by the contractor, depending upon the level of infringement (CIWMB, 2004).

State Agency Buy Recycled Campaign (SABRC)

The State Agency Buy Recycled Campaign (SABRC) is a joint effort between the California Integrated Waste Management Board (CIWMB) and the Department of General Services (DGS) to implement State law requiring State agencies and the Legislature to purchase products with recycled content. This has 12 categories of materials, the only building product included is paint and at least 50% of all budgets spent on paint must be for recycled paint. This measure will create a demand for recycled content materials.

Green Building

A green building, also known as a sustainable building, is a structure that is designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. Green buildings are designed to meet certain objectives such as protecting occupant health; improving employee productivity; using energy, water, and other resources more efficiently; and reducing the overall impact to the environment.

One element of the Green Building Programme is focused on materials efficiency and this includes:

- Selecting sustainable construction materials and products by evaluating several characteristics such as reused and recycled content, zero or low off gassing of harmful air emissions, zero or low toxicity, sustainably harvested materials, high recyclability, durability, longevity, and local production. Such products promote resource conservation and efficiency. Using recycled-content products also helps develop markets for recycled materials that are being diverted from California's landfills, as mandated by the Integrated Waste Management Act.
- Using dimensional planning and other material efficiency strategies. These strategies reduce the amount of building materials needed and cut construction costs. For example, design rooms on 4-foot multiples to conform to standard-sized wallboard and plywood sheets.
- Reusing and recycling construction and demolition materials. For example, using inert demolition materials as a base course for a parking lot keeps materials out of landfills and costs less.
- Requiring plans for managing materials through deconstruction, demolition, and construction.
- Designing with adequate space to facilitate recycling collection and to incorporate a solid waste management program that prevents waste generation.

The programme is widely publicised and has many partnerships but is currently voluntary, however the Sustainable Building Task Force is working to implement Governor Schwarzenegger's Executive Order S-20-04, which sets a goal for all new State buildings to be built to the requirements of LEED

(Leadership in Energy and Environmental Design) Silver rating. The Task Force also provides general green building guidance on State building projects.

The task force is a unique partnership of more than 40 governmental agencies, led by the State and Consumer Services Agency. It comprises representatives from various State agencies with specific fiscal, construction, and environmental policy expertise.

10.6 CANADA

The information provided below has been sourced from the Environment Canada and the Greater Vancouver Regional District websites, together with telephone conversations with Emanuel Mendoza (Environment Canada) and Craig Shishido (Buildsmart British Colombia).

The Canadian Federal Government do not regulate building product waste, all regulation and policy is developed at a regional level. One of the regions that has developed sustainable building and demolition practices is British Colombia and particularly the Greater Vancouver Regional District (GVRD). This is a partnership of 21 municipalities and one electoral area that make up the metropolitan area of Greater Vancouver and includes a population of about 4 million residents.

There are no regulatory measures to limit the disposal of building product wastes; the main driver for building waste recovery is economics. It is cost effective to take building product waste to recycling facilities rather than landfill facilities due to the relatively high cost of disposal (Canadian $7.00 – $10.00 per cubic yard). Additionally the C&D industry practices now accept recycling as an option that should be considered on all construction and demolition sites.

The flagship of the sustainable building policy is Buildsmart, www.buildsmart.ca. Buildsmart was created in January 2003 to be a resource for the design and construction industry, helping designers make smart, sustainable choices relating to the constructed environment. This innovative programme encourages the use of green building strategies and technologies; supports green building efforts by offering tools and technical resources; and educates the building industry on sustainable design and building practices.

Based on the five stages of a building's life cycle, Buildsmart present relevant green building information in the areas of:

- Design Strategies
- Construction
- Operation and Maintenance
- Retrofit and Tenant Improvements
- Renovations
- Demolition/Deconstruction

Buildsmart concentrates on the education of project/site managers, to demonstrate the economic advantages and available markets for recycled building product wastes. The Buildsmart programme also links with LEED (Leadership in Energy and Environmental Design) as LEED credits are rewarded for the recycling of waste; this is a further driver to encourage the industry to recycle the building product waste produced.

10.7 EUROPEAN UNION

The information provided below has been sourced from European Union, WRAP and other UK based websites, together with a telephone conversation with John Barritt from AggRegain (WRAP UK).

The European Union, in order to promote the recycling and reuse of C&D debris in Western Europe has established mandates for the amount of material to be recycled and a timeline to eliminate the land disposal of the material throughout its member states. The Directives are adopted and regulation is developed by member states to implement the policies of the Directives.

10.7.1 United Kingdom

Construction and demolition waste recycling is increasing in the UK due to a number of programmes and initiatives that are operating through out the industry. The need to reduce the C&D waste disposed of in the UK is due to European Directives to reduce waste and increase sustainable development. The UK has adopted these EU Directives policies and put in place a number of regulations to ensure the UK comply with the legislation.

Taxation

The UK has used taxation policy to improve the economics of C&D recycling. To increase the cost of building product waste disposal there is an inert landfill tax of £2.00 per tonne (approximately $4.50 per tonne) that was introduced with The Landfill Tax Regulations, 1996.

