

WASTES LIKELY TO REQUIRE LONG-TERM CONTAINMENT

TECHNICAL APPENDIX

Publication 947

May 2004

1 INTRODUCTION

The purpose of this document is to provide the detailed methodology and data supporting EPA publication 946 *Wastes Likely to Require Long-term Containment*. The analysis and results detailed in this publication are based on an analysis of prescribed industrial waste (PIW) data representing PIW sent to existing Tullamarine and Lyndhurst PIW landfills for the 2002 calendar year. The document also discusses a number of factors that will influence the amount of waste requiring long-term containment in the future.

EPA Victoria's *Performance Requirements for Long-Term Containment Facilities* (EPA Publication 941) set out the rules a facility must meet through the design, construction, operation, closure and post-closure phases of a containment facility. EPA has also released draft guidelines (*Draft guidelines for hazard classification of solid prescribed industrial wastes*, EPA Publication 922) setting out the criteria that define whether waste needs to be managed as Category A, B or C. A containment facility can accept Category B wastes or Category C wastes. Category A wastes can be treated to be received at a long-term containment facility. It is expected that Category C wastes will be mainly sent to best practice municipal landfills, in preference to containment.

In the context of the above, this document provides:

- a list of the industry sectors that sent waste to PIW landfill in the year 2002;

- the quantities of waste generated by these industry sectors;
- an estimate of the quantities of Category A, B and C waste generated in 2002; and
- the methodology and assumptions supporting these analyses.

2 PIW IN VICTORIA 2002

In 2002, 77 per cent of the PIW deposited at landfills in Victoria was low hazard waste such as low level contaminated soil, asbestos (appropriately packaged), and wastes such as food processing wastes. It is expected that these wastes would be classified as category C wastes under the *Draft Guidelines for the Hazard Classification of Solid Prescribed Industrial Waste* (EPA Publication 922), and hence would not require long-term containment. Some contaminated soils (high level) may require long-term containment. Of the remaining PIW generated in Victoria, 16 per cent goes to Tullamarine and Lyndhurst landfills, and further analysis was performed to consider how this waste might be managed. This situation is illustrated in Figure 1 and tabulated in Table 1.

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Figure 1 – Prescribed waste to landfill in 2002

