Industrial Waste Identification and Opportunity Analysis for Geelong Manufacturers

Main Report

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Prepared by
Meinhardt Pty Ltd

In conjunction with
ECORECYCLE VICTORIA
CITY OF GREATER GEELONG
BARWON REGIONAL WASTE MANAGEMENT GROUP
ALCOA WORLD ALUMINA AUSTRALIA
GEELONG CEMENT
ENVIRONMENT PROTECTION AUTHORITY

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FOREWORD

This report has been prepared by Meinhardt (Vic) Pty Ltd on behalf of the Geelong Manufacturing Council. It is a companion report to the summary report *Profiting from Waste Minimisation: Opportunities for Geelong Manufacturers*

This report details work undertaken by Meinhardt (Vic) Pty Ltd for the Geelong Manufacturing Council to identify opportunities for Geelong manufacturers to increase productivity by reducing and reusing waste.

Information contained in this report is current as at October 1999.

On behalf of
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EXECUTIVE SUMMARY

NEED FOR THE PROJECT

The Geelong Manufacturing Strategy and Action Plan identified industrial waste management and reuse as a key area requiring detailed analysis and consideration. Geelong has a strong manufacturing base, and improving the efficiencies of businesses through waste minimisation and reuse will serve to strengthen the Geelong and Victorian economy.

Each year, Geelong manufacturers dispose of over 65,000 tonnes of general solid waste and over 15,000 tonnes of prescribed and special wastes to landfill. Landfill waste disposal fees, transport and the introduction of a levy for disposal of prescribed to landfill will bring the cost of waste management for Geelong manufacturers to approximately $3.5 million to $4.6 million each year. These figures only reflect waste disposal costs and do not count various hidden costs such as:

- Lost production materials that leave the factory as waste rather than as products.
- Energy, water, labour, equipment times and other process costs invested in materials that are wastes.
- Costs of storing, transporting and handling waste materials both before and after they become waste.

The costs of waste disposal is often a small part of the total cost of waste to manufacturers. The study found examples where the cost of disposal was less than 1% of the full costs of the waste.

Through waste reduction and reuse, Geelong manufacturers have the opportunity to turn the current 'lose-lose-lose" situation into a "win-win-win" scenario where they win through reducing waste costs, win through reuse of wastes, and the community and environment wins through reduced pollution and resource conservation.

The Geelong Manufacturing Council, Barwon Regional Waste Management Group, City of Greater Geelong, EcoRecycle Victoria, Environment Protection Authority and participating manufacturers have a role in promotion of waste reduction and minimisation and fostering a change in the way that Geelong manufacturers and the wider community view and manage waste.

The following principals can be used to increase productivity through waste reduction and more efficient use of resources:

- Waste minimisation;
- Cleaner production;
- Eco-efficiency;
- Industrial ecology.

PROJECT APPROACH AND FINDINGS

This project identified and assessed opportunities for the Geelong Manufacturing Council and cooperating groups to facilitate and foster change through promotion, education, incentives, and facilitated waste exchanges.

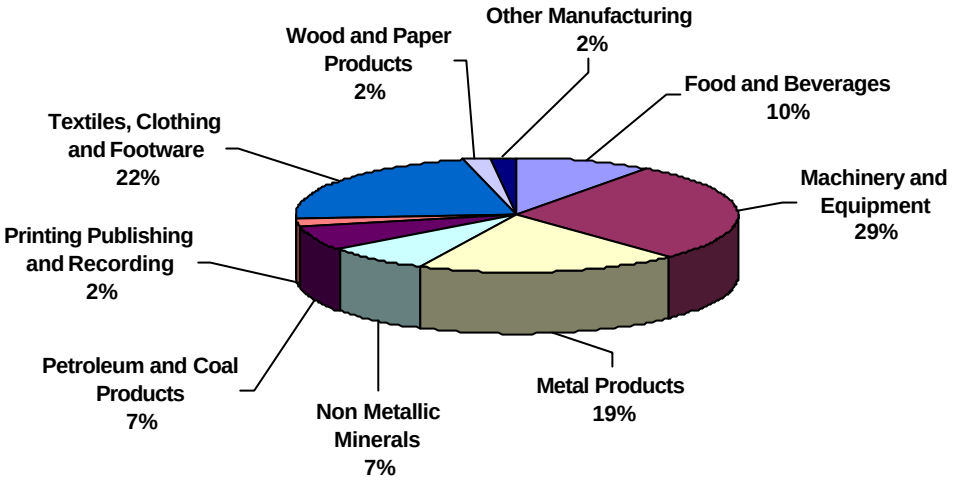
The Geelong Manufacturing Council represents approximately 500 manufacturing businesses employing approximately 15,000 people. For the purposes of this project all manufacturers have been placed in one of the following industry sectors:

- Food and beverages;
- Machinery and equipment;
- Metal products;
- Non metallic minerals;
- Petroleum and coal products;
- Printing, publishing and recording;

- Textiles, clothing and footwear;
- Wood and paper products.

Figure E1 shows the percentage of the total manufacturing workforce employed by each industry sector.

FIGURE E1 - EMPLOYMENT BY INDUSTRY SECTOR



Surveys, site visits and literature research undertaken for this project identified the main waste types generated by Geelong manufacturers. Many wastes are generated by all manufactures in Geelong while others are only generated by businesses within certain manufacturing sectors. Wastes common across all sectors include cardboard carton and packaging, paper, timber pallets and crates, plastic packaging and staff wastes.

The main waste types from the food and beverage sector include organic materials (including animal, animal product, fruit, vegetable and grain processing wastes, reject packaged food wastes and sludges) and plastic and steel buckets/tubs/drums/containers.

The machinery and equipment sector in Geelong employs approximately 25% of all employees in the Geelong region employed by the manufacturing sector. Major wastes generated include scrap (sheet, wire, redundant equipment) and swarf metals, foundry sand, plastics, and oils and oily sludges.

The main waste types from the metal products sector were identified as scrap metals (sheet metal, swarf, wire, heavy metals (zinc)), welding rods, paints/coatings/sludges, fly ash, bottom ash and casting pots.

Waste glass, contaminated sludges, contaminated/reject polymers, non-specification materials (lime), and fly and bottom ash are generated by businesses in the non-metallic minerals sector.

The main types of processing wastes from the petroleum and coal products sector were identified as acrylic polymer solution/cake, sodium hydroxide solution, oil contaminated soil, spent cracking catalyst, alumina, spent caustic, filter bags and drum liners.

There is a range of manufacturers within the Geelong area producing printing, publishing and recording products. The main sources of processing waste from this sector include paper, waste ink, solvents and ink/solvent sludges, printing plates, and containers and packaging

The main waste types from the textile, clothing and footwear sector includes synthetic and synthetic blend fibres and off-cuts, natural fibres, wool scouring waste, end spools (yarns/threads), leather/'skins', plastic extrusions.

Waste generated by businesses in the wood and paper products sector includes timber off-cuts and sawdust, scrap metal, resins/glues, and fabric, foam and plastic (from furniture manufacture).

Numerous promising examples of, and opportunities for, waste reduction, reuse and exchange have been identified. The feasibility of a number of opportunities has been assessed. In assessing options, consideration has been given to factors that are likely to influence the acceptability, success, and rate of adoption of innovations, including the following:

- Cost;
- Benefit/reward;
- Risk;
- Simplicity;
- Compatibility with existing practices;
- Trialability;
- Visibility;
- Other priorities.

There are many opportunities for industrial waste exchange in the Geelong area. Both company-specific and general/collective opportunities have been identified and assessed, with recommendations being made about the feasibility of the opportunities in terms of cost benefits and immediate practicality and ease of implementation.

Table E1 summarises the most feasible opportunities for waste exchange by Geelong manufacturers. Each opportunity has been prioritised and a comment made as to the extent of assistance from the Geelong Manufacturing Council, City of Greater Geelong or Barwon Regional Waste Management Group for this opportunity to occur.

TABLE E1 - WASTE EXCHANGE OPPORTUNITY PRIORITIES

OPPORTUNITY	PRIORITY	COMMENT
Geelong Wool Combing Composting	High	This operation already exists and therefore does not necessarily require input from the Geelong Manufacturing Council to expand.
Bioremediation at Alcoa World Alumina Australia	High	This operation has recently commenced; the Geelong Manufacturing Council may facilitate the involvement of other manufacturers.
Bioremediation trial Shell	High	It is recommended that the Geelong Manufacturing Council facilitates and promotes outcomes of this trial.
Foundry sand reuse	High	This opportunity is likely to require some facilitation by the Geelong Manufacturing Council for it to occur.
Waste exchange	High	The establishment of a non-prescribed waste exchange facility will need the support of the Geelong Manufacturing Council, City of Geelong and Barwon Regional Waste Management Group.
Education	High	Ongoing promotion of waste reduction and exchange will be required to build upon the successes of this project.
Non-returnable pallet reuse	Medium – High	This opportunity will require support from the Geelong Manufacturing Council, City of Geelong and Barwon Regional Waste Management Group for it to occur.
General untreated timber	Medium – High	Requires input from the Geelong Manufacturing Council in the form of promotion of existing transfer stations.
Textile waste	Medium	Facilitation by the Geelong Manufacturing Council is likely to encourage individual businesses reduce textile

OPPORTUNITY	PRIORITY	COMMENT
		waste generation.
Marketing of composting and bioremediation expertise	Medium	The Geelong Manufacturing Council is in a good position to promote this expertise, especially to other regional manufacturing councils.
Organic fuels and stock feeds	Medium	The Geelong Manufacturing Council and Barwon Regional Waste Management Group are likely to be required to facilitate the implementation of this opportunity.
Foundry sand reuse demonstrations	Medium	This opportunity is likely to require facilitation from the Geelong Manufacturing Council to occur.
Oil and solvent reuse, recycling and energy recovery	Medium	A number of companies presently collect waste solvents and oils for use as fuel; hence additional support from the Geelong Manufacturing Council is not essential.
Exchange of acids and alkalis	Medium	Beyond informing businesses of the opportunity to exchange acids and alkalis; no ongoing support from the Geelong Manufacturing Council is required.
Brokerage and diversion facility for textiles	Low – Moderate	Input from the Geelong Manufacturing Council is not essential in this instance.
Catalyst reuse	Low – Moderate	Again input from the Geelong Manufacturing Council is not essential in this instance.
Side-line products from scrap (textiles)	Low – Moderate	The Geelong Manufacturing Council may be required to encourage businesses to consider this option.

It is recommended that the project steering committee invite relevant sectors and individual companies to participate in trials of the opportunities identified above.

INDUSTRY WORKSHOP

An industry workshop was conducted to present the outcomes of the project and to invite manufacturers to investigate how their companies might benefit from waste minimisation and exchange. The workshop was attended by over 30 representatives from the manufacturing sector, as well as participants from private waste management and recycling companies, Regional Waste Management Groups, Local Government, EcoRecycle Victoria, EPA, Deakin University. The workshop involved presentations of opportunities for manufacturers to minimise and exchange waste, and two workshop sessions in which participants identified and further developed opportunities for waste minimisation and exchange of major waste types. Both a survey distributed to participants and comments made at the workshop indicated a high level of willingness by participants to be involved in manufacturing working groups aimed at waste minimisation and exchange. Many also indicated a willingness to work with the Barwon Regional Waste Management Group to become Waste Wise businesses.

Drafts of the case study sheets prepared as part of the project were distributed at the workshop. These provided demonstrations of manufacturers within the Region that have increased productivity through waste minimisation and exchange.

THE NEXT STEPS

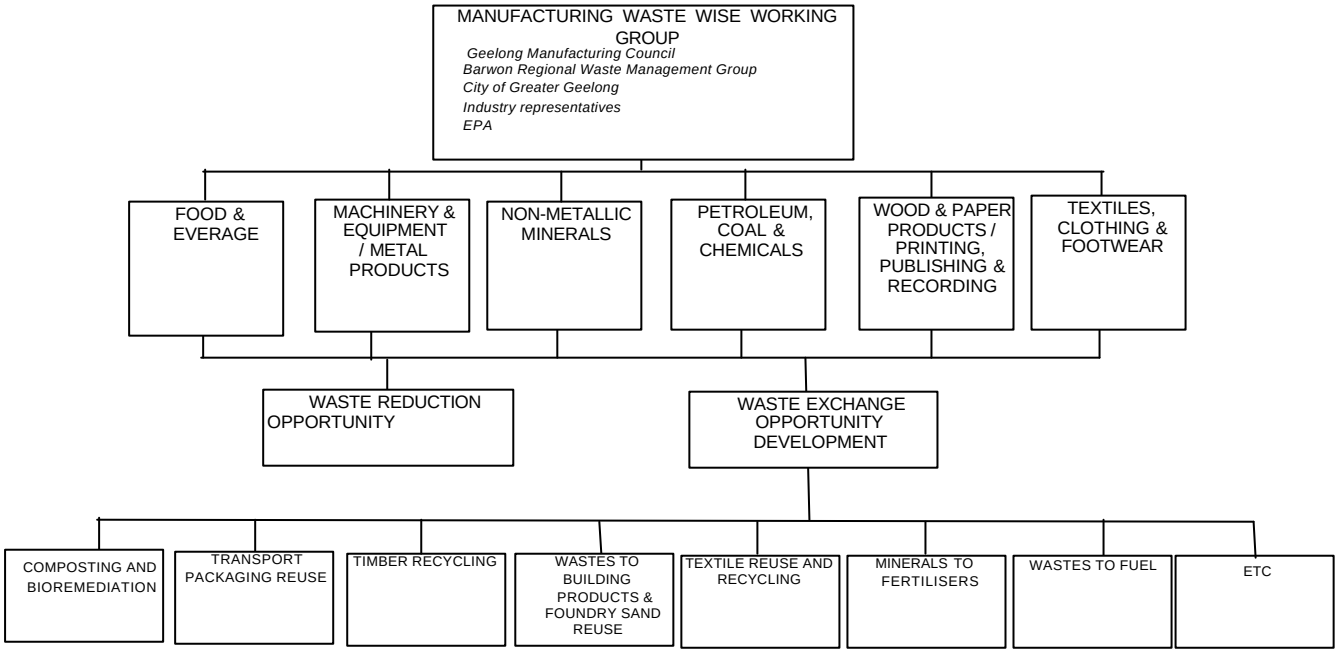
It is recommended that the project steering committee formally establish a Waste Wise Manufacturing Working Group to:

- Further develop and support feasibility trials of identified opportunities for waste minimisation and exchange by inviting businesses and sectors to become involved.
- Further publicise the outcomes of the project and the potential benefits for Geelong manufacturers.
- Provide assistance and support to manufacturers wishing to trial or implement waste minimisation and exchange initiatives.
- Promote Waste Wise business practice, and accreditation of Geelong manufacturers as waste Wise businesses.

- Facilitate links between waste generators and those that have actual or potential use for them.
- Facilitate communications and coordination between manufacturers to prevent unnecessary duplication of work.
- Maintain a register of companies that are adopting or are interested in adopting Waste Wise practices.
- Maintain a register of companies and information resources that can help businesses wanting to adopt Waste Wise practice.

It is recommended that the Working Group facilitate the formation of manufacturing sub-groups to develop and promote both waste minimisation by sectors and waste exchange between sectors. A proposed structure for the sub-groups is shown in Figure E2.

FIGURE E2: PROPOSED STRUCTURE FOR MANUFACTURING SUB-GROUPS



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1. INTRODUCTION

The Geelong Manufacturing Strategy and Action Plan identified industrial waste management and reuse as a key area requiring detailed analysis and consideration. Geelong has a strong manufacturing base, and improving the efficiencies of businesses through waste minimisation and reuse will serve to strengthen the Geelong and Victorian economy. Improving the management of commercial and industrial waste has also been identified as a priority item by the Barwon Regional Waste Management Group if the region is to achieve waste reduction targets.

The Geelong Manufacturing Council, with the support of EcoRecycle Victoria, City of Greater Geelong, Environment Protection Authority, Alcoa World Alumina Australia, Geelong Cement, Barwon Regional Waste Management Group and other Geelong industries, has commissioned a "pre-feasibility" study to identify possible opportunities for Geelong manufacturers to minimise and reuse wastes and promote waste minimisation and reuse to Geelong manufacturers. This report details work undertaken in the first stages of the study.

The project involved the following stages:

- Advertising and promoting the project to Geelong manufacturers, through the Geelong Advertiser, and inviting local manufacturers to contribute examples of best practice and ideas for waste minimisation, reuse and exchange;
- Conducting a general survey of all 500 manufacturers in Geelong to identify the types and amount of industrial waste generated in Geelong and current disposal pathways;
- Conducting a targeted survey and visiting the ‘top 50’ manufacturers in Geelong to identify best practice case studies and further identify opportunities for waste reduction and exchange. Appendix A contains an summary of all 50 site assessments undertaken for this project and Appendix B contact details for each of these manufacturers;
- Identification and review of waste management options for particular wastes and industrial sectors through a review of literature and consultation with experts such as the EPA’s Cleaner Production Unit.

One of the outcomes of this project is the preliminary assessment and scoping of feasibility studies and identification of opportunities for waste reduction and reuse by Geelong manufactures capable of immediate adoption. Best practice case studies will also developed and the outcomes of the project presented to Geelong manufacturers at a stakeholder seminar and workshop.

2. ACHIEVING WASTE MINIMISATION: KEY PRINCIPLES AND APPROACHES

2.1 BACKGROUND: TURNING "LOSE-LOSE-LOSE" INTO "WIN-WIN-WIN"

Each year, Geelong manufacturers pay for the landfill disposal of over 65,000 tonnes of general solid waste at a cost of over $2 million. Geelong manufacturers also landfill over 15,000 tonnes of prescribed and special wastes, at a cost of over $557,000 per year. These costs are for landfill gate fees alone. Waste transport costs for industrial solid wastes in Geelong are typically $10 to $25 per tonne depending on volumes, wastes types and distances to landfill, adding in the order of $800,000 to $2 million to the annual waste disposal bill.

The costs of waste disposal continue to rise, and in July 1999 the cost of disposing of prescribed waste increased by $7 per tonne due to the introduction of a levy for prescribed waste landfilled. This added a further $150,000 to the annual waste disposal bill. The total industrial waste management bill by the end of 1999 will be in the order of $3.5 to 4.6 million for all Geelong manufacturers.

Available airspace at landfills licensed to receive prescribed wastes is rapidly running out in the Melbourne/Geelong areas and prescribed waste disposal charges can be expected to rise rapidly over the next ten years, probably to levels in the order of $60 to $80 per tonne in real terms. This potentially adds $375,000 to $675,000 per year to Geelong manufacturers' costs, bring the total annual bill to at least $3.9 million and as much as $5.3 million.

The cost of general landfill also continues to increase as physically suitable landfill sites become scarce and more adequate environmental protection measures are required. Public opposition to the location of landfills near their community increases the scarcity of suitable sites.

The costs of waste to manufacturers are often two-fold. Often the waste being disposed represents lost product, such as off-cuts of material, or spoiled or obsolete stock. This means that manufacturers are "buying in" material that become waste and then paying again for its disposal. This represents a "lose-lose" situation. The environment also loses because of wasted resources and increased pollution, making it a "lose-lose-lose" situation.

Through waste reduction and reuse, Geelong manufacturers have the opportunity to turn the current 'lose-lose-lose" situation into a "win-win-win" scenario where they win through reducing waste costs, win through reuse of wastes, and the community and environment wins through reduced pollution and resource conservation.

There is a worldwide trend for manufacturers to improve their productivity and reduce their impacts on the environment. Some leading businesses have committed themselves to waste reduction targets, with eventual aims of "zero" waste. Industries adopting waste minimisation practices have increased their productivity by increasing product per unit of input and reducing waste costs per unit of product. Geelong manufacturers have the challenge and opportunity to remain internationally competitive through innovations that reduce waste and make the most out of resources.

2.2 WASTE REDUCTION AND REDEFINITION - FROM "WASTE" TO "BY-PRODUCT" TO "PRODUCTION INPUT"

2.2.1 Overview

The achievement of greater productivity through waste reduction and more efficient resource use may require a change in thinking about production and the adoption of some new production practices. Traditionally, waste has been thought of as an inevitable by-product of manufacturing. However, many companies adopting waste minimisation are committing themselves to the ultimate goal of zero waste. This does not mean that they will generate no by-products at all but rather, through waste minimisation, they will produce fewer by-products, find uses for their by-products or even change their production processes so that they produce different and more useful by-products.

The achievement of these aims requires some understanding of the following principles.