In addition, the Aggregates Levy was introduced in the UK in April 2002. The aim of the tax is to reduce demand for virgin aggregates, encourage the use of recycled materials and address the environmental costs associated with quarrying e.g. noise, dust, and visual intrusion. The tax applies to sand, gravel and crushed rock extracted in the UK or its territorial waters, or imported into the UK. The aggregate will become liable to the levy when it is commercially exploited, and is charged at £1.60 per tonne (approximately $3.60 per tonne). The levy does not apply to coal, clay, metals, gemstones and industrial minerals. The aggregate tax has as allowed the C&D recycling industry to be able to spend a further £1.60 per tonne on processing the recycled aggregate and therefore achieve a higher specification of product.

These two taxation policies are designed to act as a financial barrier for the disposal of C&D waste via the landfill tax, while making the recycled aggregate products more price competitive in the market place due to the tax on quarried aggregates.

Planning Policy

The Sustainable Building Task Force has recommended a regulated minimum quantity of recycled material to be used in the construction of every building in the UK. This has been adopted within Scotland as a regulation and is currently being considered in England. In the UK the Office of the Deputy Prime Minister (ODPM) has developed and released Planning Policy Guide 11 (PPG11) this reflects the requirements of sustainable development and states minimum levels of recycled material content with in developments.

The minimum content of recycled materials recommended is 10%, and this is calculated by the proportion of the materials value when compared with the cost of the total project, rather than being based upon a tonne or volume percentage. The 'value' of the material has been selected, as this will drive the demand for higher value recycled materials.

Procurement

To develop the market for recycled materials to be used in construction, Government Departments and Agencies together with Local Authorities (LA's) procurement and tendering practices have been identified as an area to focus on. The procurement and tender specifiers are recommended to stipulate a minimum percentage of recycled content for all purchases in construction projects and wider. This is seen a government leading by example and stimulating a demand for recycled materials in the market.

The procurement and tender documents cannot state what the recycled material should be, only the minimum percentage of recycled material contained. To increase the percentage of recycled material contained in a development, the recycled content percentage can be used as an assessment criterion for tenders. The use of 'recycled content' as an evaluation criterion has encouraged the construction industry to adopt the recycled content philosophy beyond the minimum percentage required. The industry has recognised that by increasing the recycled content used in their submissions and developments they can gain an advantage over their competitors when tendering for work. Organisations such as the Highway Agency and BAA (British Airports Authority) have both adopted the use of this criterion with their tender documents.

Case Study – Essex County Council, UK

May Gurney (Contractors) have exceeded all the recycling targets set by Essex County Council within their highways maintenance term contracts. In 2001/02 recycling levels were 15%, exceeding the target by 3%. In 2002/03 the target was 20% and May Gurney achieved a huge 59% recycling, generating cost savings of in excess of £150,000 ($350,000).
Source: http://www.aggregain.org.uk/case_studies/index.html

Industry

The construction industry in the UK have 'come on board' with the use of recycled aggregate and other building materials because they have realised that is cost effective to use recycled materials within in the regulatory and fiscal environment created with the taxation and planning policies of the UK.

Education and Communication

In the UK the Waste Resources Action Programme (WRAP) has established AggRegain, a free sustainable aggregates information service. AggRegain, was launched in February 2003 and, in response to users feedback, has undergone a major programme of expansion and development in 2005 to increase the range of information available. It is designed to assist anyone interested in producing, specifying, purchasing or supplying recycled or secondary aggregates. The information provided comes from a wide variety of sources from within the aggregates and waste management sectors.

WRAP is funded by landfill tax credits and this free service has played an important role in increasing quality supply of and demand for recycled and secondary aggregates by providing producers, specifiers, buyers and suppliers with a reliable, independent 'one-stop' source of information on which to base procurement and production decisions.

The AggRegain service has played a vital role in ensuring the uptake of the UK strategies and have liaised with LA's, Councillors, Council Officers, Engineers, Procurement Departments, Contractors, Consultants and Suppliers to ensure everyone is aware of the regulations and easiest ways to adopt them and promote their use.

11. ISSUES

This section of the report summarises the issues that have been identified during consultation with the industry and other stakeholders. The issues have been addressed to reflect the stages of the building cycle.

11.1 ENVIRONMENTAL IMPACTS OF RAW MATERIALS AND BUILDING PRODUCTS

The environmental impacts of the use of raw materials and building products, that can be minimise by the reuse or recycling of building product waste are summarised below by category.

Construction Materials (Quarried)

Construction materials obtained from quarries provide aggregate resources and raw materials for cement and other building and construction uses. Some of the impacts of quarrying include:

Engineering Impacts

- Change in geomorphology, accompanied by loss of habitat, noise, dust, vibrations, chemical spills, erosion, sedimentation and dereliction of the used mine site.

Cascading impacts

- Lowering of water table resulting in land collapse creating sinkholes
- Destruction of cave passages and the habitat it provides, causing the death of any creatures unable to adapt to the changes (Langer 2001).

Building Product Manufacturing

Manufactured building products can impact on the environment through their lifecycle:

Manufacturing impacts:

- The creation of greenhouse gases from the energy used during their manufacture and processing of materials.
- The potential of contamination of land, air and waterways with toxic chemicals, coating and cleaning agents.
- Dependence on non-renewable materials
- Workers using hazardous and toxic materials and processes (i.e. heavy materials in cleaning and surface coatings) may be exposed to elevate levels of risk.

Packaging and Distribution Impacts:

- The inefficient use of materials and the generation of solid waste associated with the packaging of primary building products e.g. paint tins, plastic films and strapping.
- Emissions to air associated with inefficient or polluting modes of transport.