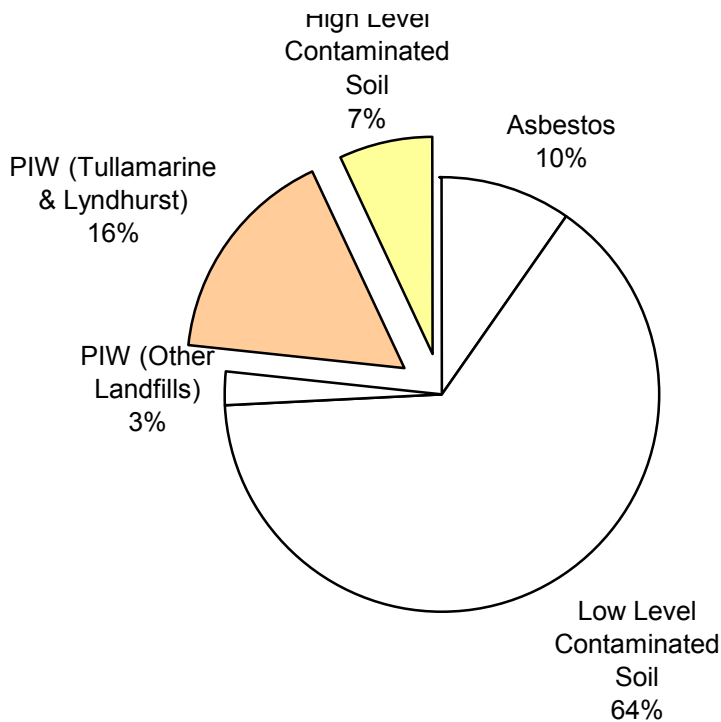


Table 1 - Prescribed Waste to Landfill 2002

| Waste Type | Tonnes | % |
|---|----------------|------------|
| Prescribed Industrial Waste from manufacturing sources (deposited at Tullamarine & Lyndhurst PIW landfills) | 85,000 | 16 |
| Contaminated Soil (High Level) | 36,000 | 7 |
| Sub total 1 | 121,000 | 23 |
| Low Hazard Prescribed Industrial Waste (from manufacturing sources) | 13,000 | 3 |
| Low Level Contaminated Soil | 332,000 | 64 |
| Asbestos | 50,000 | 10 |
| Sub total 2 | 395,000 | 77 |
| TOTAL | 516,000 | 100 |

Tonnes rounded to the nearest thousand, percentages rounded to the nearest whole number

Sub total 2 represents wastes that are expected to meet the criteria for Category C under the draft criteria set out in EPA Publication 922. Under the *Industrial Waste Management Policy (Prescribed Industrial Waste)* Category C wastes are PIWs that pose a low hazard or only exhibit offensive aesthetic properties, for example, food processing waste. The draft criteria listed in EPA Publication 922 provide further definition on what constitutes Category A, B and C wastes, and the subsequent requirements that apply for the management of these waste categories.

3 OVERVIEW OF DATA ANALYSIS

EPA Victoria uses the transport certificate system, Trancert, to track the movement of prescribed industrial wastes (PIW) throughout Victoria, from the generator to the transporter to the waste receiver. EPA collects all the data generated from this system and uses it for a range of purposes.

EPA has performed data analysis on the waste representing 16% of the total in Figure 1, using information obtained from Trancert, to identify the industry sectors that sent PIW to the Tullamarine and Lyndhurst PIW landfills in the year 2002. Because a major proportion (approximately 60 per cent) of the PIW sent to these landfills in 2002 comprised of PIW generated by waste treatment facilities¹ as a result of treating wastes from other producers, those industry sectors sending PIW to these waste treatment facilities were also identified. Figure 2 illustrates the waste pathways to PIW landfill in 2002.

In mid 2003, EPA conducted a sampling program of major PIW types sent to PIW landfill. The results of this analysis were then applied to ongoing generic PIW streams and used to support data analysis to estimate the proportions of Category A, B and C PIW sent to PIW landfill in 2002. These estimations are based on draft criteria listed in EPA Publication 922.

An overview of the factors that may influence the quantities and types of PIW that may be sent to long-term containment is also included.

¹ Waste treatment facilities – facilities that accept solid, sludge and liquid wastes for treatment. These facilities treat liquid wastes to neutralise or remove contaminants. This can generate a solid residue which is collected and then immobilised. Sludges can be dewatered and then immobilised, while solids generally just undergo immobilisation.