2.2.2 Waste Minimisation

The concept of waste minimisation can be best described through the 'Waste Hierarchy' as illustrated in Figure 2.1. The components of the hierarchy are listed in order of preferred adoption.

FIGURE 2.1 WASTE MANAGEMENT HIERARCHY

- **Waste Avoidance**

Adopting practices that prevent the generation of waste at the source. This can take the form of substituting raw materials and changing production processes so that no waste is generated at all, or using bulk refillable packaging.

- **Waste Reduction**

Adopting practices that reduce waste. For example, improving housekeeping practices and production efficiency.

- **Waste Reuse**

Replacing the mentality of 'buy it, use it and throw it away' with 'buy it, recondition it and use it again'. For example, reusing waste office paper for packaging products.

- **Waste Recycling or Reclamation**

Reprocessing wastes so that valuable components of the waste are reclaimed for use in new articles or other processes.

- **Waste Treatment**

Reducing the toxicity and/or quantity of unavoidable wastes such that its impact on human health and the environment is minimised. This requires developing effective waste treatment facilities (preferably on site) for the management of process wastes.

- **Waste Disposal**

The disposal of waste is the last resort for dealing with waste and needs to be undertaken in a manner that reduces the potential impacts to human health and the environment posed by the pollutant and waste. Waste disposal most commonly involves landfill.

2.2.3 Cleaner Production

Historically, the management of waste has typically comprised of "end-of-pipe" methods. In other words, wastes were seen as something that was inevitable that had to be treated after the fact. The concept of Cleaner Production is an "front-of-pipe" or "upstream" approach; Cleaner Production requires a holistic approach to the management of waste and conservation of resources. It involves considering how waste, energy and staff time can be reduced at all stages of the production process.

Businesses adopting the principles of Cleaner Production have obtained substantial savings and have achieved greater efficiency. Improvements are often made at no or minimal cost.

The concept of Cleaner Production can be applied to all facets of the business entity including:

- **Processes**
  - Conserving raw materials;
  - Conserving energy;
  - Eliminating the use of toxic raw materials;
  - Reducing the quantity and toxicity of emissions and wastes;
  - Increasing staff productivity.
- **Products**
  - Reducing negative effects of the product throughout its life cycle.
- **Services**
  - Incorporating environmental concerns into designing and delivering services.

Potential areas of cost saving include:

- Waste disposal bills;
- Discharge licence fees;
- Raw material use;
- Energy consumption;
- Staff time.

2.2.4 Eco-Efficiency

Eco-efficiency is about improving productivity whilst progressively minimising the impact of processes on the environment. It typically involves the adoption of waste minimisation and cleaner production principles. Figure 2.2 illustrates opportunities for businesses to use waste minimisation to increase profits.

Figure 2.3 shows the flow of materials and waste generation from the production of manufactured products. This shows that waste is typically generated at every stage of the production process. Figure 2.4 shows the same figure, but with strategies to avoid, reduce, reuse, recycle and recover wastes. In addition to reducing wastes, such strategies reduce material and energy required per unit of product.

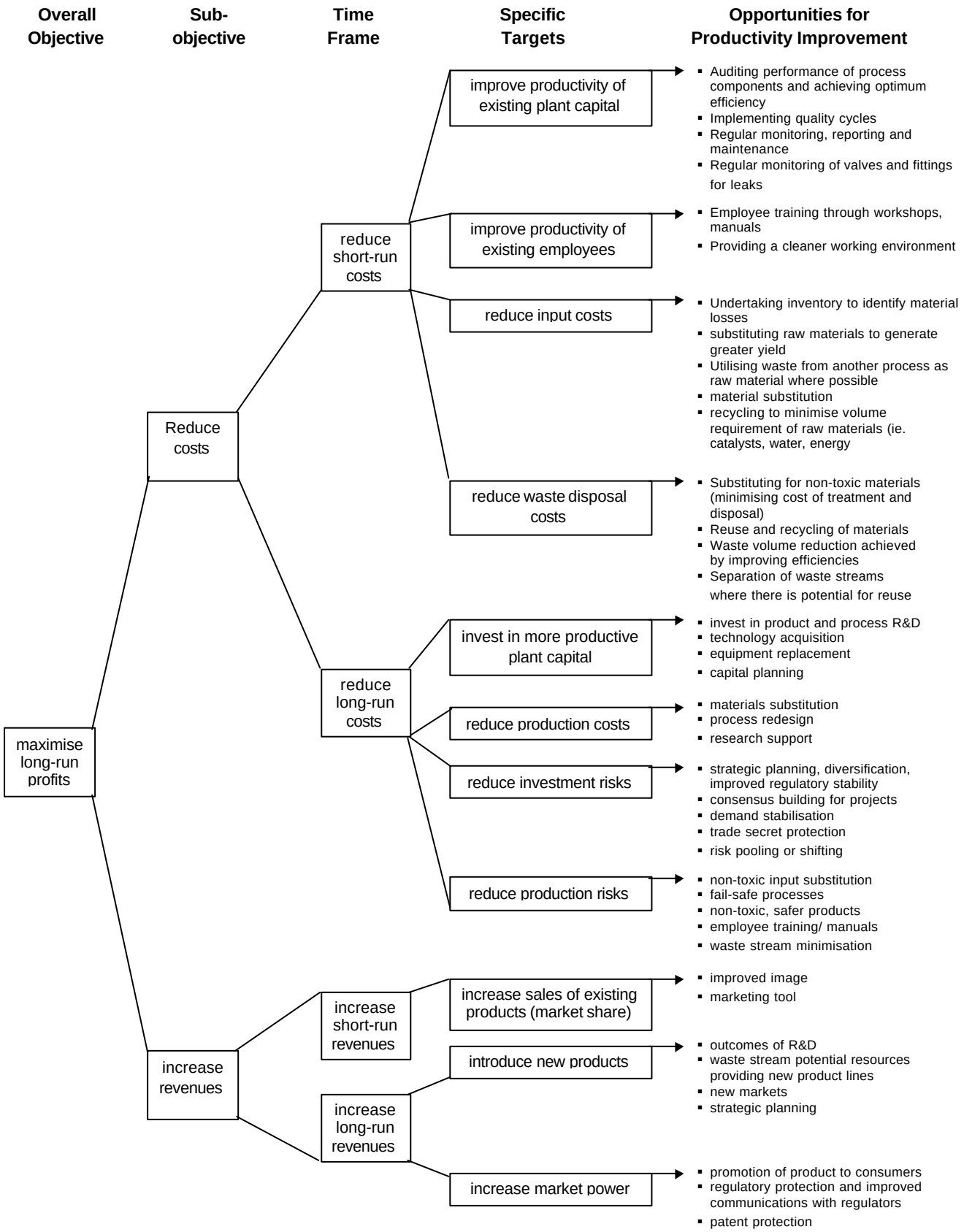
Increases in productivity have typically resulted in greater depletion of natural resources and greater generation of waste. However, improving productivity is about generating profit through increased productivity and achieving cost savings through efficiency. Achieving eco-efficiency requires a collaboration of change including technological, organisational goals and daily 'shop floor' practices that encompass environmental and human concerns and in turn provide economical gains.

Achieving Eco-efficiency can be achieved through Cleaner Production and may include minimising the use of raw resources whilst increasing yield through replacement, recycling and waste minimisation incentives, for example water and energy conservation. The World Business Council for Sustainable Development has identified seven components of Eco-efficiency:

1. Reducing material intensity of goods and services;
2. Reducing energy intensity of goods and services;
3. Reducing toxic dispersion;
4. Enhancing material recyclability;
5. Maximising sustainable use of renewable resources;
6. Extending product durability;
7. Increasing the service intensity of goods and services.

(Source: Eco-efficiency and Cleaner Production Homepage http://www.environment.gov.au/epg/environet/eecp)

FIGURE 2.2 – WASTE MINIMISATION OPPORTUNITIES FOR BUSINESSES TO INCREASE PROFITS



Adapted from R Socolow et. al (1994) Industrial Ecology and Global Change, Cambridge University Press.

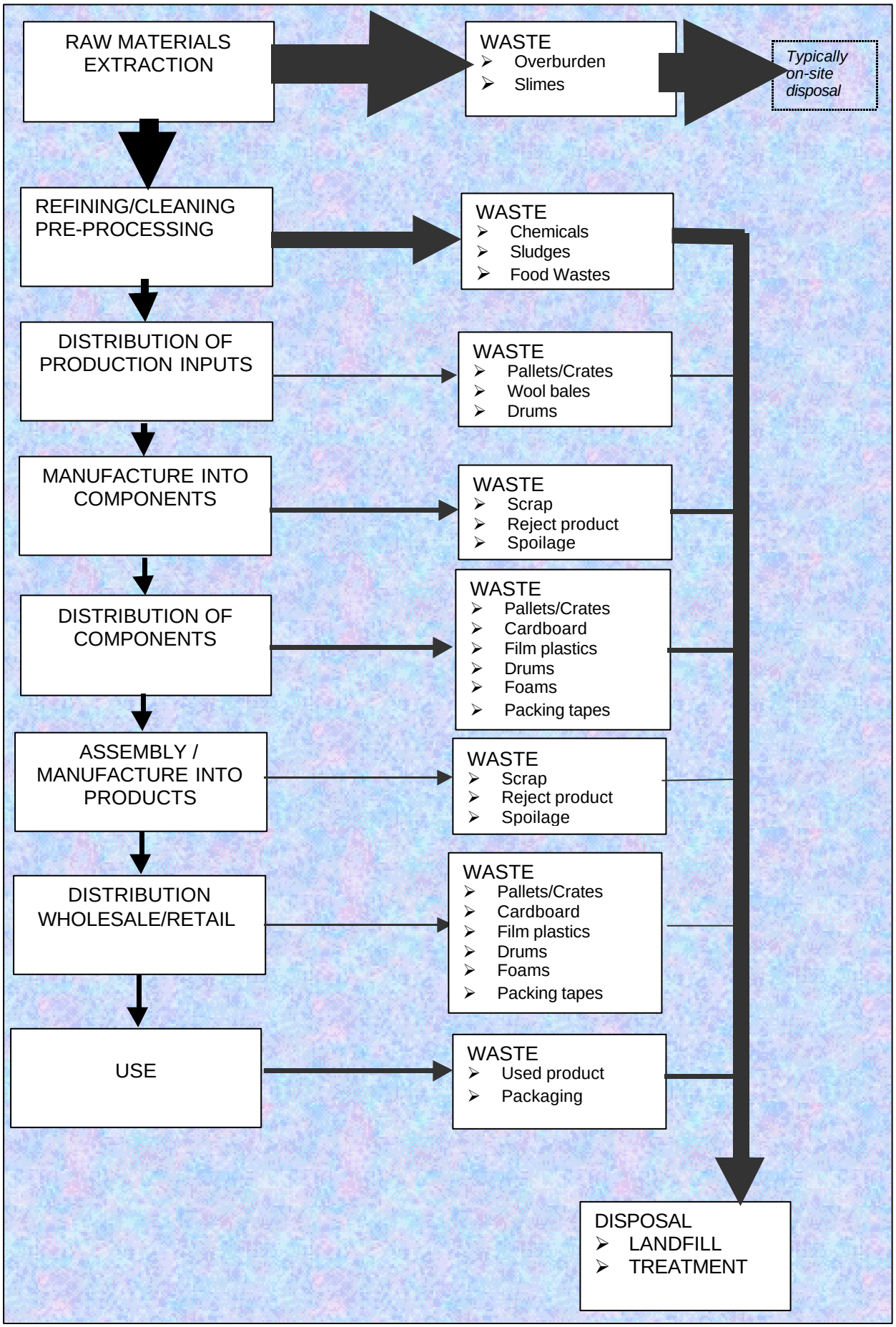


FIGURE 2.3 - SOURCES OF WASTE FROM MANUFACTURING AND "TRADITIONAL" DISPOSAL

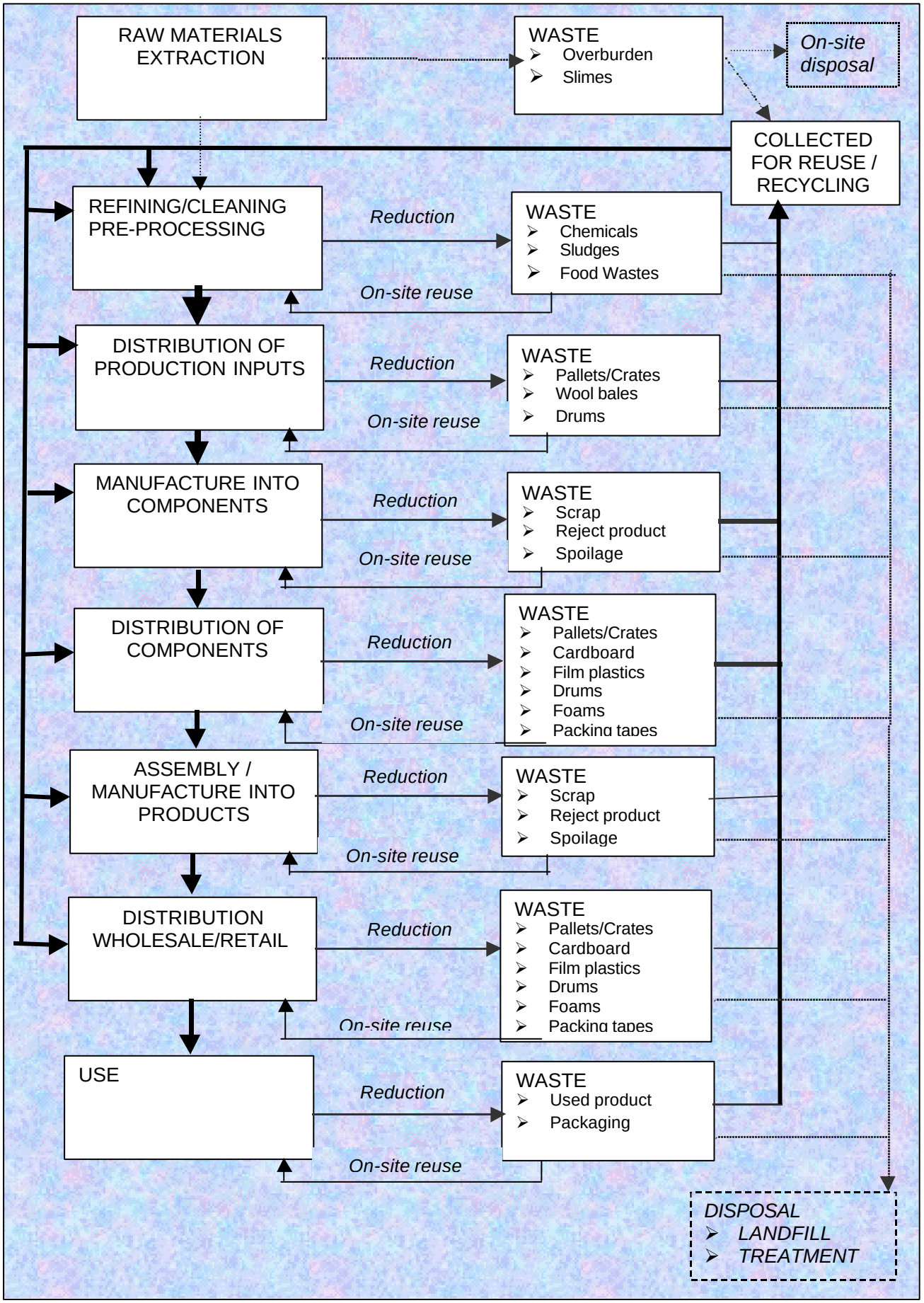


FIGURE 2.4 - RESOURCE MANAGEMENT OF MANUFACTURING WASTE USING WASTE REDUCTION, REUSE AND RECYCLING

2.2.5 Industrial Ecology

While waste minimisation, Cleaner Production and Eco-efficiency are strategies for individual companies, Industrial Ecology is about expanding these concepts to "communities" or "clusters" of manufacturers so that they collectively reduce and reuse wastes, and "close the loop" by purchasing recycled and other products from other members of the group. The aim of Industrial Ecology is emulate natural ecosystems where wastes (or by-products) from one organism are used by another.

The challenge to those participating in an "Industrial Eco-System" is to identify and exploit opportunities for symbiotic relationships. Opportunities can include:

- Reuse of each other's wastes, including longer term planning to substitute materials and/or modify production processes to generate or receive more useful wastes;
- Collective purchasing to influence suppliers to provide materials in ways that reduce waste (eg. returnable transport packaging);
- Collective recycling, where many small loads are consolidated into an larger "economic" load that either a recycler/reuser will collect or receive; or are processed by a central plant established by the cooperating manufacturers;
- Sharing of expertise and information resources to promote collective reduction in waste management costs;
- Recovery of waste heat and energy;
- Purchasing policies to favour products produced from other participating firms.

Examples of Industrial Ecology in action can be found across the Geelong region. Blue Circle Southern Cement, for example, currently use waste carbon from Alcoa World Alumina Australia as part of its fuel requirements. Geelong Wool Combing have established a composting operation to treat wastes generated during wool scouring activities. Waste from the timber industry and some tannery wastes are used in the composting process. Riverside Textiles, who are associated with Godfrey Hirst, are using recycling systems and programs developed by Godfrey Hirst.

Participants in an Industrial Eco-system can be broader than just manufacturers. Other businesses sectors such as primary producers and service sector businesses can also be involved in resource reuse and co-operative purchasing. Participating businesses can promote their involvement and the environmental and social benefits to their community to market products and services, and receive support for proposed developments. An advantage of industrial ecology is that the money for any payments by one participant to another for providing or receiving waste is kept within the cluster, strengthening the local economy.

The theoretical, long-term, aim of Industrial Ecology and the other waste minimisation principles is the virtual elimination of waste. This transition from current inefficient and wasteful processes to "eco-efficient" resource use is illustrated in Figures 2.5 and 2.6. These show that under an eco-efficient, ecological industrial system most materials are retained in circulation and energy consumption is reduced.

Although this may all seem theoretical and idealistic, companies are making real progress. For example, Alcoa World Alumina Australia/KAAL's Point Henry plant, through a commitment to waste reduction and environmental improvement, has reduced its waste to landfill from 36,000 m^3 to 800 m^3 per year in under eight years, and continues to make improvements. Other companies including Geelong's Ford, Pilkington, Rohm and Haas, Godfrey Hirst, Quiksilver, Geelong Wool Combing and Beaumont Pies, to name a few, are also making progress. This report identifies and develops opportunities for facilitating waste minimisation

and expanding the number of businesses involved in profitably reducing and reusing waste.