Use impacts:

- Adverse health effects of indoor air pollution, caused by the off-gassing of some building materials and products (for example: the slow release of volatile material from woods and paints).

Disposal Impacts:

- Wastage of resources associated with disposal of large volumes of building materials that could otherwise be re-used or recycled.
- Use of landfill space and the contribution to greenhouse and air pollution with the fuel use to transport building materials and products to landfill (RMIT, 2001).

The environmental impacts associated with the unsafe disposal of building product wastes are summarised in the issues listed below.

11.2 WASTE GENERATION DURING CONSTRUCTION

The amount of waste generated during construction is significant. A large proportion of the waste produced during the construction stage of a building project is packaging waste such as; cardboard, pallets, plastic film wrap, plastic strapping, etc. The choice of material used for the packaging is also an issue. Packaging should be made of easily recyclable materials, for example rather than using plastic strapping for bricks, steel strapping can be used, as this is an easier material to recycle.

In addition a significant proportion of ‘over ordered’ materials such as bricks and sand are left at the end of construction and require disposal. This arises from a tendency for builders to over order materials to ensure they do not run out during the project, which would cause costly delays.

A study conducted by the Building Research Centre at the University of New South Wales estimated that 5% of bricks ordered for residential brick veneer housing projects become waste at the end of the project.

Another source of waste during construction is off-cuts, for example of timber and bricks. These are largely generated because the building design does not match the standard material unit size. Therefore, materials need to be cut to fit.

11.3 BIODEGRADABLE WASTE CONTAMINATION

Building rubble, bricks and concrete are generally disposed of at Class 1 (inert) landfills. Waste from building or demolition sites is generally delivered to landfill sites as mixed loads. The loads may also contain green waste, timber off cuts, packaging waste, and other biodegradable wastes.

Until recently, individual loads disposed of at inert landfills were permitted to contain up to 5% by weight of biodegradable material. However, it is difficult for weighbridge or gatehouse operators to properly ascertain the proportion of biodegradable waste in a mixed load.

The contamination of 'inert' building waste with biodegradable waste has a negative impact on the environment due to the production of leachate and greenhouse gases resulting from the biodegradation of organic material. Class I inert landfills are unlined and have no gas-extraction systems. Therefore, the inclusion of biodegradable wastes in these landfills poses a significant pollution risk to air and water quality.

The contamination of inert waste with biodegradable material has a negative impact on the economics of building waste recycling. The biodegradable waste incurs two additional costs to a recycling operator, firstly the cost of separating the biodegradable material from the recyclable material, and secondly the disposal cost of the biodegradable waste that must be taken to a Class III landfill at a cost of $40-50 per tonne. During a visit to a C&D recycling facility the site manager stated that 70% of mixed C&D waste received is recycled, but the majority of the 30% residual waste is biodegradable material and must be disposed of at a class III landfill.

Therefore for 10 tonnes of mixed inert received (10t x $14.00 per tonne = $140.00 gate fee income. 3t x $40.00 per tonne = $120.00 residue disposal cost, so a margin of $20 to recycle 7 tonne of waste.
If the mixed loads had been taken to a class I landfill the biodegradable material would have been disposed of in an unlined landfill.

Figure 11.1: Examples of Biodegradable Contamination of Mixed 'Inert' C&D Waste Received at a C&D Recycling Operation in Perth

11.4 MIXED WASTES

Most C&D waste is generated during demolition. Based on discussions with stakeholders historically the practice of most demolishers has been to remove all the material from site as quickly as possible. The easiest way of doing this was to mix everything together by bulldozing it into a pile then removing it as mixed loads. The amount of waste generated during a building construction is also significant. The waste is generally loaded into a single skip for removal from the construction site.

These practices lead to most loads of wastes generated during construction and demolition containing a mixture of materials such as concrete, bricks, tiles, steel, etc. Assuming there is no contamination of the load from biodegradable material, the combined inert materials still act as an economic barrier for the recycling of the waste due to the additional processing cost of the recycler to separate the materials. Therefore this practice indirectly encourages the disposal of building product waste produced during the construction and demolition phases to landfill.

11.5 ILLEGAL DUMPING

Building products are common components of dumped waste. The Litter Abatement discussion paper suggests this litter is caused by poor work practices, lack of appropriate infrastructure, lack of incentive or disincentives. This problem is compounded by little or no enforcement by the Department of Environment or local government and a low level of acceptance of the problem by industry (KABC, 2004).

Apart from being an aesthetic problem, illegal dumping poses environmental and public health risks. Illegal dumping is a significant issue for Western Australia for local governments, and land managers such as the Department of Conservation and Land Management, the Water Corporation and Main Roads WA. It is not known what the true economic, social and environmental costs of illegal dumping are in WA, however undoubtedly they are substantial (Litter Abatement in Western Australia 2003). The clean up costs for illegally dumped waste is generally borne by the Local Government.

11.6 ECONOMICS OF DISPOSAL VS. RECYCLING

Currently, the cost of disposal to landfill is a more cost effective and easier option for building product waste than recycling. The cost of separating mixed inert wastes and the disposal of biodegradable contamination increase the cost of building product waste recovery and recycling when compared with the cost for the disposal of mixed and contaminated wastes in inert landfills. The cost for the disposal of mixed inert waste at landfills in Metropolitan Perth can be as low as $14.00 per tonne.