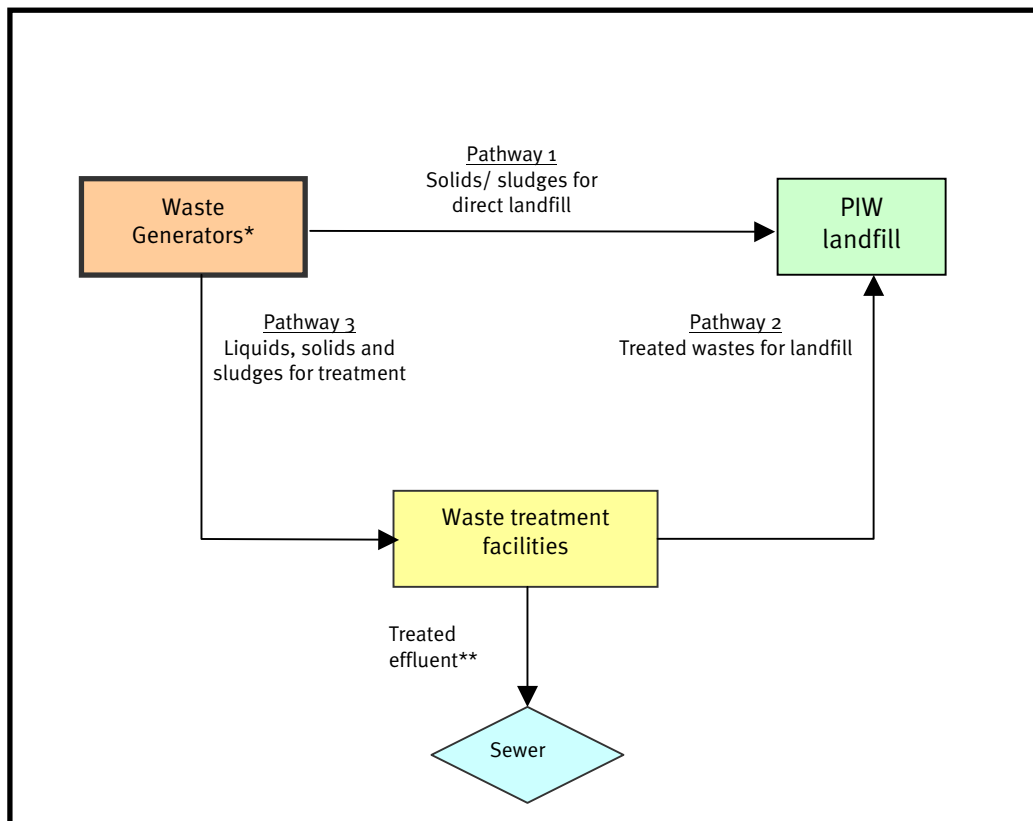
Please note that the methodology in this document describes an analysis based on a number of assumptions and estimates and uses data subject to a number of limitations. Thus, the results should be regarded as estimates only. With the implementation of the new waste categorisation system (that is, category A, B and C wastes) waste generators will be required to fully characterise their wastes, and report this information to EPA.

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3.1 Data Analysis

Figure 2 - Waste pathways to PIW landfill in 2002

(Note: These are residual wastes that cannot otherwise be avoided, reused or recycled or recovered for energy)



*Waste generators can generate solid, liquid or sludge PIW

**Discharged to sewer under trade waste agreement as regulated by trade waste authority

Data analysis was undertaken to identify both the industry sectors and waste types sent to Lyndhurst and Tullamarine PIW landfills. To account for all the industry sectors sending PIW to PIW landfill it was necessary to take into account those PIW sent to waste treatment facilities as well as PIW sent directly to landfill.

Appendix 1 lists the following:

Pathway 1: PIW sent directly to landfill and the industry sectors that generated those wastes (Table 3.1 and 3.2)

Pathway 2: PIW sent from waste treatment facilities to PIW landfill (Table 4).

Pathway 3: PIW sent to waste treatment facilities and the industry sectors that generated those wastes (Table 5.1 and 5.2)

3.2 Sampling program

A sampling program was undertaken in mid 2003 to estimate the composition of waste constituents in major PIW streams in Victoria. The program was

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based on the following methodology and assumptions:

- Only PIW streams sent directly (that is Pathways 1 and 2) to PIW landfill in 2002 were identified.
- Only premises generating more than 100 tonnes of PIW in the year 2002 were considered. This was approximately 94 per cent of the total amount of PIW sent to PIW landfill in 2002.
- Of these companies, those for which recent existing data of waste constituents was already available were identified, and removed from the list for potential sampling.
- Of those premises generating more than 100 tonnes of PIW, the largest waste generators were then identified and the major PIW streams from these companies were sampled.
- The existing company data combined with the data obtained from the sampling program represented approximately 90 per cent of the total amount of manufacturing waste (this excludes contaminated soils and asbestos) sent to PIW landfill in 2002.
- Grab samples were taken of the identified PIW streams. As these samples were grab samples only, it is recognised that the results obtained provide a snapshot of the constituents of the waste stream at the time of sampling, and are not necessarily representative.
- The sampling program involved a suite of analyses comprising:
 - USEPA 8270 semi volatile analysis – total and leachable