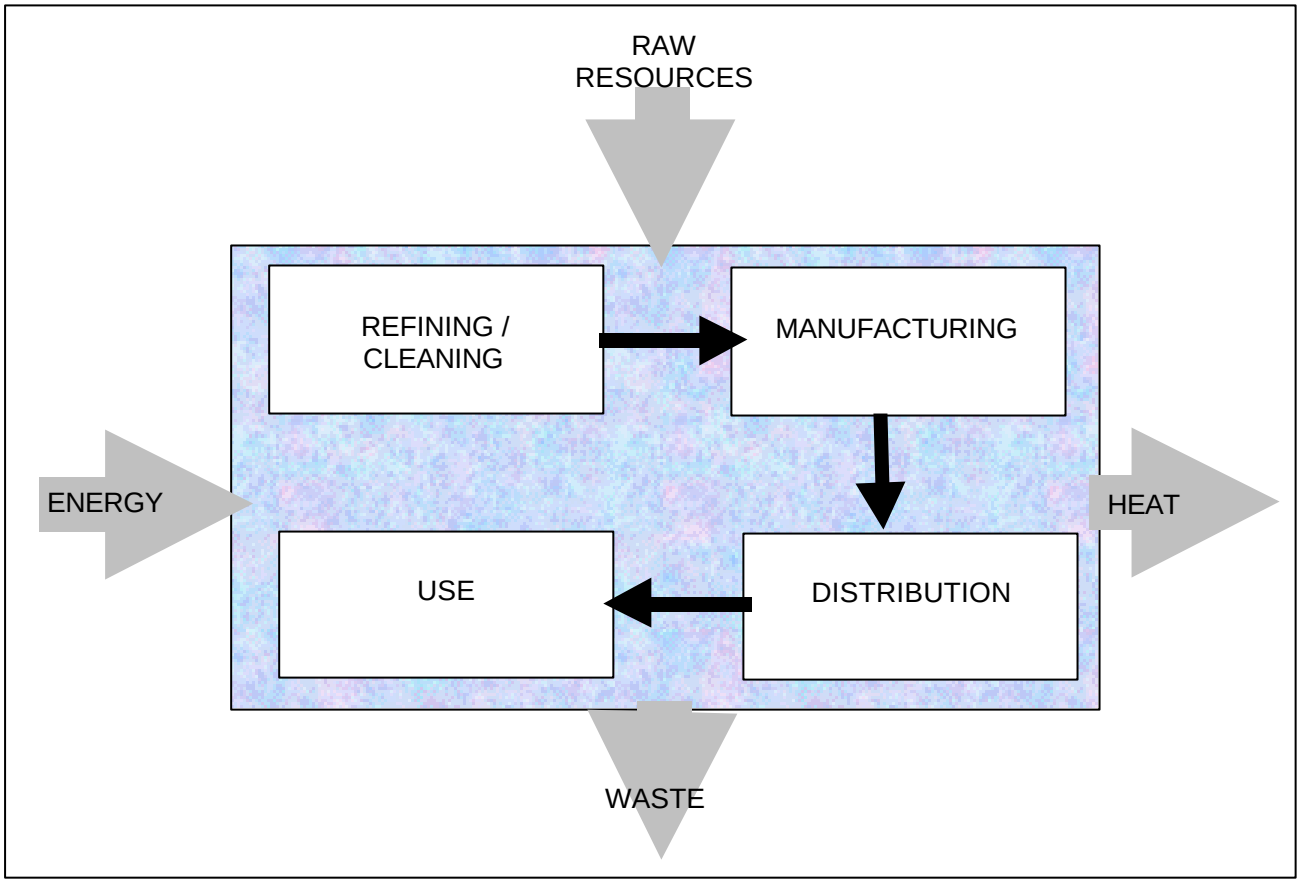


FIGURE 2.5 - "TRADITIONAL" INEFFICIENT AND WASTEFUL RESOURCE USE

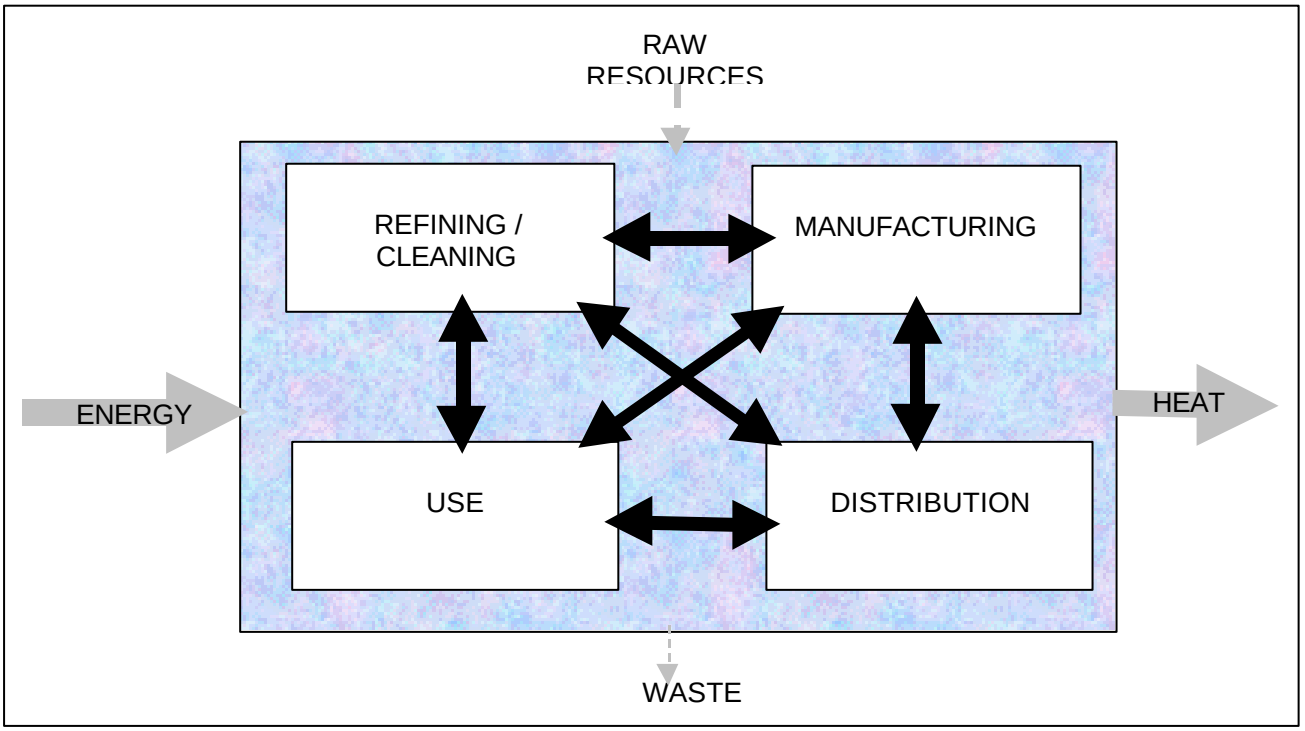


FIGURE 2.6 - "ECO-EFFICIENT" RESOURCE USE ACHIEVED THROUGH WASTE MINIMISATION (REDUCE, REUSE, RECYCLE) AND "INDUSTRIAL ECOLOGY" PRINCIPLES

2.3 FOSTERING CHANGE

The Geelong Manufacturing Council, Barwon Regional Waste Management Group, City of Greater Geelong, EcoRecycle Victoria, Environment Protection Authority and participating manufacturers have a role in promotion of waste reduction and minimisation and fostering a change in the way that Geelong manufacturers and the wider community view and manage waste.

To assist this role, key outcomes of this project have included the identification of:

- Best practice and good examples of waste reduction and reuse that have been adopted by Geelong manufacturers;
- The most viable waste reduction, reuse and exchange options for Geelong manufacturers, including the identification of specific manufacturers that could benefit from involvement in waste reduction and exchange initiatives;
- Roles for the Geelong Manufacturing Council and other key players to facilitate and foster change.

Written Best Practice case studies have been prepared and will be used to promote waste reduction and reuse initiatives. Copies of these case studies can be obtained from EcoRecycle Victoria.

It is anticipated that following completion of this project a number of Geelong manufacturers will be invited to participate in trialing waste reduction and exchange opportunities identified in this report.

This project identifies and assesses opportunities for the Geelong Manufacturing Council and co-operating groups to facilitate and foster change through promotion, education, incentives, and facilitated waste exchanges. Consideration has been given to factors that are likely to impede or promote adoption of initiatives, and the roles that the group can take to overcome or foster these factors respectively.

3. PROFILE OF GEELONG MANUFACTURING AND WASTE MANAGEMENT

3.1 INDUSTRY TYPES, NUMBER, SIZE AND TRENDS

The Geelong Manufacturing Council represents approximately 500 manufacturing companies employing approximately 15,000 people. For the purposes of this project all manufacturers have been placed in one of the following industry sectors:

- Food and beverages;
- Machinery and equipment;
- Metal products;
- Non metallic minerals;
- Petroleum and coal products;
- Printing, publishing and recording;
- Textiles, clothing and footwear;
- Wood and paper products.

These industry sectors are based on the Australian and New Zealand Standard Industry Classification (ANZSIC) system.

Figure 3.1 shows the percentage of the total manufacturing workforce employed by each industry sector.

FIGURE 3.1 - EMPLOYMENT BY INDUSTRY SECTOR

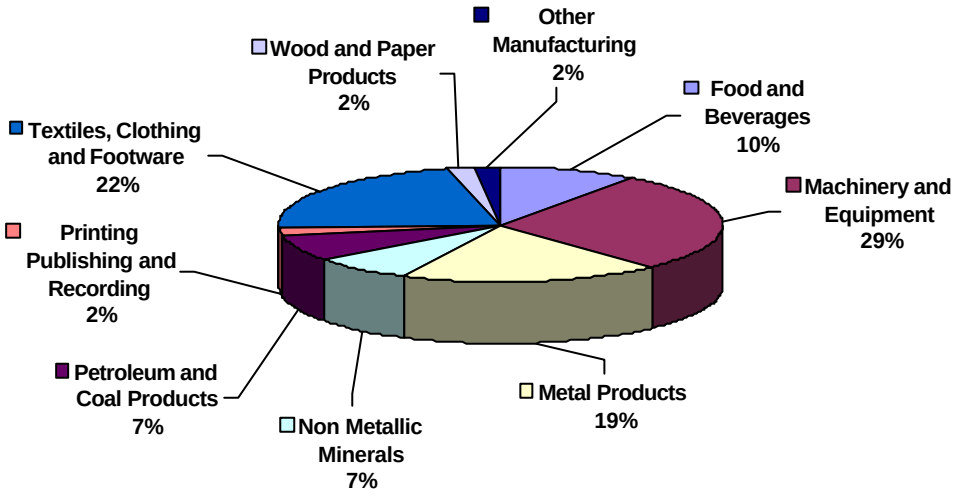


Table 3.1 summarises employment for each of the major manufacturing businesses in Geelong.

Annual turnover by Geelong Manufacturers is estimated at $5.5 billion.

Whilst the number of employees may be an indicator of production and therefore likely waste, the quantities of waste generated per production employee will vary significantly depending on the type of manufacturing and the processes used.

The number of business within each sector provides an indication of the effort that will be needed by groups (such as the Geelong Manufacturing Council, EcoRecycle Victoria, Environment Protection Authority, City of Greater Geelong and/or the Barwon Regional Waste Management Group) to influence waste reduction and reuse by an industry sector. Sectors with high employment but relatively few businesses will possibly be easier to influence, and achieve significant waste reduction outcomes, than sectors with many small businesses.

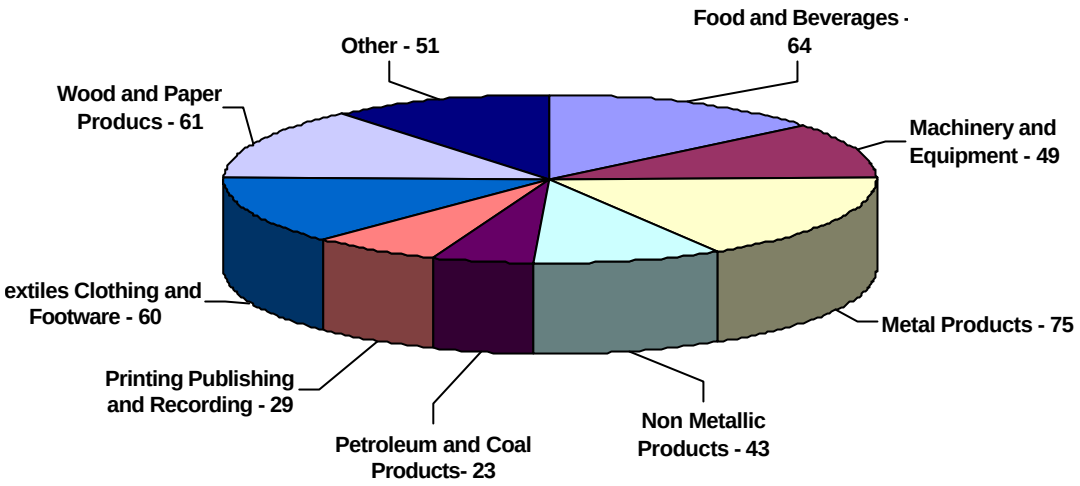
TABLE 3.1 - MAJOR REGIONAL EMPLOYERS

EMPLOYER	NUMBER OF EMPLOYEES	EMPLOYER	NUMBER OF EMPLOYEES
Ford Motor Company of Aust Ltd	2,500	UG Manufacturing Co Pty Ltd (t/a Quiksilver)	110
Godfrey Hirst Aust Pty Ltd	1,210	Geelong Wool Combing	100
Alcoa World Alumina Australia	650	Backwell IXL Pty Ltd	95
Pilkington (Aust) Pty Ltd	510	Melba Industries (Australia) Pty Ltd	95
Shell Refining (Aust) Pty Ltd	500	Kinnears Pty Ltd	90
Steggles Ltd	422	Burrowed Industries	85
KAAL Australia Pty Ltd	405	Riverside Textiles Pty Ltd	80
Candy Australia	247	BHP Geelong Rod Mill	76
MC Herd Pty Ltd	241	Express Promotions Australia Pty Ltd	75
Hendersons Automotive	187	Beaumonts Pies and Cakes	71
Pivot Ltd	187	Rohm and Haas Australia Pty Ltd	71
Classweave Industries Pty Ltd	180	Filigree Textiles Pty Ltd	70
Cahill Mechanical Installations	180	Austrimi Seafoods Pty Ltd	65
Rip Curl Pty Ltd	180	Challenge Meats Pty Ltd	63
BHP Wire Products	178	Coghlan-Russel Engineering	62
Hyuck Australia Pty Ltd	172	National Dairies (Vic) Pty Ltd	60
Brintons Carpets	164	Paratus Industries Pty Ltd	60
Blue Circle Southern Cement	160	E Brockman and Son Pty Ltd	60
Bekaert - BHP Steel Cord Pty Ltd	130	Cheetham Salt Limited	59
Calco Timbers Pty Ltd	125	Sands Print Group Ltd	58
Danum Engineering Pty Ltd	125	Sunicrust Bakeries	55
Olin Australia Ltd	125	Excell Quarries Pty Ltd	55
Air Radiators	115	Montell Australia Pty Ltd	54

Source: Geelong Manufacturing Council.

Figure 3.2 summarises the number of businesses in each industrial sector.

FIGURE 3.2 - BUSINESSES IN EACH INDUSTRIAL SECTOR



3.2 MAJOR WASTES FROM INDUSTRY

3.2.1 Overview

A general survey of Geelong manufacturers has been conducted to determine the types of wastes generated and current recycling, reuse, treatment or disposal arrangements. Respondents to the survey were also asked to nominate waste reuse or reduction options for their particular waste streams.

Detailed targeted surveys and site visits for waste minimisation assessments have been conducted for fifty of the larger (in terms of number of employees) manufacturing companies is Geelong and a number of companies in Colac. This represents about 10% of Geelong manufacturers. Approximately 60% of the 'top 50' companies approached by telephone participated in the project.

Where 'top 50' companies did not agree to site visits, telephone consultation and surveying were used to obtain information about these businesses. Site visits were conducted at substitute businesses that were just outside of the 'top 50' in size or had undertaken interesting initiatives of relevance to other businesses. A number of additional businesses just out of the top fifty have also been directly approached and questioned by telephone, particularly where further information was needed about waste from their type of business and/or opportunities for wastes that they were likely to generate had been identified.

Survey responses have been received from about 20% of manufacturers located in Geelong. This represents a good cross section of Geelong manufacturers, including the largest businesses. In addition, a review of literature has been conducted of waste generation from manufacturing sectors and waste reduction and reuse opportunities identified for these sectors. Additional businesses and organisations have been consulted, including waste management and recycling businesses in both the Geelong/Barwon region, Ballarat and Melbourne that may have a role to play in reusing Geelong's manufacturing wastes.

Information contained in the general and targeted surveys has been analysed to determine the types and amounts of waste generated by each industry sector in Geelong. The waste figures shown in the following tables are presented as average waste per respondent that identified and quantified the waste type. This

information has largely been provided by manufacturers making self-assessed estimates rather than accurate measurements.

The site visits revealed that the self assessments, while reasonably accurate in identifying the most significant volumes of wastes, were typically very conservative in estimating the total quantities of waste generated. It should be noted that many survey respondents had often severely underestimated quantities of pallet waste generated. The figures presented in the following tables should therefore be considered to be conservative for the type and size of businesses surveyed. However, because the survey sample targeted larger manufacturers, the figures should not be applied as an "across-the-board" average waste generation per business type. The information presented in the tables is most useful for identifying the relative significance and indicative quantities of waste generated by the different sectors.

The amount of waste generated is summarised in terms of the percentage of respondents to the survey generating that particular waste, and the average amount of waste generated by respondents with that waste. Respondents may in fact generate a particular waste but not have indicated so in the survey. Some respondents indicated that they generate a particular waste but did not indicate how much.

Current disposal routes (recycling, composting, and landfill) are also indicated. On-site reuse, such as re-grinding and incorporation into product, has not been considered in this analysis. Results of the survey analysis are presented in Tables 3.2 to 3.9.

3.2.2 Food and Beverage Sector

Table 3.2 shows the major waste types from the Food and Beverage Sector. This shows that the majority of food and beverage companies surveyed generates cardboard and plastic packaging waste; most of this waste is landfilled. Food waste, sludges and other organic wastes are generated in large amounts. The survey also shows that food waste is not necessarily separated from other wastes. This would need to occur if, for example, the food wastes are to be composted.

TABLE 3.2 - MAJOR WASTE TYPES: FOOD AND BEVERAGE SECTOR

WASTE	% RESPONDENTS	AVERAGE AMOUNT PER RESPONDENT (amount/year)	DISPOSAL
Plastic – (polythene film, shrink wrap etc)	60%	N/A	Landfill
Plastic buckets	30%	5,200 units	Landfill
Blood, skin, bones, fat, dead animals	40%	N/A	Rendering
Paper and cardboard (mainly packaging)	70%	830 m^3	Recycled and landfill
Food waste (off-cuts, reject product)	30%	404 tonnes	Landfill
Sludges (dewatered, grease trap, DAF)	40%	1,260 tonnes	Landfill and compost
Chicken litter/manure	15%	150,000 m^3	Landfill
Egg shells and feather dust	15%	30,000 m^3	Landfill

3.2.3 Machinery and Equipment Sector

Many wastes generated by machinery and equipment companies are recycled; this includes, scrap metal, cardboard and timber waste. The results summarised

in Table 3.3 show that packaging wastes are generated by most companies surveyed.

TABLE 3.3 - MAJOR WASTE TYPES: MACHINERY AND EQUIPMENT

WASTE	% RESPONDENTS	AVERAGE AMOUNT PER RESPONDENT (amount/year)	DISPOSAL
Cardboard	100%	3,000 m^3	Recycled and landfill
Pallets and timber	40%	12 tonnes	Recycled and landfill
Plastic – (polythene film, shrink wrap etc)	60%	30 m^3	Landfill
Polystyrene foam	20%	N/A	Landfill
Sand	20%	16,400 tonnes	Recycled
Scrap metal	40%	780 tonnes	Recycled
Sludge	20%	N/A	Landfill
Waste oil	20%	N/A	Recycled

3.2.4 Metal Product Sector

Table 3.4 summarised the types and amounts of wastes generated by metal product manufacturing companies surveyed.

TABLE 3.4 - MAJOR WASTE TYPES: METAL PRODUCTS

WASTE	% RESPONDENTS	AVERAGE AMOUNT PER RESPONDENT (amount/year)	DISPOSAL
Cardboard and paper	100%	60 m^3	Recycled and landfill
Steel	50%	825 tonnes	Recycled
Timber pallets	50%	80 tonnes	Recycled and landfill
Plastic – (polythene film, shrink wrap etc)	50%	30 m^3	Recycled and landfill
Rubber	25%	20 tonnes	Recycled
Carbon butts	25%	4,000 tonnes	Recycled (trial)
Spent pot lining	25%	3,000 tonnes	Recycled (trial)
Tie wire	25%	24 tonnes	Recycled

Many wastes generated by metal product companies are recycled including carbon butt and spent pot lining recycling trials by Alcoa World Alumina Australia. Packaging wastes are the main source of wastes landfilled according to those companies surveyed.

3.2.5 Non-Metallic Minerals Sector

Companies in the non-metallic mineral industrial sector are diverse and as a result a wide range of wastes are generated; this is illustrated by the fact that most waste types are only generated by one of the companies surveyed. Table 3.5 summarises the major wastes generated by the companies surveyed in this sector.

TABLE 3.5 - MAJOR WASTE TYPES: NON-METALLIC MINERALS

WASTE	% RESPONDENTS	AVERAGE AMOUNT PER RESPONDENT (amount/year)	DISPOSAL
Timber pallets	33%	50 m^3	Landfill
Plastic – (polythene film, shrink wrap etc)	17%	N/A	Landfill
Cardboard and paper	17%	10 tonnes	Recycled
Cement dust	17%	7280 tonnes	Landfill, stockpile, trials
Solid concrete	17%	N/A	Recycled or landfill
Interlay PVB off cuts	17%	N/A	Landfill
Oil/glass fragment sludge	17%	N/A	Landfill
Polystyrene foam	17%	1,700 m^3	Landfill
Form ply off-cuts	17%	6 tonnes	Landfill
Fabric reinforcement sheets	17%	24 tonnes	Recycled or landfill

It should be noted that waste generated by quarries, namely fines and overburden, are typically retained on site rather than disposed of in landfills off-site.