For recycling facilities to economically produce a clean product that meets industry specifications, the waste received needs to be clean, source-separated loads. With inert landfill gate fees at their current low level for missed waste loads, it is unlikely a recycling facility would be able to operate at a gate fee low enough to induce builders to take the trouble to separate materials for recycling, especially on smaller projects. Mixed loads of building product waste would be more costly to separate, and would only make low grade products. Therefore, they are unlikely to be able to compete with the low cost of landfill disposal.

11.7 ECONOMICS OF RAW MATERIALS VS. RECYCLED-CONTENT MATERIALS

One of the main difficulties in establishing markets for recycled-content aggregate is the low cost of virgin aggregate. The price differential between recycled materials and virgin raw materials is currently insignificant. This is because the cost of separating and reprocessing build product materials must be incorporated into the product price for a recycling operation to remain economically viable. Therefore with no or little price differential there is no economic driver for building product consumers to change their habits and start to use recycled materials.

11.8 RECYCLING INFRASTRUCTURE

The existing building product recycling facilities in WA reprocess a small proportion of the building product waste stream. The building product recycling industry is relatively small in Western Australia

due to the high capital cost of establishment, the low economic return of operating a facility and the small market for the recycled materials produced.

The recycling industry in Western Australia would need to grow considerably if a larger proportion of building product wastes were diverted from landfill for recycling. However, provided there was a market for the products and the financial returns ensured a viable business, the industry would react and grow to accommodate the additional demand.

11.9 QUALITY OF THE RECYCLED PRODUCTS

One of the barriers to the use of recycled building materials is the unfounded perception amongst some large purchasers of aggregate, that recycled-content products are inferior, and will ultimately cost more due to higher maintenance and replacement costs. Indeed research has shown that provided the recycled materials are produced to the required specification and standard, the recycled product performs equally as well as raw materials, and in some cases the recycled materials out perform the raw materials.

11.10 MARKETS FOR RECYCLED MATERIALS

The current potential market for recycled building material, especially reprocessed aggregates is very large in Western Australia (approximately 3.6M tonnes per annum) with the current levels of construction. However, recycled building materials are often not used in these projects partly due to:

- Poor knowledge of recycled material standards and availability
- Tender or construction designs specifying the use of quarried material
- No economic advantage for using recycled materials

These issues need to be addressed to increase the use and therefore the market demand for recycled building products.

11.11 EDUCATION AND COMMUNICATION

In order to secure co-operation and engagement from the industry on implementing waste reduction and recycling practices there needs to be a high level of awareness and knowledge of these issues among industry practitioners together with information and help to facilitate waste minimisation and recycling practices. Any communication programme must include the entire industry supply chain and other stakeholders that have an influence on waste management practices. Key stakeholders include:

- Manufacturers

- Suppliers
- Designers
- Engineers
- Consultants
- Procurement Departments
- Local and State Government
- Councillors
- Builders
- Waste Management Companies

11.12 DATA AND TRACKING OF WASTE PRODUCTION AND MANAGEMENT

The data held by the DoE and in the public arena regarding the waste quantity produced, the carrier of the wastes and the final disposal or recycling operation used. This information is needed to track the wastes produced each year, so that:

- Waste production levels can be quantified and monitored, this will allow the effectiveness of waste minimisation programmes to be assessed
- Wastes can be tracked from production to final disposal or treatment, this audit trail can be used to combat illegal tipping
- The end use of wastes can be recorded to see what proportion is disposed of or recycled

The tracking of waste production, transportation and end use are important to monitor the industry's performance against waste reduction and recycling targets.

12. OPTIONS AND DISCUSSION

A number of issues have been identified in Section 10. These issues have been examined and using examples of programmes and measures from other geographic areas together with consideration of factors specific to Western Australia, the following measures have been developed. These would require further analysis to identify the priority measures that could be easily implemented and achieve rapid improvement in terms of safe disposal and recycling of building product wastes.

12.1 EDUCATION AND COMMUNICATION – A CENTRAL MEASURE

Objective

- To involve and engage industry stakeholders
- To communicate any programmes or regulatory measures
- To provide a free information service for stakeholder effected by the programmes
- To assist in the development of markets for recycled materials
- To provide funds for other programme to increase the use of recycled building materials
- To allow the DoE to concentrate on regulatory enforcement and environmental protection

Description

These measures would be central to any initiatives, programmes or targets established to promote the safe disposal and recycling of building product wastes. Without a dedicated and co-ordinated communication, education and implementation programme, with demanding but achievable targets and appropriate resources and funding, any measures that are implemented will be far less effective. All the successful programmes from other geographic areas that have been assessed included a comprehensive communication and education strategy to ensure engagement with the industry and other stakeholders.

The role of this measure would include the engagement of stakeholders and co-ordination with industry bodies and associations to develop partnership programmes. This measure's purpose would include developing links between the industry and the implementation programme team and provide a forum for the stakeholders to provide feedback relating to the development of the programme. Ultimately, the objective would be for the industry and stakeholders to embrace and have ownership of the overall objective, which is to provide safe disposal, increased recycling and sustainable development with in the construction and building industry.

One of the proven models that could be replicated is the UK's Sustainable Aggregates Programme, Aggregain that was established by the Waste Resources Action Programme (WRAP) in February 2003. It is designed to assist anyone interested in producing, specifying, purchasing or supplying recycled or secondary aggregates. The information provided comes from a wide variety of sources from within the aggregates and waste management sectors.

WRAP is funded by Landfill tax credits and this free service has played an important role in increasing quality supply of and demand for recycled and secondary aggregates by providing producers, specifiers, buyers and suppliers with a reliable, independent 'one-stop' source of information on which to base procurement and production decisions.

The AggRegain service has played a vital role in ensuring the uptake of the UK Government's strategies and have liaised with Local Authorities, Councillors, Council Officers, Engineers, Procurement Departments, Contractors, Builders, Consultants, Suppliers and other stakeholders to ensure everyone is aware of any new regulations, programmes or measures recommended in the rest of this section, and the easiest ways to adopt them and promote their use.

This model could be expanded to include other building materials e.g. Fixtures and fittings, etc, or a parallel programme could be established for other waste streams. The model also separates advice, market development and communication from regulatory enforcement. The team selected for this programme would be (or at least perceived to be) independent from the DoE, and this would leave the DoE to concentrate on enforcement and protection of the environment.

Effectiveness

In the UK Aggregain has been very effective in communicating the programmes related to recycled aggregate and ensuring a significant increase in their use within the UK.

Efficiency

This measure would require a significant long-term investment from the DoE, however this is critical part of linking any initiatives and programmes together and ensuring all stakeholders are aware of the overall programme and have a service to provide them with any information they require. This measure should be funded by the introduction of an aggregate tax or from the existing landfill levy.

Acceptability

All stakeholders are likely to support such a measure.

Enforceability

Not applicable

Compatibility with policy principles

This measure is consistent with the Strategic Direction for Waste Management in WA.

12.2 WASTE SEPARATION AND RECYCLING AS A CONDITION FOR DEMOLITION APPROVALS

Objective

- To ensure all demolition waste is separated at site and recycled or safely disposed of.

Description

This measure would require the separation of all main waste streams during any demolition process. Greenwaste is already frequently collected separately for recycling, showing that separate waste streams can be removed from demolition sites. The categories for each waste type could be:

- ***Hazardous / Biodegradable (exc Greenwaste)***
- ***Greenwaste***
- ***Bricks and Tiles***
- ***Concrete (Base, pathways, foundations)***
- ***Metals***

Effectiveness

This would provide Local Governments with the power required to impose separate waste collection from demolition sites. If implemented this would be a very effective measure to ensure demolition waste was separately collected and recycled. Local Governments would be able to stipulate which materials were recycled depending upon the local availability of recycling operations for different waste streams.

Efficiency

The cost to the DoE will depend on how the measure is implemented. The program would need to be supported with a comprehensive education and communication program (as described above in Section 12.1), which is likely to be much more expensive than the actual implementation of the measure.

Acceptability

There may be some initial resistance from some local governments, although others will support this approach. Developers will initially oppose this measure but as sites can already separate greenwaste for recycling, they have shown that this approach can be achieved.

Enforceability

This measure is enforceable through the current approvals process. How rigorously it is enforced will depend on the approving authority.

Compatibility with policy principles

This measure is consistent with the Strategic Direction for Waste Management in WA. This measure is compatible with the mission statement of the DoE.

12.3 INCORPORATE WASTE MANAGEMENT INTO DEVELOPMENT APPROVAL PROCESS

Objective

- To ensure all approved developments prepare a Waste Management Plan.

Description

This measure would be similar to the NSW "Waste Not" Development Control Plan and the CIWMB's Waste Management Plans. Along with other documentation, any application for development approval would include a Waste Management Plan outlining how the developer intends to manage waste generated during the project. The developer would need to demonstrate that proper arrangements were in place to deal with the waste generated at the development site and for how waste generated at the premises after construction is completed and the premises are in use.

The WA State government has committed to trialling the NSW "BASIX" scheme, which requires all new developments to meet certain standards for energy and water use. It is possible that waste could be included into this scheme if it were adopted permanently.

Effectiveness

In NSW, the "Waste Not" DCP has taken a number of years to implement, mainly because take-up by individual Councils has been voluntary. It has also taken some time to train both developers and approvals assessment staff on what is a satisfactory / realistic waste management plan.

Efficiency

The cost to the DoE will depend on how the measure is implemented. The program does need to be supported with a comprehensive education and communication program (as described above in Section 12.1), which is likely to be much more expensive than the actual implementation of the measure.

Acceptability

There is likely to be some initial resistance from both local government, who will have to implement the measure, and developers, who will have to comply with the measure. However, the actual extra

work involved for both parties is minimal relative to getting developments approved. There are also benefits to both Councils and developers that could help to "sell" the measure.

Enforceability

This measure is enforceable through the current approvals process. How rigorously it is enforced will depend on the approving authority.

Compatibility with policy principles

This measure is consistent with the Strategic Direction for Waste Management in WA. This measure is compatible with the mission statement of the DoE.

12.4 INCREASED ENFORCEMENT OF LANDFILL WASTE ACCEPTANCE CRITERIA

Objective

- To protect groundwater and air quality from pollution by ensuring biodegradable material is not disposed of at unlined Class I landfills
- Ensure the real disposal cost for biodegradable and hazardous wastes is realised by requiring their disposal at Class III facilities
- Removal of biodegradable contamination from 'inert' building product wastes, therefore improving the likelihood and economics of recycling the waste.

Description

This measure would involve the State government enforcing the ban on ALL biodegradable waste being disposed to inert Class I landfill. In particular, building product waste loads would need to undergo some level of sorting to remove hazardous and biodegradable wastes.