3.2.6 Petroleum and Coal Products Sector

Major wastes generated by companies surveyed in the petroleum and coal products sector are summarised in Table 3.6.

TABLE 3.6 - MAJOR WASTE TYPES: PETROLEUM AND COAL PRODUCTS

WASTE	% RESPONDENTS	AVERAGE AMOUNT PER RESPONDENT (amount/year)	DISPOSAL
Oil contaminated soil	25%	2,000 tonnes	Landfill
Spent cracking catalyst	25%	1,000 tonnes	Landfill
Cardboard and paper	100%	120 m^3	Recycled and landfill
Plastic – (polythene film, shrink wrap etc)	50%	100 m^3	Landfill
Sodium hydroxide solution	25%	400 tonnes	Liquid waste treatment
Alumina	25%	70 tonnes	Landfill
Spent caustic (liquid)	25%	600 tonnes	Specialist treatment
Filter bags, drum liners	25%	75 tonnes	Landfill
Dried polymer cake	25%	50 tonnes	Landfill
Acrylic polymer solution	25%	50 tonnes	Liquid waste treatment

A wide variety of wastes generated by the petroleum and coal products sector require special treatment or are prescribed wastes and therefore must be disposed of to a prescribed waste landfill.

3.2.7 Printing, Publishing and Recording Sector

The analysis undertaken shows that all paper generated by those printing, publishing and recording companies surveyed for this project is recycled. Other wastes generated include packaging and liquid wastes; this is summarised in Table 3.7.

TABLE 3.7 - MAJOR WASTE TYPES: PRINTING, PUBLISHING AND RECORDING

WASTE	% RESPONDENTS	AVERAGE AMOUNT PER RESPONDENT (amount/year)	DISPOSAL
Paper	100%	1,000 m^3 plus	Recycled
Pallets	33%	5,400 units	Recycled and landfilled
Plastic – (polythene film, shrink wrap etc)	33%	240 m^3	Recycled
Printing plates	33%	10 m^3	-
Ink containers	33%	N/A	Landfill
Ink/mineral turpentine/solvent sludge	33%	3 m^3	-
Liquid wastes (solvents)	66%	Small amount	Liquid waste treatment

3.2.8 Textile, Clothing and Footwear

Table 3.8 shows that approximately half of all textile, clothing and footwear companies surveyed generated cardboard and plastic packaging waste. The type of waste generated depends on the type of company, for example wool scouring companies generate large volumes of organic waste (suitable for composting) whereas the shoe component manufacturer generated large amount of plastic wastes. Fabric off-cuts and yarn are a major waste from this industry sector.

TABLE 3.8 - MAJOR WASTE TYPES: TEXTILES, CLOTHING AND FOOTWEAR

WASTE	% RESPONDENTS	AVERAGE AMOUNT PER RESPONDENT (amount/year)	DISPOSAL
Paper and cardboard	55%	450 m^3	Recycled and landfill
Plastic (shrink wrap)	45%	1,000 m^3	Recycled and landfill
Fabric off-cuts	25%	1,000 m^3	Landfill
Neoprene off-cuts	6%	310 m^3	Landfill
Yarn fibre (natural and synthetic)	20%	N/A	Recycled and landfilled
Organic wastes (sludge, waste hair, dry wool, dirt, hide trimmings etc)	30%	670 m^3	Compost, landfill, gelatine
Plastic cones, cardboard cones	13%	200 m^3	Landfill
Polyurethane	6%	20 tonnes	Landfill
PVC	6%	5 tonnes	Landfill
ABS polystyrene	6%	2 tonnes	Landfill

3.2.9 Wood and Paper Products Sector

Wastes generated by the wood and paper product sector is summarised in Table 3.9. All of the respondents were from wood product manufacturers. There is only one paper product manufacturer, a cardboard carton supplier, listed in the Geelong Manufacturing Council's register.

TABLE 3.9 - MAJOR WASTE TYPES: WOOD AND PAPER PRODUCTS

WASTE	% RESPONDENTS	AVERAGE AMOUNT PER RESPONDENT (amount/year)	DISPOSAL
Timber (off-cuts, chips)	80%	2720 m^3	Landfill, burn,
Saw dust	20%	N/A	Compost
Oil	40%	N/A	Recycled
Scrap steel	40%	N/A	Recycled
Oily rags	40%	N/A	Recycled and landfill
Filters	40%	N/A	Recycled
Plastic – (polythene film, shrink wrap etc)	20%	625 m^3	Landfill

The surveys show that timber off-cuts is the main waste type for this sector. Surprisingly most of this waste is either landfilled or burnt. Many other wastes are recycled including filters, oil and scrap steel.

3.2.10 Summary

The types of waste generated by the companies surveyed vary largely depending on the industry sector they belong to. Packaging wastes, namely cardboard, plastic and timber pallets, are a common waste across all sectors. Much of the plastic and timber packaging waste generated is landfilled. However, cardboard and paper recycling is common. This is despite perceived problems with markets for recycled cardboard and paper, and the cost of cardboard and paper collection services.

The results contained in Section 3.2 are based on information provided by respondents to the survey and information collected during site visits. Because these surveys targeted larger businesses, the results obtained in the surveys cannot be used to accurately estimate the total Geelong manufacturing solid waste stream. However, the figures are very useful for identifying the most significant types and indicative quantities of waste generated by different sectors.

3.3 EXISTING WASTE RECOVERY AND RECYCLING INFRASTRUCTURE

3.3.1 Existing Facilities and Services

Many waste and recycling collection companies service Geelong manufacturers. A range of materials is collected for recycling including ferrous and non-ferrous metals, paper, cardboard, glass and plastics (PET, HDPE, shrink wrap). Metalcorp Recyclers have indicated that many companies are not selling their scrap metal at present due to low commodity prices. Geelong Recyclers, for example, collect a range of recyclables including shrink wrap; shrink wrap can be used in a number of applications, including heavy duty film and extruded plastic products, but due to a lack of market at present is currently stockpiled.

A number of tyre collection services are provided in the area. However, much of this is shredded and landfilled due a lack of markets for the material; this is despite the fact that some tyre waste is used as a fuel source at Blue Circle Southern Cement. It is understood that Blue Circle Southern Cement find no difficulties in sourcing waste tyres.

Waste recycling contractors who operate in Geelong include those businesses listed in Table 3.10.

TABLE 3.10 - RECYCLING SERVICES IN GEELONG

BUSINESS	TELEPHONE	MATERIALS RECYCLED
AT Hayes Recycling Pty Ltd	5248 2066	Various
CBM Waste Management	5231 3076	Plastic, paper, aluminium, cans, glass, cardboard, ferrous and non-ferrous metals
Colac Bottle Merchants	5231 3076	Glass
Colac Recycling Centre	5231 4858	Paper, cardboard
Geelong Recyclers	5233 5233	Glass, aluminium, plastic, paper, cardboard, tyres
Metalcorp Recyclers	5278 8333	Aluminium, copper, brass, batteries, steel

Landfills are located at Corio, Drysdale and Fyansford, and a transfer station in Geelong North. These facilities also provide material recycling services, including separation of concrete, scrap metal, plastics, tyres, batteries, and glass.

A number of organic waste treatment companies are located in Geelong. This includes Geelong Wool Combing who compost their own and other companies' wool scour waste, and an operator located in Mount Duneed offering similar services.

Waste Werks is an organisation located in Geelong providing waste recovery and reuse services for industry. Waste Werks collect wastes from various manufacturers in Geelong and resells the wastes to schools and the general public for use. They have indicated that demand for the wastes is large and could be larger with better marketing of the services and products provided. Many manufacturers stated during the site visits or on the surveys that they currently divert some of their waste to Waste Werks. Waste Werks have recently moved to larger premises in Geelong.

3.3.2 Prescribed Waste Treatment and Disposal Facilities

A number of prescribed waste treatment and disposal facilities, licensed by the EPA, are located in the Geelong area. The facility, location, wastes received and treatment or disposal type are summarised in Table 3.11.

TABLE 3.11 - PRESCRIBED WASTE TREATMENT AND DISPOSAL FACILITIES

FACILITY	LOCATION	WASTE	TREATMENT OR DISPOSAL
Corio landfill	Corio	Abattoir effluent Wool scouring effluent Asbestos	Landfill
Drysdale landfill	Drysdale	Asbestos Animal effluent and residues Scallop processing wastes	Landfill
Nationwide Pty Ltd	Moolap	Waste mineral oils Waste oils/water, hydrocarbon/water mixtures, emulsions (oil > 50% and water > 50%)	Other physio/chemical treatment Storage prior to recycling
Jupe Julien Pty Ltd	Moolap	Waste oils/water, hydrocarbon/water mixtures, emulsions (oil > 50% and water > 50%)	Storage prior to recycling

Source: List of Treatment and Disposal Facilities for Prescribed Waste, EPA Bulletin, Publication 423, January 1998.

Many Geelong manufacturing companies use prescribed waste treatment facilities and services located in Melbourne.

Any facility storing, treating, reprocessing or disposing of prescribed waste is a schedule four premise under the Environment Protection Act 1970 and the Environment Protection (Scheduled Premises and Exemptions) Regulations 1996. The occupier of a schedule four premise is required to comply with sections of the Environment Protection Act relating to works approvals, licences, transport certificates and financial assurances.

A number of companies provide liquid and prescribed waste collection services to Geelong manufacturers. These wastes are either landfilled or treated.

4. WASTE MINIMISATION AND REUSE OPPORTUNITIES

4.1 "GENERIC" AND GENERAL WASTES

The surveys, site visits and literature research has indicated that a number of wastes are generated by most manufactures in Geelong, including transport packaging and general office and staff wastes. Reduction, reuse and recycling options for these wastes are discussed in Sections 4.1.1 to 4.1.4.

4.1.1 Cardboard Cartons and Packaging, and Paper

Sources

Cardboard cartons, dividers, pallet pads and other cardboard packaging wastes are generated through the transport of raw materials and finished goods on- and off-site. Much of the cardboard packaging is typically used only once prior to either recycling or disposal.

The generation of office paper waste is common across all industry sectors.

Reduction Opportunities

Office paper waste can be reduced by double siding photocopies, not printing e-mails and other reports unless absolutely necessary and by monitoring usage of paper at photocopiers and the like. Support for the recycling industry can be also be demonstrated through the use of recycled paper.

Reduction of cardboard packaging waste can be achieved through use of reusable, returnable plastic packaging. Ford, for example, uses collapsible plastic containers for some packaging. Cardboard dividers could be replaced with reusable plastic or fabric dividers, depending on the material being transported.

Placing holes in the cartons to reveal package labelling can eliminate use of labelling on the outside of cardboard cartons reducing waste and saving money.

Reuse Opportunities

Use of stronger cardboard cartons may result in the carton being reused many times compared to weaker single use cartons. A deposit on return of cartons may encourage buyers of products to return the packaging to the manufacturer for reuse. Manufacturers may specify in supply contracts that all packaging must be returnable and reusable.

Many companies surveyed reuse cardboard packaging from in-coming raw materials for packaging outgoing goods.

Office paper can be reused on site. E. Brockman and Sons, for example, shred waste office paper and use it for packaging small components. Other companies use waste paper for wrapping products manufactured on site.

Recycling Opportunities

At present many manufacturing companies in Geelong recycle waste cardboard and paper through external waste management or recycling contractors. Some use bales for storage and others presses for compaction.

Feasibility and Priority

The Carton Company is a company operating in Geelong who buy and sell cardboard cartons for reuse. At present they collect cartons from a number of manufacturers in Geelong including carpet and textiles manufacturers. They are interested in receiving additional cartons from Geelong manufacturers involved in this project. This represents an immediate opportunity to divert waste cardboard packaging for reuse.

4.1.2 Timber Pallets and Crates

Sources

Most timber wastes are generated from the use of non-returnable pallets, either softwood or hardwood, some of which are still in a useable condition. Some of this has originated overseas from import of raw materials; returning the pallets to the supplier is therefore uneconomical in this instance.

Reduction Opportunities

Where possible manufactures should specify that goods are to be transported to their premise on returnable pallets. This may be either standard returnable Chep, or similar, pallets. The same applies in reverse; where possible products should be transported to clients on returnable pallets.

Another option for reducing pallet and crate waste is to specify that suppliers collect all timber packaging used to transport raw materials. This allows the suppliers to reuse the packaging and minimises waste for Geelong manufacturers.

Reuse Opportunities

Options for on-site reuse for pallets are usually limited. However, the timber in pallets can be used for mulch and composts. Alcoa World Alumina Australia, for example, chip pallets for landscaping and use in bioremediation activities. Many workplaces make pallets available to staff or others that want them for fire wood or other uses.

Recycling Opportunities

Any timber packaging waste not able to be reused may be diverted from landfill and either mulched, composted or used in particleboard manufacture. Composting and particleboard manufacture are discussed in detail elsewhere in this report.

Feasibility and Priority

There is business potential for the reuse of sturdy non-returnable pallets. Many of the non-returnable hardwood pallets are almost indistinguishable from returnable pallets. The main difference is that nobody owns them. There is potential for an existing or new pallet repair business to collect, repair and label these pallets for reuse or resale. Several such operations have been established in Melbourne but none in Geelong have been identified.

Any timber packaging waste not able to be reused may be diverted from landfill and either mulched, composted or used in particleboard manufacture. There may also be opportunities to use chipped treated timber and particle boards in the stabilisation of high calorific liquid hydrocarbon wastes prior to use as an industrial fuel.

4.1.3 Plastic Packaging

Sources

Plastic packaging includes pallet and shrink wrap, heavy duty film wrap, bubble wrap, plastic buckets and containers, polystyrene and bags. Most plastic packaging waste is sourced from incoming materials and typically comprises a large proportion of the total volume of waste sent to landfill by Geelong manufacturers. Plastic film wrap, in particular, is a problem due to its low density and bulky nature. Another problem with plastic packaging is the variety of plastics used; including polyethylene, polypropylene and polystyrene.

Reduction Opportunities

Reduction of plastic packaging waste may result from an overall review of packaging from suppliers and outgoing goods. This may result in increase use of returnable bulk containers, elimination of shrink wrap in some instances or eliminating the need to wrap individual items.

Styrene foam waste, for example, can be avoided through use of alternative packaging materials. Test Technology, located in Geelong, is currently investigating the use of alternative packaging materials such as popcorn or fibre packaging for materials sent to their clients.

Reuse Opportunities

Opportunities exist to reuse some plastic packaging. Plastic buckets, used predominantly in the food and beverages industry, may be reused once cleaned. Plastic buckets may be directly exchanged between two companies or via a central waste exchange facility. The intended reuse of the buckets will dictate the level of cleanliness required, ie reuse of the buckets for sale of wool grease would require a high level of cleanliness than on-site storage of waste solvents prior to recycling.

Other plastic packaging wastes such as polystyrene, bubble wrap and plastic bags may be reused. Waste polypropylene bags, for example, may be able to be used off-site as garbage bin litters.

Recycling Opportunities

Plastic packaging, such as shrink wrap, can be recycled into heavy duty film and extruded plastic products. However, at present the market is depressed and much of this material is stockpiled despite being collected from many Geelong manufacturers.

Feasibility and Priority

Establishing a facility to facilitate the exchange of plastic buckets and the like will provide an opportunity for waste exchange in Geelong. Geelong manufacturers should also work with their suppliers and buyers of product to eliminate waste packaging through changes in packaging design and use of returnable containers where possible.

4.1.4 Staff Waste

Sources

Staff waste includes food scraps, and food and beverage containers mostly originating from staff canteens and lunchrooms, paper towels from bathrooms and kitchens, cleaning materials (gloves, rags, empty containers) and other miscellaneous wastes.

Reduction Opportunities

Initiatives to reduce staff wastes include the provision of reusable cloth towels in kitchens and bathrooms.

Encouraging staff to use ceramic mugs instead of disposable polystyrene cups reduces waste; mugs with company logos may be provided to all staff. Companies with staff canteens may encourage the use of ceramic mugs by offering a discount on the price of a cup or tea or coffee to discourage use of polystyrene mugs.

Use of cleaning chemicals in transported or stored in bulk or returnable containers will reduced waste.

Reuse Opportunities

Many businesses surveyed dry clean rags and gloves for reuse. Some textiles companies surveyed use fabric off-cuts for use as cleaning rags on-site.

Recycling Opportunities

Many companies surveyed currently supply bins for the collection of glass bottle and aluminium cans from staff lunchrooms prior to recycling. While this practice diverts relatively small volumes of material from landfill it does reinforce the company's commitment to waste reduction.

Alcoa World Alumina Australia currently operate a successful worm farm and Quiksilver are planning to compost food scraps and lawn clippings in a staff initiative to reduce waste.

Feasibility and Priority

Provision of bins for collection of glass bottles and aluminium cans, and reusable cloth towels and cleaning rags provides and opportunity for immediate waste reduction that is easy to implement.

4.2 FOOD AND BEVERAGES

The food and beverage sector is diverse including:

- Meat, seafood and poultry processing and packaging;
- Wine-making, malting and brewing;
- Processing and packaging of pre-processed foods;
- Bakeries.

The main waste types from the Food and Beverage Sector were identified as:

- Organic materials consisting of:
  - Animal and animal product processing wastes;
  - Fruit, vegetable and grain product processing;
  - Bakery wastes;
  - Food-contaminated cardboard and paper;
- Reject packaged food wastes;

- Plastic and steel buckets/tubs/drums/containers;
- Paper and cardboard packaging;
- Film plastics;
- Transport pallets;

The latter four types of waste have been discussed in Section 4.1. An assessment of the opportunities for the reduction and reuse of the other wastes follows.

There are a number of significant sources of food and beverage organic wastes within the Geelong area with distinctly different types of waste generated in different ways.

4.2.1 Animal and animal product processing wastes

Geelong has a significant presence of animal and animal product processing manufacturers. There are also manufacturers that receive and process hides, which are therefore not considered to be a waste.

Sources

The main sources of waste from animal and animal product processors are:
- paunch waste from dressing carcasses;
- fats, skins, offal, and skeletal remains;
- manures from raising and holding pens;
- dairy wastes, including some confectionary wastes;
- grease trap wastes;
- carcasses - dead animals from raising and holding yards;
- spoilt product.

A significant “problem” waste generated by Geelong seafood processors are “wet” fish processing wastes and scallop and abalone shells. Each year about 3,600 tonnes of these shells are received at Corio landfill.

Reduction Opportunities

Opportunities for reduction of the animal processing wastes listed above are limited to production and storage to limit spoilage of products. Manufacturers have strong economic incentive to do this, and incidents of spoilage are always due to system breakdowns.

Reuse/Recycling Opportunities

Several animal processing facilities use on-site or external rendering operations to process fats, skins, offal, skeletal remains and carcasses. These effectively reuse/recycle most non-paunch animal wastes and generate little solid waste (As one operator stated, they “get pretty much everything except the ‘moo’.”). Rendered products include tallows, fats, protein supplements, animal feeds, pet food and fertilisers. Animal processing operations not currently sending materials for rendering could investigate this opportunity. “Wet” fish processing wastes (guts, scales, heads, etc) may have potential to be processed into animal protein feedstock, or the production of liquid and dry fertilisers.

There are opportunities to compost organic animal processing wastes. Composting and related bioremediation, which are seen as significant opportunities for better managing Geelong’s wastes stream, are detailed elsewhere in this report. Animal wastes typically have higher levels of nitrogen than the woody wastes mulched and composted by municipal waste management operations. As such they are a potential source of nitrogen for composting operations. Some organic wastes, such as poultry manures, seafood

processing wastes, dairy wastes and fats/grease-trap sludges also contain higher levels of minerals such as phosphorus, potassium, calcium and other trace elements that improve the fertilising properties of compost products. Trials have successfully composted seafood processing wastes although there is a high risk of odour.

All food manufacturers that process animal products will typically generate grease trap waste that will periodically need to be collected and disposed as prescribed waste. Composting is a proven technology for the recycling of this waste. Grease-trap wastes from smallgoods and meat-pie manufacturers, and non-manufacturers such as restaurants, fast-food outlets and butchers, and could also be fed into a composting stream, reducing waste disposal costs to Geelong businesses.

Incidents of product spoilage are uncommon for individual companies and, when they do occur, most manufacturers have or know of any option other than landfill. Often due to hygiene and odour concerns, spoilt material must be removed immediately. Systems need to be developed for informing manufacturers where they can take spoiled consignments of animal and other food waste for composting, and for them to receive confirmation from the composter prior to delivery that the material can be accepted at that time.