Effectiveness

It is envisaged that this measure would, over the long term, be highly effective in meeting the objective of groundwater and air quality protection, together with ensuring the real disposal cost is paid for these biodegradable materials. Indirectly this option would ensure the production of clean mixed inert wastes, which while not segregated, would improve the economics of recycling these materials and therefore assist in diverting these materials from disposal to recycling.

Efficiency

Enforcing the ban would be expensive and resource-intensive under the current prosecution system. For the enforcement of the ban to be effective, a comprehensive communications plan relating to the regulations and dedicated landfill inspectors would be required to ensure the ban was being implemented. However, after an initial period of intensive communication and enforcement it is likely that the level of inspection could be reduced.

Acceptability

This measure is likely to meet with resistance from both the C&D industry and inert landfill operators until the culture of accepting biodegradable and hazardous wastes within mixed C&D waste loads is changed and accepted as the norm. However provided the intension to enforce the ban with prosecutions and a timetable for enforcement was communicated to the industry this resistance should be minimised.

Enforceability

As mentioned above, enforcement of this measure would be resource-intensive. However providing there were mechanisms put in place to easily penalise non-compliance this would be effective. For example any biodegradable or hazardous waste found at a landfill site would lead to prosecution of the landfill operator resulting in fines or suspension of the operating license until the site was compliant. This would provide an incentive for any contaminated loads brought to the site to be rejected by the landfill operator. This would lead to a rapid change in building product waste disposal practices.

Compatibility with policy principles

This measure is compatible with the mission statement of the DoE.

12.5 BAN ON UNSORTED WASTE TO INERT LANDFILLS

Objective

- To improve the economic balance between C&D waste disposal and recycling and therefore facilitate recycling

Description

This measure would involve the State government issuing a ban on unsorted loads of waste being disposed of at landfills. In particular, building product waste loads would need to be separated prior to disposal or recycling. The categories for each waste type could be:

- ***Hazardous / Biodegradable (exc Greenwaste)***
- ***Greenwaste***
- ***Bricks and Tiles***
- ***Concrete (Base, pathways, foundations)***
- ***Metals***

This would facilitate the recycling of the majority of the wastes produced, as separated materials can be recycled more economically than mixed loads. It is envisaged that during sorting, the more valuable recyclable materials such as doors, windows and other salvageable products may also be separated out

for further processing and re-use. This measure would also ensure all biodegradable material was removed from waste loads prior to disposal in inert landfills.

Effectiveness

It is envisaged that this measure would, over the long term, be highly effective in meeting the objective. Provided the waste separation was required prior to disposal it would improve the economics of recycling these materials by passing the cost of separation to the waste producer rather than the waste recycler and therefore ensure that recycling was cost competitive with disposal.

Efficiency

Instituting the ban would require a minimal cost to DoE. However, the subsequent enforcement would be expensive and resource-intensive. For the ban to be effective, a comprehensive communications plan relating to the regulation and dedicated landfill inspectors would be required to ensure the ban was being implemented. However, after an initial period of intensive communication and enforcement it is likely that the frequency of inspections could be reduced.

Acceptability

This measure is likely to meet with resistance from both the C&D industry until the separation of wastes became accepted as normal operating practice.

Enforceability

As mentioned above, enforcement of this measure would be resource-intensive. There would also need to be mechanisms put in place to easily penalise non-compliance.

Compatibility with policy principles

This measure is compatible with the mission statement of the DoE.

12.6 INTRODUCTION OF WASTE TRANSFER NOTES (WTN)

Objective

- To reduce the incidence of illegal dumping of waste
- To provide an audit trail for waste disposal and recycling
- To provide a mechanism to track waste production
- To provide a mechanism to recording levels of recycling for any potential ‘recycling credit’ system

Description

A Waste Transfer Note (WTN) is a document which must be completed and accompany any transfer of waste between different holders. A WTN must be created for each load of waste that leaves your site. The WTN must contain enough information about the waste to enable anyone coming into contact with it to handle it safely and either dispose of it or allow it to be recovered within the law. Failure to give enough information may result in prosecution.

Waste Transfer Notes have been used in the UK since the introduction of Duty of Care with the Environmental Protection Act 1990. Companies must keep their WTN for two years and provide them to the Environment Agency for inspection upon request.

Effectiveness

This provides a very useful source of information that can be used for measuring disposal and recycling rates, waste generation and industry practice. It also provides a tool for auditing operators and prosecuting illegal waste tipping (fly-tipping).

Efficiency / cost to DoE

This is likely to be a relatively expensive measure, to gather and process the information. Electronic or on-line systems could automate the process and reduce the resources required to maintain the system.

Acceptability

WTN have been adopted and taken up by the waste industry in the UK. International companies operating in Western Australia (e.g. SITA, Cleanaway, Collex) are already using this system in the UK.

Enforceability

This measure would be difficult to enforce without extensive administration.

Compatibility with policy principles

This measure is compatible with the Waste Management Branch's data collection programme.

12.7 INCREASE ENFORCEMENT AGAINST ILLEGAL DUMPING

Objective

- To reduce the incidence of illegal dumping of construction and demolition waste.

Description

As the cost of disposal increases there will be a possible increase in 'fly tipping'. This measure involves period, high-profile "blitzes" on illegal dumping. Each "blitz" would target known problem areas for illegal dumping, particularly of building product waste. Each "blitz" would be accompanied by a media campaign advertising penalties and numbers of people fined.