A large generator of de-watered paunch waste sludge, MC Herd, has previously tried vermiculture to treat this waste stream, but found that the worms were unable to keep up with production in the available area. This vermiculture operation attempted to use windrows, and the worms did not penetrate far into them, with the result that practices were modified so that the "windrows" were only 30-40 cm high, meaning that a larger area would be needed. Some odour complaints were received from neighbours during the vermiculture trial. A large-scale vermi-compost operation in Queensland successfully processes stockyard manures (which is essentially similar to paunch waste from sheep and cattle) using boxes/throughs. There may be opportunity for a similar operation to be established in Geelong to process this material.

Feasibility and Priority

MC Herd, Steggles and Austrimi Seafoods are very interested in investigating opportunities for composting and/or vermiculture their organic wastes. Although classified as primary production (rather than manufacturing), Steggles' poultry raising sheds generate a large amount of manures and rice hull from the deep litter. The litter also contains egg shells and feathers from the hatching rooms, and often contains dead birds. All of the manures and animal processing wastes are typically odorous and have potential to generate offensive odour in composting operations.

Under EPA Best Practice Management Guidelines, *Environmental Guidelines for Composting and Other Organic Recycling Facilities* (Publication No. 508), the minimum recommended buffer distances between sensitive land uses (eg. housing) and any open composting facility receiving more than 10 tonnes of manures and/or food processing wastes per day are between 1,000 and 2,500 metres. These minimum buffer distances are not mandatory, and if it is demonstrated through air modelling that odours can be managed, lesser buffer distances will be allowed. This will largely depend on the extremity of meteorological (especially wind) conditions near a proposed site. Typically at least 500 metres, and more usually 600-1,000 metre buffers will be required for such a facility. This can reduce the feasibility of composting facilities. However, Steggles have properties with large buffers for their chicken raising sheds. Also, a bioremediation facility about to be established at Alcoa World Alumina Australia's Point Henry site (commencing operation 3 May 1999) has

considerable buffers and will require nitrogen sources. Both operations have expressed interested in sourcing or trialing materials for composting.

Other possible composting facility sites include Barwon Water's sewage treatment facilities and Geelong Wool Combing, although this latter site might not have sufficient buffer distances to accept poultry manures and other high odour-generating materials.

The Barwon Regional Waste Management Group is currently investigating the feasibility of Regional composting facilities, primarily for the processing of garden and food wastes from domestic sources. A key limitation to the establishment of any facility will be the strength of markets for compost products. There may be a role for those involved in the Geelong Manufacturing Council project to promote compost products to householders and primary producers.

There may be potential for seafood processing wastes to be manufactured into protein animal feed (possibly for the emerging aquaculture market, which would "close the loop" for recycling), or liquid and dry fertilisers.

4.2.2 Fruit, vegetable and grain product processing

Sources

The main sources of organic wastes from fruit, vegetable and grain processors are trimmings, pulp/leys from produce, and spoilage. Although not classified as a manufacturers, grain handling operations such as VicGrain can generate large volumes of grain dust, spoiled grain and screenings.

Reduction Opportunities

Waste reduction strategies for fruit, vegetable and grain processors include:

- Purchasing and storage to minimise spoilage;
- Having specifications to suppliers for pre-trimmed produce. This will encourage growers to keep wastes on-site where they might be composted or dug into the soil;
- Using or selling trimmings as products (eg. potato chip off-cuts sold as potato cubes for pasty makers).

Reuse/Recycling Opportunities

Opportunities and issues for the reuse/recycling of fruit, vegetable and grain wastes are similar in many ways to animal processing wastes.

Some wastes such as starches, oils and yeasts could be sold to other food processors, although no such examples were identified.

The Geelong Brewery currently sends spent malt to animal feedlots, but does not sell its yeast waste to Kraft in Port Melbourne (for vegemite production) because volumes are too small.

Some wastes, such as grape marc (pressings) from wineries are typically disposed of on site. These wastes could potentially be refined to obtain alcohol, tartaric acid, food colouring and grape-seed oil. The volumes required to sustain such operations are greater than those currently generated in the Geelong area, although vine plantings have recently increased. There is a tartaric acid recovery operation near Mildura, but this is too distant for the Geelong wineries to transport wastes. Grape marc might also be able to be used as stock feed, or may be composted under more controlled conditions (static heaps at wineries can create leachate and odour problems) at an established composting facility.

Composting is considered to be a favourable management pathway for fruit, vegetable and grain processing wastes. These wastes are also often more suited to vermiculture than are woody and animal wastes.

Feasibility and Priority

In the event that composting facilities are established, fruit, vegetable, and grain processing wastes should be able to be received. Some of the waste streams, such as brewery wastes and grain dust (which may form pastes when wet and promote odorous yeast activity) may need to trialed.

Other than the sale of brewery yeast leys to Kraft, no specific opportunities for "higher order" waste management, such as the extraction of starches, oils, tartaric acid, etc were identified for Geelong businesses .

4.2.3 Bakery wastes

Sources

In addition to those discussed above, other manufacturers of products such as pies, pastries, breads, and confectionary generate organic scrap and reject food products.

Reject food products can result from spoilage, overcooking, damage to product, or poor appearance.

A pie factory and bakery visited generated several cubic metres per day of pastry and pastry/meat scraps. It also generated a significant amount of defective/reject product due to overcooking and poor shape.

Another likely significant type of waste from small to medium size bakeries located across Geelong is old or stale bread and defective products.

Reduction Opportunities

There are strong opportunities for reductions in scrap and reject food wastes. Scraps can be reduced by refitting cutting equipment and training staff. Beaumont Pies has managed to reduce scrap waste by in the order of 30% through a combination of staff training and monitoring. This factory also, where possible, fed clean pastry scraps into production.

Reject products might be reduced through better heat control in ovens, storage and staff training. Obviously businesses have strong incentive to minimise such wastes.

Reuse Opportunities

Reject products can be donated to charity. Beaumont Pies donates "bent" pies and pastries to charities, reducing its waste bill while performing a community service.

There may be potential for waste bread to be made into breadcrumbs for use by other food processors (eg. producers of crumbed/pre-cooked seafood and poultry products) or restaurants. Alternatively, bakeries could make croutons.

Some wastes such as breads could be used for animal feeds.

Recycling Opportunities

Scrap and reject food wastes may be able to be composted.

Feasibility and Priority

Promotion of reduction strategies could reduce wastes from this sources.

In the event that a composting facility is established, such materials should be able to be accepted, although some materials (such as uncooked pastry and doughs) may not be suitable.

Further investigation is required to assess the viability of bread crumbs to be reused by other food manufacturers. This would require either a new business or an addition to an existing food waste processor's operation to collect/receive bread wastes, perform quality assurance on the received material, crumb and package the material, and market/supply the new product to potential users. Environmental Health standards and regulations would need to be considered and the Department of Human services consulted regarding the legality of such an operation.

Piggeries, and possibly pet food manufacturers (which use cereals in many of their products), could be approached regarding trialing the use of reject breads.

4.2.4 Food-contaminated cardboard and paper

Source

Many food processors generate quantities of food-contaminated cardboard and paper from pre-packaged food stuffs. For example, Challenge Meats process small goods with meat is delivered to Challenge Meats in polythene lined cardboard boxes for processing. Much of the cardboard becomes contaminated and is therefore unable to be reused.

Reduction Opportunities

Reduction strategies may include negotiating with suppliers so that they use returnable and/reusable packaging. Companies may even supply their suppliers with returnable/reusable containers. Again, Environmental health requirements will need to be considered.

Reuse/Recycling Opportunities

While food-contaminated cardboard and paper are not suitable for reuse or conventional recycling, they are organic and are readily composted.

Feasibility and Priority

In the event that composting facilities are established, those involved in the Geelong Manufacturing Council Industrial Waste Identification and Opportunity Analysis Project could encourage participants in a trial to separate such cardboard/paper for composting. Contamination of the cardboard/paper composting stream with plastics and other non-biodegradable wastes could limit the potential of better managing this waste stream.

4.3 MACHINERY AND EQUIPMENT

The machinery and equipment sector in Geelong employs approximately 25% of all employees in the Geelong region employed by the manufacturing sector. Large companies such as Ford are also major contributors to the Geelong manufacturing waste stream.

Major waste types include:
- Scrap (sheet, wire, redundant equipment) and swarf metals;
- Foundry sand;
- Plastics;
- Oils and oily sludges;
- Fabric;
- Cardboard;
- Shrink wrap and other film plastics;
- Pallets and other timber.

The latter three have been dealt with in Section 4.1. Fabric waste is dealt with in Section 4.8. A discussion of issues and opportunities for the management of the remaining waste categories follows.

4.3.1 Scrap and Swarf Metals

Source

Scrap metal results from the cutting of sheet metal and are the off-cuts from this process. Scrap metal also comprises steel drums used for transport and storage of materials, steel strapping, wire and bands, and old redundant equipment and machinery.

Swarf metal results from the turning and drilling of metal.

Reduction Opportunities

Reduction of metal off-cuts will be achieved through better design of processes. By incorporating the size of standard steel sheets as a design issue and by cutting the steel a different way the amount of waste can be minimised.

Reduction of scrap metal may also result from improved house keeping practices such as maintaining machinery in a good condition to maximise its lifespan.

Reuse Opportunities

Some larger businesses in Geelong, such as Ford, reprocess all scrap and swarf metals internally.

Opportunities exist to reuse filters following reconditioning; Scott Filter Services, located in Geelong, offer filter recycling services.

Recycling Opportunities

At present most companies use external recycling contractors to collect and recycled scrap metal. Due to the bulky nature of scrap metal, some companies have established drop-off areas on site for storage of scrap metal prior to collection. Metals collected by recycling contractors include both ferrous and non-ferrous metals (copper, brass, batteries and radiators); steel is collected in the greatest amounts compared to other scrap metals.

The collection of swarf for recycling is limited due to relatively small amounts generated and occupational health and safety concerns.

Feasibility and Priority

Continued emphasis should be placed on collection of scrap metal for recycling.

4.3.2 Foundry sand

Sources

Foundry sands are typically disposed of as low level contaminated soil or prescribed waste depending on the levels of contaminants. Contaminants are principally phenolic compounds and, depending on the metals cast, heavy metals. The phenols come from casting and binding agents.

Sources of foundry sand include:
- Used moulds;
- Scrapped moulds (Typically if heat variations are too great during firing, moulds will be damaged and discarded. Poor calibration of ester binders can also lead to waste moulds unsuitable for use, and those with too high levels of esters are not suitable for sand reuse);
- Spillages/dust/wind blown dispersions which are swept up or caught in drainage pits;
- Use of larger than required mould holding containers.

Ford generates large amounts of waste foundry sand at approximately 45 tonnes per day. Foundry sand will also be generated at other, smaller businesses (from the Machinery and Equipment and Metal Products sectors) throughout Geelong. The presence of binders and other inorganic chemicals restricts the reuse of foundry sand unless the binders can be removed.

Reduction Opportunities

Some reduction in foundry sands can be achieved through:
- Use of appropriately sized mould containers;
- Better calibration of the addition of binders;
- Better control of heat and cooling to reduce the incidence of reject moulds;
- Better control of fugitive emissions of sand.

Reuse Opportunities

A number of technologies exist to facilitate reuse of foundry sand; these technologies include thermal recycling and low energy recycling systems. Ford currently reuse much of their foundry sand. Thermal recycling involves use of a shaker unit to break up sand lumps and a gas fired burner to burn residual casting binder from sand grains.

Low energy systems involve use of an attrition unit in which sand grains are rubbed together at high speed; residual binders and inorganic contaminants are scrubbed from the sand surface by abrasion. A low pressure air stream is used to transport sand chips and eroded binder and contaminants to a dust collection system. These technologies are expensive and may not be economically viable for smaller businesses. However, opportunities may exist where foundry sands are sent to a central treatment facility; this may be an existing or new facility. Businesses with existing facilities may be able to offer a user pays service for foundry sand reuse/recycling.

Collected fugitive emissions of sand can be fed back into on-site re-use systems. Foundry sands can be reused on-site a number of times, but need periodic "topping-up" with clean sand with removal of a corresponding amount of used

material. Alternative management pathways for the waste sand must be developed.

Recycling Opportunities

Ford has received EPA approval for reuse of foundry sands that meets certain contaminant level specifications as a cement additive. Ford achieved foundry sands that met the specifications through more precise calibration of binder application and quality control systems. The sand/cement material, called "flowable fill", has greatest application for slab laying, trench-filling and sealing surfaces. It could be used for production of drain linings.

Local Mix Concrete located in Geelong is interested in using foundry sands from Ford in the production of concrete. Vic Pits have expressed interest in using the product for the production of drainage pits. Potential exists for other companies to send waste foundry sands to Local Mix Concrete, and other concrete manufacturers in Geelong, for recycling. Quality Control procedures will need to be established with emphasis on the level of contaminants in the sand.

At present some foundry sand generated in Geelong is used as cover material at Corio landfill.

Ford has an on-site demonstration site where flowable fill has been used to line an oily sludge settling dam. This could be used to promote its application.

Feasibility and Priority

The diversion of waste foundry sands generated by Geelong manufacturers to Local Mix Concrete and Vic Pits should be encouraged. Local Mix Concrete has expressed an interest in using this waste material in the production of concrete.

Given that Ford reuse foundry sands on site there may be potential to divert foundry sands from other smaller manufacturers to Ford for reuse there.

The Geelong Manufacturing Council could work with Ford to promote and market flowable fill. An opportunity for a synergetic waste exchange would be the use of Flowable Fill to seal working surfaces at a composting or bioremediation or timber waste recovery facility. These surfaces could then be used to further demonstrate the applications of Flowable Fill.

City of Greater Geelong could also support the use of Flowable Fill for public works, again demonstrating applications for the product.

4.4 METAL PRODUCTS

The metal products sector is diverse including:

- Aluminium production at Alcoa World Alumina Australia;
- Steel cord, roofing and wire production at BHP;
- Foundries;
- Sheet metal work/fitting and turning;

The main waste types from the Metal Products Sector were identified as:

- Scrap metals (sheet metal, swarf, wire, heavy metals (zinc));
- Welding rods;
- Paints/coatings/sludges;
- Fly ash, bottom ash;
- Casting pots.

Scrap metal is discussed in Section 4.3.1 and fly and bottom ashes in Section 4.5.1.

4.5 NON METALLIC MINERALS

The non-metallic minerals sector is diverse including:

- Automotive glass manufacture;
- Salt production;
- Cement production;
- Stoneware and pottery;

The main waste types from the non-metallic minerals sector includes:

- Overburden
- Slimes
- Glass
- Contaminated sludges
- Contaminated/reject polymer
- Waste water
- Non-specification materials (lime)
- Fly and bottom ash

4.5.1 Cement Kiln Dust, Fly Ash and Bottom Ash

Sources

Cement kiln dust is generated during cement manufacturing and consists of unreacted raw material, partially calcinated raw material and clinker dust, free lime, alkali salts and volatile compounds. Cement kiln dust has similar properties to Portland cement upon the addition of water.

Fly ash, and lesser volumes of bottom ash, are generated during the production of electricity at coal fired power stations including Anglesea Power Station. Fly and bottom ash is also generated through most combustion processes.

Reduction Opportunities

Reduction opportunities for cement kiln dust, fly ash and bottom ash is limited. Emphasis therefore needs to be on capturing and utilising the materials beneficially.

Reuse Opportunities

Small quantities of fly ash can be used as filler in asphalt. Fly ash is a reactive substance and is therefore able to be used for cement replacement. Fly ash can also be used in the manufacture of aerated concrete, synthetic aggregates, bricks, tiles and roads and pavements. Fly ash is used in all these applications overseas, whereas in Australia fly ash is used predominantly as cement replacement.

Cement kiln dust may be able to be fed into concrete manufacturing operations.

Recycling Opportunities

Moisture conditioned cement kiln dust has been used as landfill liner and cover material in the United States. When properly mixed with water and compacted, cement kiln dust is capable of setting and has hydraulic conductivities similar to that of compacted clay. However, under some conditions (particularly when placed below the water table) use of cement kin dust may result in groundwater contaminant plumes high in total dissolved solids concentrations.

Cement kiln dust may contain up to 15% potash (K_2O) which is an important source of fertiliser in agriculture. Cement kiln dust may therefore be added to

compost products to improve the fertilising capacity of the compost subject to the level of other metals in the dust. Alternatively, one of the fertiliser manufacturers in Geelong may be interested in using the cement kiln dust in their fertiliser manufacturing operations.

Potash is also an important fluxing agent in the ceramic industry; cement kiln dust may be used as a replacement to imported felspar in some applications.

Feasibility and Priority

Many reuse and recycling opportunities exist for cement kiln dust, fly ash and bottom ash; however, many of these options are not yet fully utilised in Australia. Use of this waste type in fertiliser, concrete and asphalt is likely to present the best opportunities in the short term for beneficial use of these wastes and should be further investigated.

4.5.2 Solid Concrete

Sources

Solid concrete is generated through the manufacture of a range of concrete products including precast panels, stormwater pits, drains and slabs. Much of this is from reject or non-specification product and excess concrete. Significant quantities of concrete are also generated through demolition activities.

Reduction Opportunities

Reduction of solid concrete may result from mixing only the quantities of concrete required to produce a product and using a high level of quality control to minimise production of reject products. This reduced wastes and makes better use of raw materials.

Reuse Opportunities

Reuse opportunities for solid concrete are limited. Some respondents to the survey indicated that waste solid concrete is used on site as internal road material.

Recycling Opportunities

Recycling concrete is a viable and growing industry. Crushed waste concrete is increasingly seen as a alternative material to crushed rock for use as a road sub base. Other opportunities for use of recycled concrete aggregate in pre-mixed concrete for non-structural construction applications such as footpaths, bike tracks and water channels, and use in driveways, drainage pipe bedding and bank erosion prevention.

Local Mix Quarries in Geelong own a mobile concrete crusher and are able to provide concrete crushing services.

4.5.3 Glass

Sources

Waste glass is generated in the manufacture of automotive glass (at Pilkington), windows, mirrors, picture faming, furniture and bathroom fittings. This may be from non-specification product, off-cuts, broken glass and waste cullet.

Reduction Opportunities

Better process control and quality procedures may minimise the generation of non-specification product and broken glass.

Opportunities exist to reduce waste by finding markets, or outlets, for lower quality products that may not meet the specification of a businesses primary client. Pilkington have found an outlet for non-show room quality windscreen glass (for example glass windscreens with minor scratches on it but still meeting all safety requirements). This waste product is used for windscreen replacements.

Redesigning production processes may result in fewer off-cuts produced. Alternatively, manufacturers may discuss with suppliers the size of standard sheets of glass supplied with a view to changing these so that less waste off-cuts are produced per standard sheet.

Reuse Opportunities

Reduction of glass waste sent to landfill has concentrated on reduction of the waste and recycling rather than reuse.

Recycling Opportunities

Waste glass can be used in a number of applications. This includes sand blasting, abrasives, filtration media, paint additives and premixes, sand filters, non-skid coatings, paving tiles, reflective road markings, fibre glass, industrial mineral uses, insulation, art glass or landscaping material. EcoRecycle Victoria has recently advertised for tenders for the preparation of a glass market development strategy for Victoria. It should be noted that the primary market for recycled glass is packaging namely beverage containers.

Laminated glass can also be recycled.

A recent EcoRecycle Victoria grant was awarded to ARRB Transport Research for investigation into the use of waste glass as a pozzolanic material in concrete.

Feasibility and Priority

Emphasis should be placed on reduction of glass waste through improvements to quality control (to minimise wastage) and development of markets for recycled glass.

4.6 PETROLEUM AND COAL PRODUCTS

There is a diverse range of manufacturers within the Geelong area producing petroleum related products. The processors and the wastes generated are distinct from each other. Manufacturing processes include:

- Water Based Acrylic Polymer;
- Brush Manufacturer;
- Plastic Moulding;
- Petroleum Products.

The main types of processing wastes from this sector include:

- Acrylic Polymer Solution/Cake;
- Sodium Hydroxide Solution;
- Oil contaminated Soil;
- Spent Cracking Catalyst;
- Alumina;
- Spent Caustic;
- Filter Bags, drum liners.

Waste oils and general waste materials such as cardboard/paper and scrap metals have been earlier in this section.

Many businesses in this industrial sector are committed to reducing the amount of waste generated. Many have also adopted measures to minimise the amount of waste generated through recycling. For example, a particular industry uses recycled liquid sulfur in their process. Other initiatives include recycling of drums. Opportunities for waste reduction exist in process monitoring to detect any leaks and subsequent loss of product.

4.6.1 Acrylic Polymer Solution/Cake

Sources

Rohm and Haas manufacture water based acrylic polymers. Waste acrylic polymer solution arising from this process is treated at a waste water treatment plant; this process produces a dried polymer cake.

Reduction Opportunities

There could be several opportunities to minimise the amount of polymer waste generated. This includes improving catalyst performance or reaction parameters including composition of raw materials and/or modifying the process. However, it is difficult to ascertain any potential changes without understanding the process in detail. Alternatively these wastes may be reduced through improved housekeeping practices.

Reuse Opportunities

Opportunities may exist to recover the waste acrylic polymer solution either on- or off-site.

Recycling Opportunities

Opportunities may exist for its use as a low grade paint for fence staining or sign writing. In particular, the acrylic polymer solution could be used to recondition wooden pallets. Large volumes of wooden pallets are non-returnable; coating pallets with this low grade paint presents opportunities to retrieve and reuse much of this material.

Other identified reuse opportunities include use as a dust suppressant or fuel source.

Feasibility and Priority

The potential for reusing the polymer on wooden pallets is considerable given that large quantity of wooden pallets in good condition are currently disposed to landfill. The option should be a priority for the management of this waste. However, other reuse or recycling options will need to be developed as the amount of waste acrylic polymer solution is likely to be greater than used in reconditioning waste pallets.

4.6.2 Sodium Hydroxide

Sources

Sodium hydroxide solution liquid waste is generated from an air emission scrubbing process. The sodium hydroxide solution generated is relatively weak; however, the amount generated is considerable.

Reduction Opportunities

Existing waste reduction incentives include recirculation of the solution internally. However, after several cycles the solution reaches a relatively low concentration where it is no longer viable to recycle. At this point the solution is diverted to a waste water treatment plant.

Reuse Opportunities

Opportunities may exist for using sodium hydroxide for acid neutralisation. The compatibility for reuse would be dependent on the purity of the solution, volumes available and concentration. Alcoa World Alumina Australia currently utilises lime slurry to neutralise acid. This and other similar processes may present an opportunity for sodium hydroxide reuse.

Feasibility and Priority

The most immediate opportunity for waste exchange is acid neutralisation. The feasibility for reuse of this waste is dependent on the demand and the compatibility of the proposed application in terms of degree of solution purity, volumes required and concentration of solution. However, acid neutralisation may be a viable option worth pursuing and opportunities should be discussed with Alcoa World Alumina Australia and others in the Geelong area.

4.6.3 Oil Contaminated Soil

Sources

Sources of oil contaminated soil includes interceptor sludges, tank sludges, roadside drains and spill clean-ups. At present most oil contaminated soil is disposed of at landfill as prescribed waste. The largest source of this waste is the petrochemical companies. Smaller quantities are also generated at other manufacturing companies, for example, from fuel storage areas.

Much of the oil contaminated soil may be the result of previous practices when environmental protection was not a high priority. While environmental protection standards are much higher today, many companies are faced with the costs of cleaning up contamination caused long ago.

Reduction Opportunities

Opportunities to reduce the amount of oil contaminated soil includes improved housekeeping practices to prevent spillages, ensuring oil storage areas are properly bunded and lined (ie concreted) and monitoring of valve and pipe leakage occurs on a regular basis.

Reuse Opportunities

Technology does exist to recovery hydrocarbons from soil (for example using solvent extraction technology) and reusing them; however, this is generally prohibitive due to the high costs involved and there are cheaper, low technology soil clean up options.

Recycling Opportunities

Opportunities exist for the bioremediation of oil contaminated soil. This also presents an opportunity for reuse of timber waste as a bulking agent. A detailed discussion of this is provided in Section 5.

Feasibility and Priority

Bioremediation through composting appears to be the most viable means of managing contaminated hydrocarbon soil giving consideration to support networks and economic viability. Shell have expressed an interest in trailing bioremediation of their oil contaminated soil. This is discussed in Section 5 of this report.

4.6.4 Spent Cracking Catalyst

Sources

Spent cracking catalysts and other process catalysts were generated from the petroleum refining and polymer production process. Several different types of catalysts are used.

Reduction Opportunities

It is difficult to ascertain whether reduction can be achieved through process modification without fully understanding the process. Reduction may be achieved through rejuvenation of the catalyst and/or recycling as a make-up catalyst. However, at some point the catalyst becomes ineffective and requires replacing.

Reuse Opportunities

Opportunities for reuse include blending spent catalysts with other materials for use as a road base.

Recycling Opportunities

Many catalysts are valuable sources of silica, alumina, vanadium, nickel, chromium, zinc, copper and cobalt depending on the particular catalyst type. Potential therefore exists to recover these metals from the catalysts subject to the market for individual metals.

Those catalysts high in alumina and silicon are a potential raw material for production of portland cement. It is understood that Blue Circle Southern Cement currently receives spent catalysts from Esso and Mobil refineries.

Feasibility and Priority

The feasibility of reduction of catalyst waste to landfill depends on the characteristics of the catalysts and demand for recovered metal products. Investigating the use of this waste from Shell, in particular, in cement manufacture should also be further investigated.

4.6.5 Alumina

Sources

Process units at Shell's petrochemical refinery are a source of waste alumina. Alumina waste is currently disposed of to landfill.

Reduction Opportunities

Reduction of alumina waste is difficult. Process modification may achieve some small reductions, but this waste is expected to continue to be produced.

Reuse Opportunities

There may be opportunities to reuse the alumina waste on site at Shell through rejuvenation of the material.

Recycling Opportunities

There may be opportunities to reprocess the alumina waste at Alcoa World Alumina Australia.

Feasibility and Priority

Discussions between Shell and Alcoa World Alumina Australia should be facilitated to determine the options for reprocessing of the waste at Alcoa World Alumina Australia.

4.6.6 Spent Caustic

Sources

Spent caustic is generated from the process units at the Shell refinery in Geelong. Waste caustic is also generated from cleaning at wineries and breweries.

Reduction Opportunities

There may be opportunities for reduction in caustic waste generated at Shell, breweries and wineries, and other industries generating caustic through review of processes. There are cleaner production examples where the use of caustic in pipe cleaning has been reduced through the use of air cleaning using compressed air and scouring “pigs” (plugs of material that are forced through pipes using compressed air).

Reuse/Recycling Opportunities

Caustic waste may be used to neutralise acid and sewage sludges. However, the presence of heavy metals and mercaptans in the spent caustic generated at the Shell refinery limit opportunities for its reuse. Mercaptans are used to taint and give odour to natural gas, and the caustic generated by Shell is highly odorous.

Feasibility and Priority

The volumes of spent caustic generated at breweries and wineries, and possibly other industries, may warrant collection and reuse for acid neutralisation and stabilisation of sludges. However, reuse of the spent caustic from the refinery does not appear to be feasible due to the presence of contaminants and the odorous nature of the material.

4.7 PRINTING, PUBLISHING AND RECORDING

There is a range of manufacturers within the Geelong area producing printing, publishing and recording products; this includes:

- Companies servicing the photographic industry
- Magazine, posters and calendar publishers

The main sources of processing waste from this sector include:

- Paper
- Waste ink, solvents and ink/solvent sludges
- Printing plates
- Containers and packaging

4.7.1 Paper

Sources

Most paper waste generated by companies in the printing, publishing and recording sector results from trimming rolls of paper, set-up and end of roll paper waste, and from the binding process. Defective process runs also result in waste paper.

Reduction Opportunities

Reduction of waste paper may result from 'fine-tuning' the printing process to minimise wastage and storing and handling stock and product to minimise damage.

Reuse Opportunities

Reuse of the paper waste in-house may be limited. However, shredded paper can be used for packaging products manufactured elsewhere in Geelong in the place of polystyrene balls, for example.

Shredded paper may also be used in horse stables or chicken sheds. The resulting paper and manure material could then be composted.

Waste resulting from initial process runs is ideal for use as smaller sized paper in applications such as schools and kindergartens for art and crafts.

Recycling Opportunities

At present much of the waste paper from this sector is recycled by external recycling contractors. Several of the operators consulted expressed disappointment that systems that were introduced with free pick up several years ago when commodity prices for waste paper were more favourable now cost in the order of $2 to 3 per 240 L wheelie bin, or $5 to 10 per bale/skip.

Some waste paper from printing and publishing processes could be considered for composting, however, the presence of ink may be limiting and therefore trials could be conducted.

.***Feasibility and Priority***

Reduction of paper waste is potentially dependent upon process modification and control. Since much of the waste paper generated is high-grade reuse opportunities, for example supply to schools, are feasible. Given the quantity of waste paper generated recycling should also be a priority.

4.7.2 Ink and Other Printing Chemical Containers

Sources

Many inks, solvents and other chemicals used by the printing, publishing and recording products sector are stored in small containers resulting in large amount of packaging wastes. Empty chemical containers typically contain some ink and other chemical residues.

Reduction Opportunities

Reduction of this waste will result from use of bulk or refillable containers. For ease of handling and to eliminate occupational health and safety concerns, containers should have a tap attached so that lifting of the larger containers is not required. Manufacturers should explore alternative means of chemical packaging with their supplies, one that provides the raw materials in bulk and does not compromise occupational health and safety.

Reuse Opportunities

Ink and other printing chemical container waste may be reduced through reusing the containers and/or returning the empty containers to the suppliers. However the presence of contaminants does limit options for reuse unless a system can be established where the original chemical stored in the container is easily identifiable.

Recycling Opportunities

Plastic containers may potentially have a high calorific value for use as a fuel source. Alternatively glass and plastic containers may be collected for recycled; the feasibility of this would depend on the toxicity of the chemical stored in the container.

Feasibility and Priority

It appears that the most feasible option for the reduction of ink and other printing chemical containers is to use bulk containers that can be refilled by the supplier(s). This may require an approach by this industrial sector as a whole to pressure suppliers to provide bulk containers.

4.7.3 Waste Chemicals

Sources

Relatively small amounts of inks, solvents, ink and solvent sludges, and photographic development solutions are generated through the printing and publishing processes.

Reduction Opportunities

Reduction of chemical wastes may result from fine tuning the printing process, for example, adjusting the amount of solvents used.

Reuse Opportunities

Opportunities exist to recover solvents, either on- or off-site for potential reuse.

Solvents may be utilised as a fuel source.

Solvents that are slightly dirty from a single use for cleaning printing equipment may be able to be used by other industries for cleaning. For example, machinery and equipment workshops cleaning oily surfaces may not need virgin quality solvents.

Recycling Opportunities

Technologies exist to recovery metals from photographic films, silver in particular is recovered. At Sands Print Group process plant, an in-house de-silvering unit is used to recover silver from photographic solutions.

There are a number of solvent recycling operations in Melbourne that may be able to receive used printing solvents. Alternatively, solvents could be used as a fuel source at cement kilns.

Review of literature has revealed that the Clean Washington Centre has investigated the use of de-inker sludge, and pulped mixed waste paper, for use as fire door core material. The project developed manufacturing procedures and fire resistance testing for the doors.

Feasibility and Priority

Given the market value for silver and current practice, it appears that the recovery of silver and other metals is a viable option for the management of photographic chemicals.

Opportunities for solvent reuse by other manufactures, solvent recycling, and/or use as a fuel source should be further investigated by relevant stakeholders in the Geelong region.

4.8 TEXTILES, CLOTHING AND FOOTWEAR

The textile, clothing and footwear sector is diverse and includes:

- Wool scouring businesses;
- Carpet manufacturers;
- Industrial fibre manufacturers;
- Clothing, curtains and bedding manufacturers;
- Shoe and shoe components.

The main waste types from the textile, clothing and footwear sector includes:

- Synthetic and synthetic blend fibres and off-cuts;
- Natural fibres;
- Scouring/cleaning wastes;
- End spools (yarns/threads);
- Cones;
- Leather/'skins';
- Plastic extrusions;
- Cardboard tubes.

4.8.1 Fabric off-cuts

Sources

Fabric off-cuts include side trimmings, fabric from the end of rolls and off-cuts from the cutting of pieces prior to sewing garments. Fabric off-cuts result from the manufacture of the fabric and manufacture of fabric products such as clothing and curtains.

Reduction Opportunities

Reduction of fabric off-cuts will be achieved through better design of processes. For example, a number of pieces of clothing sections can be cut from standard lengths of fabric with the remainder becoming waste. By incorporating the size of the fabric as a design issue (by cutting the fabric a different way), the amount of waste can be minimised.

Manufacturers should discuss with suppliers/clients their specific needs so that fabric bought/sold is the size required to minimise wastage.

Reuse Opportunities

Fabric off-cuts can be reused in a number of applications. Fabric off-cuts can be converted to polishing and cleaning rags or into new textile fibre.

Treemax (telephone 9429 6000, located in North Richmond) manufacture erosion control jute matting and are interested in receiving waste fabric for use. Unfortunately they are unable to use wool because it is water repellent. They are particularly interested in cotton and poly-cotton and may be able to receive up to 70 tonnes per year of this particular waste.

Recycling Opportunities

A number of textile merchants exist. Pioneer Textiles Pty Ltd (located in Fitzroy, telephone 9419 4658) have expressed an interest in receiving waste textiles from Geelong manufacturers. They are able to accept waste wool, nylon, polypropylene, acrylic, cotton and polyester raw fibre through to finished off-cuts. Pioneer Textiles also collect synthetic and wool carpet ends; they currently collect carpet waste from Godfrey Hirst.

Carpet is a difficult material to recycle as it is a composite product consisting of a number if materials including latex, polypropylene, PVC, nylon and natural fibres. However, in the United States a number of chemical and mechanical recycling systems have been trialed. The main motive to recycling carpets is to recover nylon. Nylon can be recovered for use in making black recycled-content engineering resins such as those used in automotive parts. Reclaimed carpet materials have also been used to make backing for new carpet. The feasibility of carpet recycling would be improved if both carpet off-cuts and old carpets no longer required were to be recycled at the same facility.

Feasibility and Priority

Where feasible the exchange of waste fabric between Geelong manufacturers and companies such as Treemax, Pioneer Textiles are others that may be identified in the future as a immediate option for waste exchange should be encouraged.

4.8.2 Thread and Yarn

Sources

Waste thread and yarn is primarily generated from partially used spools. Weaving machinery is typically set up so that a weaving run stops before any spool empties, and all spools, some with tens or even hundreds of metres of yarn, are then replaced. The length of thread/yarn on a new spool can vary significantly, so operators tend to conservatively estimate the duration of runs. Operators prefer to leave a significant “margin of error” between the weaving run finishing and the total expiry of spools, with some stating that breakages in thread were likely as spools approached their end. This results in many unused spools

and large amounts of waste thread and yarn. The mixed composition of thread/yarn with a plastic, cardboard or plastic/ceramic cone makes these end spools recycling a problem.

Reduction Opportunities

Reduction of waste thread and yarn could be reduced if machines were better calibrated so that weaving runs finished closer to the total expiry of the spools. Those interviewed about this agreed that this would work, but preferred to keep "a margin of error" rather than risk breakage or one spool finishing. Suppliers of threads/yard could assist in promoting reduction by adopting quality assurance that ensured more standard lengths of thread/yarn on each spool and design so that breakages were less common.

Reuse Opportunities

Melba Industries currently recover yarn from partially used spools using a full-time staff member and re-spooling machine that winds and joins partial spools to make a "seconds" grade thread/yarn that is used for edges of fabrics (which are trimmed). They could also be used for lesser grade fabrics. The respooling equipment is thirty or more years old, and although labour-intensive saves resources and empties plastic polypropylene cones that will be able to be recycled, resulting in significant reduction in waste volumes and disposal costs.

There may be an opportunity for weavers (or an entrepreneur) to individually or collectively invest in respooling machines to recover thread/yarn for reuse and recycle or reuse cones.

There is potential for excess thread/yarn to be reused off-site by individuals, businesses or organisations wanting them. Some threads could be used for sowing, while carpet yarns may be used for cottage industry and craft weavers. Threads, yarns and cones can also be used by school arts and craft classes and Waste Werks currently takes some of these materials to supply this market, which is very small relative to the quantities of thread/yarn generated.

Recycling Opportunities

It may be possible for threads/yarns to be shredded and either re-spun or used in non-woven fibre products. One business consulted is developing technology for shredding and re-spinning synthetic threads. The development of this technology is currently confidential, although once developed there may be potential for the firm to receive suitable threads from other businesses for recycling.

Feasibility and Priority

Emphasis should be placed on reducing this waste by retrieving yarn from half empty spools by an existing or new business.

4.8.3 Plastic and Cardboard Cones and Cardboard Rolls

Sources

Plastic and cardboard cones and cardboard rolls are sourced predominantly through transport of yarn and fibre to the manufacturer.

Reduction Opportunities

Reduction of this waste will occur by returning empty cones to the supplier. It should be noted that some yarn is imported; hence returning empty spools to the supplier is not likely to be feasible.

Use of stronger, returnable rolls for fabric will encourage reuse and therefore waste avoidance.

Reuse Opportunities

The empty cones and rolls could be sent to manufactures of yarn and fibre for reuse there. Other reuse options include use in craft and hobby applications; however this will be limited.

Recycling Opportunities

The plastic cones used for yarn are made from polypropylene. This material can be recycled and markets for recycled polypropylene are increasing but require further development.

The cardboard cones and rolls are also able to be recycled.

Feasibility and Priority

Reuse and recycling opportunities will be greater is any remaining yarn or fabric is removed from the canes and rolls. Returning empty rolls and cones to suppliers presents the greatest opportunity to reduce this waste type.

4.8.4 Acrylic butyl styrene (ABS)

Sources

Acrylic butyl styrene (ABS) is generated by Burrowes Industries, through the shoe component moulding process, at a rate of 3 tones per year; some of this is reground and incorporated into new product and the remainder landfilled.

Reduction Opportunities

Reduction of ABS waste may result from process fine tuning and greater quality control to reduce reject and non-specification products.

Reuse Opportunities

Burrowes Industries grinds and incorporate some waste ABS into new product.

Recycling Opportunities

Wharington International Pty Ltd, located in Huntingdale telephone 9544 5533, manufacture a range of products from recycled ABS resin. They predominantly manufacture outdoor and office furniture and exterior planters. Their products incorporate up to 75% recycled resins which has been sourced from a variety of materials that would have otherwise been landfilled. Contact details for Burrowes Industries has been passed onto Wharington International.

Feasibility and Priority

Diversion of ABS waste to Wharington International, or any other businesses recycling this waste, presents an immediate opportunity to reduce this waste.

4.9 WOOD AND PAPER PRODUCTS

The wood and paper products sector is diverse and includes:

- Timber milling and chipping operations;
- Furniture manufacturing.

The main waste types from the wood and paper products sector includes:

- Timber off-cuts and sawdust;
- Scrap metal;
- Resins/glues;
- Fabric, foam, plastic (from furniture manufacture).

4.9.1 Timber off-cuts and chips

Sources

Waste timber off-cuts are sourced from a number businesses in Geelong, including furniture manufacturers, cabinet makers, floor and wall truss manufacturers, and timber milling and treatment companies. The timber milling and treatment companies are typically located in Colac rather than Geelong.

Reduction Opportunities

Reduction of waste timber off-cuts can be achieved through better design of processes. For example, a number of pieces for a furniture item can be cut from standard sized timber panels with the remainder becoming waste. By incorporating the size of the standard panels as a design issue (by cutting the panels a different way), the number of panels used per item and the amount of waste can be minimised.

Reuse Opportunities

Furniture manufacturers, cabinet makers and the like can reuse timber off-cuts on site. Timber off-cuts can be cut to size and incorporated into new products as support, spacers or packer pieces.

Timber off-cuts and chips may be diverted from landfill and processed into products such as particleboard. Laminex Industries, formerly located in Ballarat, used waste timber off-cuts in particleboard manufacture. Unfortunately Laminex's Ballarat operation ceased production in July 1999.

Recycling Opportunities

Timber off-cuts and chips can be incorporated into composting systems as a bulking agent. Alcoa World Alumina Australia/KAAL are to commence the composting of oily waste waters with chipped timber as part of the bulking agent to be used. There is potential to do the same elsewhere in Geelong; this includes composting hydrocarbon wastes at Shell and food and wool scour waste generated across the region.

Feasibility and Priority

Use of timber off-cuts in composting operations should be seen as a priority in the Geelong area. Treatment of a range of organic wastes via composting already occurs in Geelong and an increase in this practice is likely to occur. Composting hydrocarbon wastes in particular requires use of a bulking agent of which waste timber is an ideal material.

4.9.2 Saw dust

Sources

Sawdust is generated via the cutting of timber either at the mill or in production of furniture and other timber products. Timber mills generate large volumes while the furniture and other timber product manufacturers typically manufacture smaller volumes.