One potential model for this measure is the NSW "Regional Illegal Dumping (RID) Squad". In this program, all Councils within the Western Sydney region authorised RID Squad staff to target illegal dumping on their behalf, allowing them to operate across local government boundaries. The RID Squad used a range of surveillance and investigative techniques to identify and penalise illegal dumpers.

Effectiveness

Illegal dumping is an extremely difficult problem to address. Any single measure will have limited effectiveness. However, the combination of regulation/enforcement and communication is likely to be the most effective.

Efficiency

This is likely to be a relatively expensive measure, requiring increased enforcement and a substantial level of communication. In addition, it could potentially move a substantial cost from local government to State government.

Acceptability

Illegal dumping measures are very popular with the public and with local government.

Enforceability

This measure could be implemented and enforced under the Litter Act 1979.

Compatibility with policy principles

This measure is compatible with the Strategic Direction for Waste Management in WA and with the mission statement of the DoE.

12.8 RESTRICTION ON NEW QUARRIES CLOSE TO THE PERTH METROPOLITAN REGION

Objective

- To increase the cost of raw (virgin) aggregates
- To reduce the availability of future inert landfill sites

Description

The two main economic factors that undermine recycling of building product waste are, firstly, the low cost of inert landfill and secondly the low cost of virgin aggregate materials. This measure is essentially the use of regulation to conserve bushland and land amenity by restricting the number and size of new quarries close to the Perth Metropolitan Region. However, this would have the added benefit of restricting supply of both virgin aggregate and landfill space, which is the most common use for old quarries.

It is anticipated that restricting supply would increase the cost of both virgin aggregates and landfill disposal, which should make recycling build product waste for use as aggregate more economically viable. A comprehensive Regulatory Impact Statement (RIS) would be required prior to the deliberate implementation of this measure. However, over time this may occur naturally as potential quarry sites close to Perth run out.

Effectiveness

It is difficult to assess the effectiveness of this measure without an economic evaluation and a RIS. However this policy would take a number of years or decades before it had an impact upon the rate of recycling in the Metropolitan area.

Efficiency

This measure would involve very low cost to DoE.

Acceptability

There is likely to be resistance from both quarrying and inert landfill industries to this measure.

Enforceability

This measure could be enforced through the existing approvals and licensing systems.

Compatibility with policy principles

This measure is compatible with the mission statement of the DoE.

12.9 INTRODUCTION OF AN AGGREGATE TAX ON QUARRIED (VIRGIN) AGGREGATES

Objective

- To increase the cost of raw (virgin) aggregates
- To include the 'environmental cost' of the extraction of raw materials
- To provide funds for other programme and measures introduced to increase the use of recycled building materials

Description

The Aggregates Levy was introduced in the UK in April 2002. The aim of the tax is to reduce demand for virgin aggregates, encourage the use of recycled materials and address the environmental costs associated with quarrying e.g. noise, dust, and visual intrusion. The tax applies to sand, gravel and crushed rock extracted in the UK or its territorial waters, or imported into the UK. The aggregate will become liable to the levy when it is commercially exploited, and is charged at £1.60 per tonne. The levy does not apply to coal, clay, metals, gemstones and industrial minerals.

Effectiveness

In the UK the aggregate tax has been effective in making recycled aggregate more price competitive and together with the landfill tax has provided a strong economic driver for recycling and created a demand for recycled aggregates.

Efficiency

This measure would involve low cost to DoE.

Acceptability

There is likely to be very strong resistance from the quarrying industry to this measure. It would be important to ensure all funds collected were used to promote the use of recycled aggregates, this will avoid the accusation of a green tax being used for general government spending.

Enforceability

Taxes are generally straightforward to administer and enforce.

Compatibility with policy principles

This measure is incompatible with the state government's policy of reducing the number of taxes.

12.10 LANDFILL LEVY ESCALATOR

Objective

- To increase the cost of disposal to landfill and make recycling more price competitive
- To provide a strong signal to the industry that waste disposal will only get more expensive

Description

The cost to dispose of mixed wastes to inert landfills is currently very cheap and does not reflect the true cost of the environmental legacy relating to air and water pollution and the future clean up costs of these facilities. The low cost of landfill also encourages the disposal of wastes rather than the recycling of the waste. The introduction of a landfill levy escalator would reflect the true cost of waste disposal in unlined landfills and also provide a clear signal to the industry and stakeholders that the recycling of these wastes will become more cost effective than their disposal.

An increase of $0.50 - $2.00 per year for the next ten years provides the industry and stakeholders with a clear signal that disposal is no longer an accepted practice, while providing time for the industry and stakeholder to plan and react as the levy increases. Therefore after ten years the landfill levy for inert wastes would be between $5.00 - $20.00 more than current levels.

The increased revenue can be used to fund other waste reduction and recycling programmes, or for capital infrastructure such as to provide weighbridges at all landfill sites.

Effectiveness

This would be a very effective way of increasing the cost of disposal while making recycling a more cost effective option for building wastes.

Efficiency

This measure would require no additional funding of the existing landfill levy scheme

Acceptability

The landfill industry and waste producers are likely to be opposed to this measure. However, most are aware that landfill taxes in Europe and landfill levies in most other states within Australia are already far higher than the levy in Western Australia.