Reduction Opportunities

Reduction of sawdust waste is difficult as it is basically inherent in the process of sawing timber. Emphasis therefore should be placed on collected this waste and using it in a beneficial application.

Reuse Opportunities

Fuel made from sawdust is currently offered for sale in many parts of Europe and America. There are attempts being made in Australia to establish a commercially viable wood briquette operation. No glues or resins are used to manufacture the product; the sawdust 'logs' are extruded from a machine under pressure which relies on natural adhesion between wood components. The product competes with firewood rather than coal-based briquettes.

Waste sawdust can be used as a floor base in chicken sheds and horse stables. Steggles, for example, use wood shavings and rice hulls as chicken litter at their farms throughout Victoria. There may be opportunities for diverting waste sawdust to Steggles for use.

Recycling Opportunities

Sawdust can be composted. Envirogreen, located in Moolap, currently use some sawdust to produce a range of potting mixes and soils. Composting is discussed elsewhere in this report in greater detail.

Feasibility and Priority

Emphasis should be placed on diverting waste sawdust to companies such as Steggles for reuse; this will result in immediate diversion of waste from landfill.

In the longer term, establishment of a composting operation to treat industrial organic wastes is likely. The use of sawdust in such an operation should be investigated at that time.

4.10 OPPORTUNITIES FOR GEELONG BUSINESSES TO DEVELOP AND MARKET TECHNOLOGIES AND EXPERTISE

As more companies adopt waste minimisation principles there will be an increasing demand for products and services that help manufacturers to increase productivity through waste minimisation.

A number of opportunities for Geelong manufacturer's that have developed technologies and expertise have been identified, including:

- **Alcoa World Alumina Australia /KAAL.** Alcoa World Alumina Australia and KAAL could market expertise gained through the development and implementation of their highly successful waste minimisation systems. They will also be in a position to market the expertise that they will gain through the operation of a bioremediation facility that they have trialed and will commence full operation of during May 1999. They are potentially a very valuable source

of information and expertise and have a strong commitment to environmental improvement and community involvement.

- **Geelong Wool Combing.** Geelong Wool Combing could also market their experience in developing and implementing waste minimisation systems, particularly to the textile industry. They also have a high level of expertise in the area of composting non-petroleum organic sludges.

- **Pilkington.** Pilkington could also market the expertise that they have developed in implementing waste minimisation systems. They may be able to market or share their experiences with reusable and returnable transport packaging.

- **Ford.** Ford have experience in the area of waste reduction from foundry and machinery and equipment tooling and assembly operations. They are also exploring options for reducing and reusing transport packaging. The expertise gained through these programs may be marketable.

- **Blue Circle Cement.** Blue Circle's main expertise in the area of waste management is regarding the suitability and economic viability of recovering energy from particular waste streams.

- **Quiksilver and Rip Curl.** Both of these companies have undertaken initiatives to increase productivity through wast reduction and reuse. Some of their initiatives are of particular relevance to small to medium sized businesses, such as the:
  - introduction of environmental/waste staff representatives
  - reuse of cartons in which stock is received
  - introduction of returnable and reusable plastic cartons for suppling retailers
  - reuse of fabric (neoprene) scraps to make small saleable products (this examples could be adopted by leather cutting enterprises such as footwear manufacturers, who could possibly sell leather off-cuts for production of key-rings, wallets etc.)

- **Godfrey Hirst and Riverside Textiles.** These two associated businesses are innovators in waste minimisation and are developing technologies to maximise the reuse and recycling of products. Their expertise is particularly applicable to the textile industry.

- **Beaumont Pies.** Beaumont Pies are another medium-sized business undertaking simple but effective measures to reduce waste. Their innovation of monitoring wastes and educating staff to achieve a 30% reduction in prescribed waste is an excellent example of management rather than physical measures that can be taken to profitably reduce waste.

- **Rohm and Haas.** As another company that has a continually improving waste minimisation program, Rohm and Haas could provide expertise to the chemical industry regarding technologies and management systems to reduce and reuse wastes and increase productivity.

It is recommended that these and other businesses that have adopted and developed waste minimisation technologies and expertise should be invited to contribute to the development of an "experts register" that can provide advice and support to other Geelong manufacturers seeking improvements in waste minimisation and management.

Case study fact-sheets and posters are being prepared describing the innovations of these companies.

5. CONCLUSIONS AND RECOMMENDATIONS: PRELIMINARY ASSESSMENT AND SCOPING OF FEASIBILITY STUDIES

5.1 OVERVIEW

Numerous promising examples of, and opportunities for, waste reduction and reuse have been identified in Section 4. General opportunities for waste exchange are summarised in Figure 5.1.

Information contained in Figure 5.1 can be used to facilitate waste exchange between individual manufacturers and should be used in conjunction with the contacts list in Appendix B and possibly the list of recycling contractors operating in Geelong provided in Table 3.10.

The matrix in Figure 5.1 has been derived through identifying potential opportunities for material exchange between industry sectors. The industry sectors identified in the columns have the potential to accept specific materials generated by sectors listed in the corresponding rows.

For example, waste textiles could be used by the printing, publishing and recording, metal products, non-metallic minerals, machinery and equipment, and petroleum and coal products sectors as cleaning cloths and rags. Figure 5.1 also shows that organic sludges from the food and beverage, and textiles, clothing and footware (namely wool scour waste) sectors are suitable for composting. Foundry sands generated by metal products, and machinery and equipment sectors could be used in the manufacture of cement (non-metallic minerals sector).

The feasibility of both general, but more particularly, specific options are assessed in Sections 5.2 to 5.11. Conclusions and recommendations are made regarding actions that the Geelong Manufacturing Council and other stakeholders in the Geelong region can take in encouraging and investing in trials or direct up-take for opportunities.

In assessing options, consideration has been given to factors that are likely to influence the acceptability, success, and rate of adoption of innovations, including:

- **Cost:** For most manufacturers, the capital cost of implementing or participating in systems to minimise and reuse wastes will be a major limiting factor. Many small and medium sized companies with limited cash flow and uncertainty about the future will be unable or unwilling to invest in expensive plant or equipment. Typically companies will give preference to low-cost systems where the benefits are immediate and large relative to investment.
- **Benefit/Reward:** Manufacturers will typically expect to financial benefit from waste reduction and reuse. However, a number indicated a willingness to be involved if it was cost neutral and benefited the environment or stopped what they saw as wasteful use of resources, indicating that non-financial rewards can motivate adoption.
- **Risk:** Manufacturers are likely to need to be reassured that there are no risks associated with trials. Options with no risk to participants have been favoured. Potential liability issues are considered.
- **Simplicity:** Innovations are more likely to be adopted if they are simple to understand. Although consideration has been given to some reciprocal waste for waste and waste for product/service “swap” options, direct one-way transactions of waste for free or reduced cost without reciprocal obligation have been favoured.

THESE SECTORS SUPPLY	THESE SECTORS CAN ACCEPT								PROCESSING OPTIONS		
	FOOD AND BEVERAGE	**TEXTILE, CLOTHING AND FOOTWARE**	**WOOD AND PAPER PRODUCTS**	**PRINTING, PUBLISHING AND RECORDING**	**METAL PRODUCTS**	**NON-METALLIC MINERALS**	**MACHINERY AND EQUIPMENT**	**PETROLEUM AND COAL PRODUCTS**	**COMPOST/ BIO-REMEDIATION**	**PALLETS / TRANSPORT PACKAGING REUSE**	**GENERAL RECYCLING**
FOOD AND BEVERAGE	A	-	-	-	B	B	B	B, C	a, b	✓	✓
TEXTILES, CLOTHING AND FOOTWARE	-	D	-	E	E	E	E	E, C	a, b	✓	✓
WOOD AND PAPER PRODUCTS	-	-	F	-	G	-	-	C	a	✓	✓
PRINTING, PUBLISHING AND RECORDING	-	-	-	-	-	H	-	C, H	a	✓	✓
METAL PRODUCTS	-	-	-	-	I, J	J,K	K	C, K	c	✓	✓
NON-METALLIC MINERALS	-	-	L	-	K	J, M	K	C, K	c	✓	✓
MACHINERY AND EQUIPMENT	-	-	L	-	I	J,K, M	K	C, K	c	✓	✓
PETROLEUM AND COAL PRODUCTS	-	-	-	-	K	J,K,M	K	C,K	c	✓	✓

FIGURE 5.1 - OPPORTUNITIES FOR WASTE EXCHANGE IN GEELONG

KEY

A =Food by-products can be reused (eg. Yeast to vegemite production, animal oils to bakeries)
B = Acid neutralisation (Caustic)
C = Oil/Solvent to fuel
D = Textile reuse/recycling (eg. yarn/thread, scrap)
E = Cleaning Cloth
F = Timber reuse/recycling
G = Metals recycling
H = Chemical recycling/reuse – (eg. silver, solvents, tints)
I = Scrap metals
J = Use of foundry sands, ashes
K = Use of acids, alkalis, abrasives
L = Paints/coatings/sands
M = Reuse of production minerals, fly & bottom ash
a = Composting food, natural fibres and timber
b = Composting non-petroleum organic sludges
c = Bioremediation of petroleum oily sludges and dusts
✓ = All waste types/sources

- **Compatibility with existing practices:** Changes that are compatible with existing practices are more acceptable to industry.
- **"Trialability":** Companies are likely to adopt an innovation if they can first trial it, with the option of reversing the decision with minimal/no cost if it fails to meet their expectations.
- **Visibility:** Up-take of innovations by other businesses is likely to be quicker if they are visible. Individual companies may also be more likely to adopt an innovation if they can derive benefit and/or kudos from being seen to "do the right thing".
- **Other Priorities:** Companies may be have other compatible priorities such as environmental management policies, environmental management systems, ISO 14000 accreditation (or commitment to achieving accreditation or ISO 14000 standards without accreditation), EPA Accredited Licensee status (or desire to achieve it), BRWMG/EcoRecycle Victoria Waste Wise recognition; or market opportunities if they can demonstrate environmental improvement.

There are many other opportunities for industrial waste exchange in the Geelong area. Sections 5.2 to 5.11 contain details of a number of opportunities for waste exchange and developed into investment opportunities for the second stage of the Geelong Manufacturing Council Industrial Waste Identification and Opportunity Analysis Project that will involve the trial and implementation of favourable opportunities. Both company-specific and general/collective opportunities have been identified and assessed, with recommendations being made about the feasibility of the opportunities in terms of cost benefits and immediate practicality and ease of implementation.

5.2 COMPOSTING AND BIOREMEDIATION

This project has identified great potential for composting operations to process:

- Organic wastes from food processors and wool scourers;
- Wood chip and shaving waste from sawmills, timber processors and wood chip exporters;
- Chipped timber waste from wood product manufacturers and transport pallets;
- Manures from animal raising and holding yards.

Organic materials, particularly garden and food wastes, could be sourced from domestic and service sector sources. Bio-solids from Barwon Water treatment facilities could also be composted.

Markets for composting products will need to be further developed. Promising markets include parks and gardens, domestic gardeners, nurseries and "instant" turf growers. Potentially large markets that require further development are the market garden horticultural, viticultural and broad-acre agricultural applications.

Barwon Regional Waste Management Group and Barwon Water are both currently investigating the feasibility of opportunities for composting organic wastes.

OPPORTUNITY 1: Geelong Wool Combing Composting

Geelong Wool Combing operate a composting facility to process their wool scour wastes using all sawdust/wood-shavings from Tasco (as a bulking agent) and some hide/hair waste from Vic Hides (as a nitrogen source) to produce high grade compost products. The facility currently processes about 100 tonnes of wool scour waste and produces over 500 tonnes of compost each week.

There is opportunity for other wool scour wastes, and possibly food processing wastes to be processed at the facility. Because all of Tasco's wood waste is absorbed by the current operation, additional bulking agents are needed. Geelong Wool Combing have expressed preference for clean softwood shavings similar to the Tasco by-product. There is potential to source this material from wood processors, such as Colonial Pine. Clean pallets or other timber waste could also be ground to an acceptable particle size.

The Geelong Wool Combing site has area to expand up to four times the current production, although buffer distances from residents would have to be maintained. As volumes of wool scour, and particularly food processing wastes increase, greater buffer distances will typically be needed.

Geelong Wool Combing have expressed interest in investigating, and possibly trialing, receiving wool scour wastes from other textile manufacturers. They have expressed some concerns regarding chemical wool scouring and quality assurance for wool scour wastes from other sites. There may be opportunities for companies currently paying $36.50 per tonne for the landfilling of their wool scour wastes to modify practices to ensure that the by-product is acceptable to Geelong Wool Combing.

Clyde Wool Scouring currently send wool scour waste to Mt Duneed for land farming (it is not composted, but allowed to mature on the site). This material might be better processed at the Geelong Wool Combing facility. The facility has capacity to process all of Geelong's wool scouring waste. In 1996, 3,400 tonnes of wool scour waste were received at Corio landfill.

It is recommended that Geelong Wool Combing, Clyde Wool Scouring (or other wool scourer(s)), and Colonial Pine (or other generator(s) of clean fine timber shavings) are invited to participate in a trial expansion of the Geelong Wool Combing composting operation. If successful, encourage expansion of the operation to receive, on a cost-for-service basis, wool scour waste and possibly less odorous food processing wastes such as grease-trap waste as a nitrogen source.

Potential annual cost savings to Geelong manufacturers (additional to existing savings):
Avoided landfill costs of up to

- 3,400 tonnes of wool scour waste @$46.50/tonne	=	$158,100
- 10,000 tonnes of timber waste @ $30.00/tonne	=	$300,000
- 30 tonnes of grease trap waste @ $46.50/tonne	=	$ 1,395
TOTAL		**$459,485**

FEASIBILITY: HIGH PRIORITY: HIGH

5.3 BIOREMEDIATION

A promising extension of composting is "bioremediation". Bioremediation involves the biological metabolism and decomposition of industrial wastes including mineral oils and petroleum hydrocarbons. Mixing contaminated liquids, sludges and soils with a compost starter mix allows microorganisms to metabolise and biodegrade hydrocarbon contaminants.

This project has identified bioremediation as a potential alternative for the management of oily sludges from the petroleum and chemical, metal products, and potentially machinery and equipment sectors. Oily sludges from interceptors from Geelong mechanics and auto workshops might also be able to be processed through bioremediation. Sites contaminated with hydrocarbons (such as former gasworks and petroleum storage sites) can also be cleaned using bioremediation. A key issues for bioremediation include the levels of other contaminants, particularly heavy metals, which can restrict uses of bioremediation compost products. Compost products may not meet specifications allowing sale, but can be either disposed of to land under controlled conditions, or, if levels are too high for this, disposed of to landfill as Low level Contaminated Soil at a significantly reduced rate than disposal as prescribed waste. This material can be used as cover material in landfills.

Alcoa World Alumina Australia have recently conducted successful bioremediation trials for processing oily waste streams generated at their Point Henry facility, and will commence a full scale operation in May 1999. Previously these wastes were incinerated or sent to settling and evaporation ponds with the sludge being disposed of as prescribed waste. This facility will require woody bulking agents and sources of nitrogen, potentially from food waste processors. The facility will also trial the composting/bioremediation of fly ash from Alcoa World Alumina Australia's Anglesea power station. Bioremediated products will be used for landscaping on-site as part an EPA approved waste reuse program. This will require that environmental impacts of reuse of the materials are monitored and that materials are not used in sensitive areas.

During the course of this project, Midway Pty Ltd which currently landfills large quantities of dirty woody waste (1,500 m^3 per month) and Steggles which generates large quantities of high nitrogen chicken manure/litter, have been put in contact with the contractor establishing the Alcoa World Alumina Australia site, Organic Recyclers Pty Ltd. These by-products may now be used in the Alcoa World Alumina Australia bioremediation operation.

Another opportunity that has been identified is the bioremediation of oily sludges from Shell. Currently, they dispose of 2,000 tonnes per year of this material as prescribed waste and welcome the opportunity to trial bioremediation opportunities. They have a large site with buffers of over 800 metres that, due to safety restrictions on developments near a refinery, will not be encroached on by urban developments. These buffers make the site a potentially excellent compost and bioremediation site. Shell believes that soils could be bioremediated for "land-farming" (ie. on-site use).

OPPORTUNITY 2: BIOREMEDIATION AT ALCOA WORLD ALUMINA AUSTRALIA

There is opportunity for Geelong manufacturers to provide Alcoa World Alumina Australia's bioremediation operation with wood waste and sources of nitrogen. It is recommended that the involvement of Midway and Steggles (and other sources of suitable by-products if additional materials are required) be encouraged and that outcomes of the trial are promoted. Potential savings in landfill gate fees for Midway and Steggles are in the order of $100,000 and $50,000 per year respectively.

OPPORTUNITY 3: BIOREMEDIATION TRIAL AT SHELL

It is recommended that Shell be encouraged to trial bioremediation of oily sludges. Wood waste from Midway or an alternative source and nitrogen from food processing/ grease-trap/ leather processing and/or Steggles' chicken raising sheds should be sourced for the trial.

Shell will require an EPA Research, Development and Demonstration approval to conduct the trial. In the event that the trial is successful and Shell decide to proceed, they will be able to apply for the approved reuse of the oily waste and other prescribed wastes (such as food processing waste) received at the bioremediation facility. The potential waste disposal cost savings to Shell and other manufacturers that will not have to pay for prescribed waste transport are in the order of $100,000 to $200,000 per year.

It is recommended that relevant stakeholders facilitate a Bioremediation trial of Shell's oily sludges and promote outcomes of the trial.

FEASIBILITY: GOOD PRIORITY: HIGH

OPPORTUNITY 4: MARKETING OF COMPOSTING AND BIOREMEDIATION EXPERTISE

Geelong businesses have potentially valuable expertise in the composting and bioremediation of prescribed manufacturing wastes. These could potentially be marketed to other businesses. As the cost of prescribed waste disposal increases, the demand for such services is likely to grow.

It is recommended that the Geelong Manufacturing Council, City of Greater Geelong and Barwon Regional Waste Management Group considers promoting the Alcoa World Alumina Australia and Geelong Wool Combing examples to Victorian and Australian industries as Best Practice examples.

FEASIBILITY: GOOD
PRIORITY: MEDIUM (PARTICULARLY UNTIL FURTHER TRIALS HAVE BEEN CONDUCTED)

5.4 ORGANIC FUELS AND STOCK FEED

Another opportunity for organic waste management may be the production and use of wood-derived fuel and/or the production of animal stock feeds from food processing wastes, including vegetable, meat and seafood processing operations. Integrated Environments Pty Ltd has approached the Barwon Regional Waste Management Group regarding technologies that they claim can economically produce fuels and stock feeds. Further information will be supplied to the Barwon Regional Group as a submission being lodge in response to a call for expressions of interest from companies wanting to use the region's wastes as resources.

OPPORTUNITY 5: ORGANIC FUELS AND STOCK FEEDS

It is recommended that relevant stakeholders consider the Integrated Environments proposal for diverting timber and food processing wastes. The food processing operation is not dependent on the use of timber, and may be an appropriate way of managing potentially odorous seafood processing wastes. Integrated Environments claim to have matching funding support from the Pig industry for the development of the food processing technology and are seeking additional funding for a trial. The food processing technology which involves heat sterilisation of mammalian and avian wastes. In the event that timber-derived fuels were not used, waste heat from other industrial processes (eg. Shell's refinery, Pilkington's baking ovens may be able to be used)

FEASIBILITY: UNKOWN – WORTHY OF FURTHER INVESTIGATION
PRIORITY: MEDIUM

5.5 FOUNDRY SANDS

Due to innovations undertaken by Ford in developing and achieving EPA approval for Flowable Fill material in Australia, Geelong manufacturers generating foundry sand now have opportunity for reuse. Ford also has the opportunity to market the service to foundries within the Geelong and Melbourne areas. Market demand considerations will largely determine whether Foundry sands are reused.

Waste reduction strategies such as the use of more appropriately sized moulding containers should also be promoted.

Markets for Flowable Fill need to be developed. This project has identified two possibly collaborators, Vic Pits and Local Mix Concrete, willing to trial the use of Flowable Fill in pre-poured concrete products.

OPPORTUNITY 6: FOUNDRY SAND REUSE

It is recommended a trial of Flowable Fill by Vic Pits and Local Mix Concrete be encouraged and promoted. It is also recommended that foundry from other sand be chemically tested to determine whether it would be suitable for reuse. Ford may be able to provide advice regarding achievement of reusable quality sands.

FEASIBILITY: HIGH PRIORITY: HIGH

OPPORTUNITY 7: FOUNDRY SAND REUSE DEMONSTRATIONS

A possible demonstration application of Flowable Fill could be sealing windrow areas in any Composting or Bioremediation facility if required by the EPA, or timber processing facility work. These options could be considered if such facilities are established.

FEASIBILITY: GOOD PRIORITY: MEDIUM
FEASIBILITY: MODERATE PRIORITY: LOW – MODERATE

5.6 TIMBER WASTE DIVERSION

5.6.1 Hardwood Non-Returnable Pallets

Geelong manufacturers generate a large number of sturdy hardwood pallets each day. To an extent this is an “invisible” waste with many of the sites visited not initially recognising it as a waste in their survey responses. Many others appeared to under-estimates its significance to their waste stream. Many of those surveyed and visited had ad hoc systems for the removal of pallets with people taking them on an infrequent basis for firewood or small structural jobs (cubby houses, kennels, etc). Many of the sturdy non-returnable hardwood pallets are virtually indistinguishable in dimension and strength to commercially returnable pallets. These pallets are largely from imported stock.

There is a business opportunity for sturdy unreturnable pallets to be reclaimed as a free resource, screened, repaired and labelled, and then sold or hired to transport and other companies as reusable pallets. Reusable pallets retail for $10 to $15 each. Waste paint from Rohm and Haas (who have a suitable polymer waste) or other sources (such as waste paint from manufacturing, commercial or domestic sources) could be used to paint and label reclaimed pallets. Waste paints could be mixed and possibly tinted to a standardised colour so that the pallets are readily identifiable as returnable. It may be possible to paint and label “customised” pallets for sale to Geelong manufacturers who have need to own pallets for movement of stock within or between facilities.

In the event that a new business is established to reclaim these pallets then Business Victoria may be able to assist with funding to enable the preparation of business plans and the like.

OPPORTUNITY 9: NON-RETURNABLE PALLET REUSE

It is recommended that the feasibility of diverting non-returnable hardwood pallets for conversion into reusable pallets be investigated and trialed. The City of Greater Geelong transfer station may be able to use existing or potentially available space (there is a site adjacent to the facility available for hire or sale) and staff, including some mildly intellectually disabled people working under an assisted employment scheme, to divert these and other timber wastes. The facility could also be used as a central depot for the grinding and load consolidation of untreated pine (see Opportunity 8) and chipping for mulching or composting (see Opportunity 10). It is recommended that Rohm and Haas be invited to provide waste paint polymer and technical advice for painting and labelling pallets. It is also recommended that Geelong manufacturers be invited to participate in the trial by using reclaimed pallets on-site and for the transport of stock.

FEASIBILITY: MODERATE - HIGH
PRIORITY: MODERATE - HIGH

5.6.2 Other Untreated Timber Diversion

Because most of the hardwood pallets are from imported stock, the diversion for reuse will not stem the flow of this waste and domestic markets may become saturated with the reclaimed pallets. Although export of the pallets may be possible, it is likely that alternatives will have to be found for many diverted pallets. Other hardwood and softwood timbers from manufacturers that are not suitable for recycling or reuse also need alternative management options.

OPPORTUNITY 10: GENERAL UNTREATED TIMBER

There is an opportunity to process general untreated timber to produce mulches for use as groundcover or use in composting and bioremediation. Such operations could also receive waste timber from construction and demolition, and domestic sources.

It is recommended that promoting to manufacturers the use existing facilities at transfer stations for the diversion of waste timber occur.

FEASIBILITY: HIGH
PRIORITY: MODERATE – HIGH (supports other timber waste diversion)

5.6.3 Treated Timber Diversion

Geelong manufacturers generate timber wastes including treated pallets and crates, particle boards and laminates. These wastes are not considered suitable for recycling or composting. However, there may be potential for them to be ground and used to stabilise high calorific liquid hydrocarbon waste prior to use as an industrial fuel in cement kilns. This needs to be investigated further. The main restriction on this use is the presence of heavy metals in some timber treatments.

5.7 TEXTILES

This project has identified significant opportunities for reduction, reuse and recycling of textile wastes

Reduction opportunities include controlling fugitive fibre “dust” and recovering it for re-spinning, and modifying leather, neoprene and fabric cutting to maximise product from lengths of material. Spinning and weaving enterprises that do not currently control and recover fugitive fibre emissions

Reuse opportunities include the re-spooling of partially empty spools of thread and yearn from weaving operations. Re-spooled threads can be reused on-site or possibly sold/given to other users.

Another reuse opportunity is the use of leather, neoprene and fabric cutting scraps for production of new products. The examples of Rip Curl making “stubby” holders and pencil cases from neoprene scraps; Godfrey Hirst sale of carpet scraps for mat manufacture; and Filigree Textile re-using fabric cuttings from edges of woven cloth to put “lace” on the edges of products, could be emulated by businesses such as Candy’s footwear manufacturing. Scrap leather may be reused on site or sold/given to other manufacturers to produce items such as key-rings, pencil cases, and wallets. Production of small items such as

key-rings and pencil cases labelled with the manufacturer's name could be give away with products (eg. a pair of school shoes) as a promotional exercise and incentive to buyers (eg. "A free pencil case with every pair of school shoes".). Stitching of such products could use excess threads from weaving operations.

Some soft fabrics, waste foams, and possibly neoprene may be able to be used for stuffing cushions. A limited market to supply cottage industry scale manufacturers of dog beds appears to have been quickly saturated.

Waste soft cloth (particularly fleece) fabrics have a reuse market as cleaning cloths. Direct exchange between textile manufacturers and businesses requiring cleaning cloth (representatives were found in most other sectors) could be promoted. However those using cleaning cloths should also be encouraged to consider waste minimisation strategies such as process modification to eliminate/reduce cleaning cloths and/or dry-cleaning of cloths for reuse.

Waste fabrics and threads can be shredded for re-spinning or the manufacture of non-woven fibre products such as insulation, carpet underlay and cleaning cloths. One Geelong textile manufacturer is developing a process for shredding and re-spinning synthetic fibres and may be willing to receive and process suitable materials from other manufacturers on a fee for service basis.

While there are established textile recycling markets in Melbourne, Geelong manufacturers have reported some difficulty in obtaining a consistent collection of waste textiles. There may be benefit in Geelong Manufacturing Council investigating opportunities for consolidating loads of waste textile for collection by a recycler. Pioneer Textiles, textile waste merchants based in Fitzroy, have expressed interest in clean and consistent textiles. Melba Industries, which each day produces almost 4 kilometres of inch- wide edge cuttings from woven poly-cotton blend material, is an obvious candidate for this market. They have been put in touch with Pioneer Textiles.

OPPORTUNITY 11: TEXTILE WASTE

It is recommended that Geelong Manufacturing Council work with Godfrey Hirst, Riverside Textiles and Melba Industries to achieve further waste reduction. In particular, all firms need to secure reliable contracts/agreements for the collection an reuse /recycling of their waste fabrics. They also have issues with the management of cardboard and polypropylene cones and partially full spools and thread and yarn. Godfrey Hirst and Riverside Textiles have made and are making considerable progress, while Melba Industries has opportunities including textile recycling and recycling of empty polypropylene cones.

FEASIBILITY: HIGH PRIORITY: MODERATE

OPPORTUNITY 12: BROKERAGE AND DIVERSION FACILITY FOR TEXTILES

An opportunity may exist for Geelong Manufacturing Council or other body to act as an agent for negotiating agreements with textile recyclers and, possibly with the City of Greater Geelong, providing facilities for the drop-off and sorting of types of textiles to consolidate loads for sale to textile recyclers.

FEASIBILITY: LOW - MODERATE
PRIORITY: LOW - MODERATE (Subject to success of individual companies negotiating with Textile Recyclers)

OPPORTUNITY 13: SIDE-LINE PRODUCTS FROM SCRAP

It is recommended that manufacturers such as Candy be encouraged to nominate and trial the production of products from scrap lengths of material. A discussion topic at the proposed workshops could focus on opportunities and constraints for such side lines. Any trials of the production of such side-lines should measure costs and benefits of sales of side-line products, or, where they are used as promotional items, increased sales of main products..

FEASIBILITY: MODERATE **PRIORITY: LOW - MODERATE**

5.8 CATALYST REUSE

OPPORTUNITY 14: CATALYST REUSE

Catalysts from petroleum and chemical manufacturers have potential reuse as either input for fertiliser manufacture or in the manufacture of portland cement. Shell, which has investigated these options, has found local manufacturers unresponsive. There may be a role for the Geelong Manufacturing Council or other body to ask local fertiliser companies and Blue Circle cement kilns to the trial reuse of catalysts from Shell. Catalysts with mineral content might be able to be reused in composting operations to improve the fertility of products. Other generators of suitable catalyst waste should be identified and invited to participate in a trial.

FEASIBILITY: MODERATE **PRIORITY: LOW - MODERATE**

5.9 CHEMICAL REUSE AND EXCHANGE

There is potential for Geelong manufacturers to reuse each other's chemical wastes. Review of other industrial waste exchange systems has revealed that oils, solvents, acid, alkalis and paints/coatings are commonly traded wastes.

A number of opportunities have been identified for trial within the Geelong area.

It should be noted that operations handling industrial chemical wastes typically require the use of an EPA waste transport and handling operator and a Schedule 4 premises under the *Environmental Protection (Schedule premises and exemptions) Regulations, 1996* for the testing, sorting, stabilisation and reuse/disposal/marketing of collected materials. Direct exchange of prescribed wastes between individual companies may be possible, particularly if an APA approved reuse system is developed. However, it is considered desirable that quality assurance measures are employed including testing of incoming products, screening, treatment and final testing of products prior to exchange. These measures should guarantee the quality of the products and reduce liability associated with possible contamination of exchanged chemicals.

OPPORTUNITY 15: OIL AND SOLVENT REUSE, RECYCLING AND ENERGY RECOVERY

Opportunities exist for oils and solvents to be reused and recycled. There are at least two established solvent recycling operations in Melbourne and a number of operators that clean oils for use as hydraulic oil or use in diesel fuel.

Solvents and oils are also screened, tested and sold to Blue Circle Southern Cement as a fuel. Waste paints may also be processed and used as cement kiln fuel.

There may be potential for solvents that are too dirty after a single use for on-site reuse to be reused by other manufacturers as a cleaning agent. Lower grade uses such as cleaning oil/grease of metals are candidates for such "dirty" solvents.

It is recommended that further investigation of the feasibility of facilitating the exchange of oils and solvents between manufacturers occur, and promoting the use of waste collection services that recycle these materials or process them for use by Blue Circle Southern Cement. A trial of exchange of dirty solvent for reuse for cleaning could be carried out, with the solvent/oil-grease sludge from the cleaning operation sent for recycling or reuse as fuel. Individual companies willing to take part in such as trial could be identified through the proposed workshop process. An EPA approved chemical waste collection and handling company should be involved in such a trial.

FEASIBILITY: MODERATE PRIORITY: MODERATE

OPPORTUNITY 16: EXCHANGE OF ACIDS AND ALAKALIS

There may be opportunities for exchange of acids and alkalis. These could be used a neutralisation agents or as process chemicals.

It is recommended that further investigation of the feasibility of facilitating exchange of these chemicals occur. A trial could be conducted to assess the feasibility of such exchanges.

FEASIBILITY: MODERATE PRIORITY: MODERATE

5.10 WASTE EXCHANGE

Many wastes generated by Geelong manufacturers may potentially be exchanged; this includes timber pallets, plastic buckets and drums, fabric off-cuts, cardboard packaging and other solid and liquid wastes. However, a system needs to be established to facilitate the exchange of the wastes between businesses.

The Geelong Manufacturing Council, along with the City of Greater Geelong, Environment Protection Authority and other bodies, also has a role to play in promoting waste collection and treatment businesses that reuse and recycle wastes. These contractors may act as an agent for waste exchange of prescribed wastes such as acids and alkalis and used solvents.

EcoRecycle Victoria's waste exchange database, located on their Internet site, facilitates the exchange of wastes generated by all businesses in Victoria. Geelong manufacturers could be encouraged to use this free service to find markets for their by-products and source input. Alternatively, a separate waste

exchange system specifically for Geelong could be developed. This is considered to be unnecessary duplication, given the existence of the EcoRecycle Victoria electronic waste exchange. However, recognising that not all manufacturers have the resources or time to access the Internet, it is strongly recommended that a waste exchange directory in which all companies willing to participate list the types and quantities of exchangeable wastes that they generate or could use.

Such a directory could be circulated in "hard" or electronic format and used as a directory of useful contacts. Waste management companies that recycle and reuse wastes could also be listed on such a directory. Such a resource could be up-dated periodically, and would allow manufacturers to deal directly with each other without the need for a "brokerage" role by a third party. Geelong Manufacturing Council and/or the Barwon Regional Waste Management Group could consider providing administrative support to develop, promote and distribute the directory that may be funded through advertising paid by waste collection companies.

The proposed workshops will be used to inform and encourage Geelong manufacturers to recognise the by-products and resources they could exchange. They will also be used to gather initial information about participants willing to trial exchange and details of the types and quantities of by-product they generate or could use.

OPPORTUNITY 17: WASTE EXCHANGE

A system for waste exchange between Geelong manufacturers should be established with support from industry. A register of businesses in Geelong offering waste recycling and reuse services should made available to all Geelong manufacturers in hard copy and/or electronic format.

It is recommended that further investigation of the possibility of establishing a facility for non-prescribed waste exchange occur. The Barwon Regional Waste Management Group and City of Greater Geelong are currently considering the possibility of purchasing a property adjacent to Geelong North transfer station for this purpose. This facility is more centrally located than other sites, such as Corio landfill. Such a facility would need to be well promoted to ensure its success.

FEASIBILITY: HIGH – MEDIUM **PRIORITY: HIGH**

5.11 EDUCATION AND PROMOTION

Education is an important factor in waste minimisation. Geelong manufacturers need to be made aware of the benefits of reducing waste and opportunities for waste reduction in their own businesses. This project forms stage one of the education process.

Waste minimisation education needs to encompass all aspects of manufacturing from staff education and training, to promoting opportunities for waste reduction and exchange.

Subject to the availability of funds and resources there may be opportunity for the creation of a Regional Education Officer role dedicated to industrial waste minimisation and exchange. The Barwon Regional Waste Management Group, whose responsibility it is to provide waste reduction education services to

Geelong manufacturers, is interested in the creation of such a position, which will require funding, possibly from EcoRecycle Victoria, member councils and industry.

OPPORTUNITY 18: EDUCATION

It is recommended that promotion of the benefits of and best practice examples of waste reduction to Geelong manufacturers occur. This should be done in conjunction with the Barwon Regional Waste Management Group and their Regional Education Officer. There may be a role for an Education Officer dedicated to the facilitation of industrial waste reduction and exchange.

FEASIBILITY: HIGH PRIORITY: HIGH

The proposed industry workshops to be held as part of this stage of the project will be used to actively promote waste minimisation and exchange. Several opportunities for waste minimisation and exchange have already been identified and acted on, with individual manufacturers being introduced to others that may be able to receive or supply useful by-product materials. The workshops will be used to identify and expand possible exchange networks and to move to secure agreement from interested parties to participate in trials of reduction and exchange initiatives.

Case study fact sheets and posters are being prepared, and these will be able to be used to further promote waste minimisation and exchange.

5.12 SUMMARY

The opportunities outlined in the previous sections have been prioritised according to the costs and benefits of each opportunity. Table 5.1 summarises this.

TABLE 5.1 - WASTE EXCHANGE OPPORTUNITY PRIORITIES

OPPORTUNITY	PRIORITY	COMMENT
Geelong Wool Combing Composting	High	This operation already exists and therefore does not necessarily require input from the Geelong Manufacturing Council to expand. However, there is potential for wool scour waste from other textile manufacturers to be processed on site.
Bioremediation at Alcoa World Alumina Australia	High	This operation has recently commenced; the Geelong Manufacturing Council may facilitate the involvement of other manufacturers.
Bioremediation trial at Shell	High	It is recommended that the Geelong Manufacturing Council facilitates and promotes outcomes of this trial.
Foundry sand reuse	High	This opportunity is likely to require some facilitation by the Geelong Manufacturing Council for it to occur.
Waste exchange	High	The establishment of a non-prescribed waste exchange facility will need the support of the Geelong Manufacturing Council, City of Geelong and Barwon Regional Waste Management Group.
Education	High	Ongoing promotion of waste reduction and exchange will be required to build upon the successes of this project.
Non-returnable pallet reuse	Medium – High	This opportunity will require support from the Geelong Manufacturing Council, City of Geelong and Barwon

OPPORTUNITY	PRIORITY	COMMENT
		Regional Waste Management Group for it to occur.
General untreated timber	Medium – High	Requires input from the Geelong Manufacturing Council in the form of promotion of existing transfer stations.
Textile waste	Medium	Facilitation by the Geelong Manufacturing Council is likely to encourage individual businesses reduce textile waste generation.
Marketing of composting and bioremediation expertise	Medium	The Geelong Manufacturing Council is in a good position to promote this expertise, especially to other regional manufacturing councils.
Organic fuels and stock feeds	Medium	The Geelong Manufacturing Council and Barwon Regional Waste Management Group are likely to be required to facilitate the implementation of this opportunity.
Foundry sand reuse demonstrations	Medium	This opportunity is likely to require facilitation from the Geelong Manufacturing Council to occur.
Oil and solvent reuse, recycling and energy recovery	Medium	A number of companies presently collect waste solvents and oils for use as fuel; hence additional support from the Geelong Manufacturing Council is not essential.
Exchange of acids and alkalis	Medium	Beyond informing businesses of the opportunity to exchange acids and alkalis; no ongoing support from the Geelong Manufacturing Council is required.
Brokerage and diversion facility for textiles	Low – Moderate	Input from the Geelong Manufacturing Council is not essential in this instance.
Catalyst reuse	Low – Moderate	Again input from the Geelong Manufacturing Council is not essential in this instance.
Side-line products from scrap (textiles)	Low – Moderate	The Geelong Manufacturing Council may be required to encourage businesses to consider this option.

Based on the priority of each opportunity and level of support required from the Geelong Manufacturing Council and other working group members, the following opportunities should be further pursued in the short term:

- Trial of expanded wool scour waste composting at Geelong Wool Combing
- Bioremediation trial at Shell;
- Shell foundry sand reuse;
- Trial of non-returnable pallet recovery for reuse and/or wood chip production.
- Textile waste drop-off for recycling

It is also recommended that the working group develop a waste exchange system to facilitate the exchange of wastes, and continue to promote Wase Wise business practices through education.

6. INDUSTRY WORKSHOPS AND PROMOTION

An industry workshop was conducted to present the outcomes of the project and to invite manufacturers to investigate how their companies might benefit from waste minimisation and exchange. The workshop was attended by over 30 representatives from the manufacturing sector, as well as participants from private waste management and recycling companies, Regional Waste Management Groups, Local Government, EcoRecycle Victoria, EPA, Deakin University. The workshop involved presentations of opportunities for manufacturers to minimise and exchange waste, and two workshop sessions in which participants identified and further developed opportunities for waste minimisation and exchange of major waste types. Both a survey distributed to participants and comments made at the workshop indicated a high level of willingness by participants to be involved in manufacturing working groups aimed at waste minimisation and exchange. Many also indicated a willingness to work with the Barwon Regional Waste Management Group to become Waste Wise businesses.

Drafts of the case study sheets prepared as part of the project were distributed at the workshop. These provided demonstrations of manufacturers within the Region that have increased productivity through waste minimisation and exchange.

6.1 THE NEXT STEPS

It is recommended that the project steering committee formally establish a Waste Wise Manufacturing Working Group to:

- Further develop and support feasibility trials of identified opportunities for waste minimisation and exchange by inviting businesses and sectors to become involved.
- Further publicise the outcomes of the project and the potential benefits for Geelong manufacturers.
- Provide assistance and support to manufacturers wishing to trial or implement waste minimisation and exchange initiatives.
- Promote Waste Wise business practice, and accreditation of Geelong manufacturers as waste Wise businesses.
- Facilitate links between waste generators and those that have actual or potential use for them.
- Facilitate communications and coordination between manufacturers to prevent unnecessary duplication of work.
- Maintain a register of companies that are adopting or are interested in adopting Waste Wise practices.
- Maintain a register of companies and information resources that can help businesses wanting to adopt Waste Wise practice.

It is recommended that the Working Group facilitate the formation of manufacturing sub-groups to develop and promote both waste minimisation by sectors and waste exchange between sectors. A proposed structure for the sub-groups is shown in Figure 6.1.

FIGURE 6.1: PROPOSED STRUCTURE FOR MANUFACTURING SUB-GROUPS