Enforceability

There would require no additional enforcing than the existing landfill levy

Compatibility with policy principles

This measure is compatible with the mission statement of the DoE.

12.11 DEVELOPMENT OF C&D RECYCLING INFRASTRUCTURE

Objective

- To ensure there is sufficient recycling infrastructure to process the additional material diverted from landfill

Description

The measures adopted by the DoE will achieve a significant diversion of building waste from landfill to recycling facilities and there is a genuine concern that there will be insufficient recycling infrastructure in place to process the increased volumes.

However, as the measures will have to be timetabled for the construction, demolition and waste management industry to have time to prepare for the changes, this will also provide the recycling industry with the confidence that the industry will grow and give them time to increase their processing capacity.

Grants may be useful to stimulate and accelerate the increase in infrastructure if a shortage is foreseen; such a process is used in South Australia.

Effectiveness

Having adequate recycling infrastructure to process C&D waste would be an essential element of maximising the amount of C&D waste recycled. However, this measure would need to be supported by other measures to be effective.

Efficiency

The cost of this measure to DoE would depend on the nature of the program. Grants could be expensive. However, low interest loans could possibly be cost neutral.

Acceptability

This measure would be popular with the waste industry.

Enforceability

N/a

Compatibility with policy principles

This measure is consistent with the Strategic Direction for Waste Management in WA. This measure is compatible with the mission statement of the DoE.

12.12 MARKET DEVELOPMENT VIA PROCUREMENT AND TENDERING PROCESSES

Objective

- To create a demand for recycled materials
- For Government to lead by example

Description

To develop the market for recycled building product materials, procurement and tendering practices within Government Departments and Agencies together with Local and Regional Government are an area to focus on. There is potential to rapidly create a large demand for recycled materials using this approach.

Procurement and tender specifications released would stipulate a minimum percentage (e.g. 10%) of recycled content for all purchases in construction projects and wider. This would be seen as the Government leading by example and stimulating a demand for recycled materials.

In addition the percentage of recycled material contained can be included as an assessment criterion for tenders, therefore promoting contractors and organisations to increase the recycled content of construction project beyond the minimum requirement.

This approach has been adopted in the UK and has generated a significant demand for recycled content building products and the industry has rapidly changed its established practice to embrace this approach.

Effectiveness

This measure would be very effective in creating a demand for recycled materials in construction projects.

Efficiency

This measure would require a funding programme to communicate the strategy with all government departments including designers, engineers, Councillors, Procurement Departments and any contractors or consultants. In addition an advice service would be need to assist in the development of

these clauses for tender documents. This would be linked with the Education and Communication measure as described above in Section 12.1.

Acceptability

There may be some resistance, however a comprehensive communication programme should address any concerns and overcome any initial resistance.

Enforceability

This measure would be difficult to enforce. However, support from the Department of Premier and Cabinet, as well as Treasury and Finance, would substantially assist in achieving compliance.

Compatibility with policy principles

This measure is consistent with the Strategic Direction for Waste Management in WA. This measure is compatible with the mission statement of the DoE.

12.13 OTHER OPTIONS

Once initial measures have been introduced to address the main areas relating to the safe disposal and recycling of building product waste; waste minimisation and issues relating to product manufacture, building design and packaging can be addressed. This includes issues such as:

- Ensuring all material packaging is reusable or easily recyclable
- Construction designs minimise the production of waste due to off-cuts, i.e. specifying standard sizes
- Reviewing manufacturing processes to minimise waste production and if possible recycle any reject product

These future options would require expanding (once the measures that will have a greater impact have been suitably implemented), and would achieve further improvement throughout the entire building product supply chain.

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APPENDIX 1 – CONSULTATION LIST

Building Product Material Manufacturers
Department of Industry and Resources

Building Product Manufacturing
Department of Industry and Resources
Chamber of Commerce and Industry – Mary Ascii and Bill Fashegi
Housing Industry Association
Master Builders Association
BGC Cement
BGC Concrete
Cockburn Cement
Midland Brick

Construction Industry
Australian Constructors Association – Jim Barrett
Master Builders Association (WA) – Gavin Forster
Housing Industry Association (WA)
Reed Construction Data
Dale Alcock Homes
Gavin Construction
BGC Construction – Frank Italiano
BGC Contracting – Greg Heylen

Demolition Industry
Demolition Industry Association / Raptor Demolition – Mike Harper

Disposal / Reprocessors
Elipse Resources – Richard Kerr
Beetle Environmental – Charles Begley
All Earth Contracting and Resource Recyclers – Heidi Dauth
C&D Recycling - Adrian Lester
Collex (Jandakot Recycling) - Geoff Hodges and Darren Edis
Waste Management Association of Australia: Landfill Interest Group
Cleanaway Australia – Bill Marchbank
Geraldton Greenough Regional Council - Ron Boucher

Programmes
Cleansites Program - Justin Mowatt
Bunbury EcoHome - Sandii Rogers

Other Jurisdictions

EcoRecycle Vicotria - Jan Vandegraaf

ZeroWaste South Australia – John Blumson

Department of Environment and Conservation (DEC) – Resource NSW – Steve Mitchell

California Integrated Waste Management Board – Clark Williams – Sustainable Building Program

Canada Environment - Emanuel Menzodza

Buildsmart British Colombia (Canada) - Craig Shishido

Waste & Resources Action Programme: Aggregain (UK) – John Barritt