- USEPA 8270 volatile analysis – total and leachable
- Standard metals scan – total and leachable
- Cyanide and fluoride analysis - total and leachable

The results from these analyses were used to categorise 2002 data against the draft hazard criteria, as set out in publication 922, *Draft Guidelines for the Hazard Classification of Solid Prescribed Industrial Waste*. This process categorised the waste into category A, B or C. The results of this analysis are presented in Table 2 below.

Table 2² – Estimated waste categories for solid PIW³ using 2002 waste data

| Estimated Waste Category ⁴ | Estimated Amount (tonnes) | Percentage (%) |
|---------------------------------------|---------------------------|----------------|
| A | 35,000 | 41% |
| B | 27,000 | 32% |
| Subtotal | 62,000 | 73% |
| C | 9,000 | 11% |
| P | 5,500 | 6% |
| Uncategorised | 8,500 | 10% |
| TOTAL⁵ | 85,000 | 100% |

Packaging waste (*P*) has been segregated, with a view to undertaking further investigation and consultation on the composition and management of this PIW stream.

² Table 2 is not a prediction of waste quantities for long-term containment, but an estimate of the composition of waste categories in the PIW stream generated in 2002.

³ This analysis does not include contaminated soil and asbestos.

⁴ Estimated waste category based on existing data, or results obtained from the sampling program conducted in 2003 and then applied to the waste amounts generated in 2002.

⁵ It is estimated that this total will reduce subject to the influencing factors including those outlined in Section 4.

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“Uncategorised” represents those PIW streams which, although are currently managed in terms of existing EPA licence requirements, were not assessed against the new A, B, C hazard classification framework as part of this process.

Table 2 indicates that, based on 2002 data of wastes sent to Tullamarine and Lyndhurst PIW landfills, about 60,000 tonnes of waste would have been Category A or B waste and required long-term containment. The analysis, and hence Table 2, excludes contaminated soils and asbestos because of the marked variability of the generation of these wastes from year to year. The actual volumes of waste that may be sent to a future containment facility will be further influenced by a range of factors as outlined in section 4. Tables 3.1, 3.2 and 4 in Appendix 1 provide a detailed list and amounts of the industry sectors and the waste types going to Lyndhurst and Tullamarine PIW landfills.

3.3 Industry sector analysis

EPA Publication 946 *Wastes Likely to Require Long-term Containment* lists the major industry sectors that are likely to send PIW to a long-term containment facility. In short, this analysis combined industry sectors likely to send PIW directly to long-term containment and industry sectors that are likely to send PIW to waste treatment facilities, prior to long-term containment. The methodology and assumptions behind this analysis are outlined below.

- Two data sets were analysed – industry sectors sending PIW directly to PIW landfill and industry sectors sending PIW via waste treatment facilities to PIW landfill.
- PIW unlikely to go to a long-term containment facility was eliminated from the data set. PIW considered unlikely to be sent to a containment facility included:
 - ♦ PIW estimated to be Category C by the waste sampling program;
 - ♦ Organic putrescible PIW such as wastes generated from food manufacture, wool scouring or leather tanning; and
 - ♦ Some packaging wastes.
- The industry sectors sending PIW via waste treatment facilities to PIW landfill were identified. Some assumptions were then applied to the different physical forms of PIW streams, that is solid, liquid and sludge streams that were sent to waste treatment facilities to determine the amount then sent to PIW landfill (see Figure 3 – for an illustration of the assumptions used to estimate PIW amounts to landfill via waste treatment facilities).

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Figure 3 PIW pathways to PIW landfill



S_{out} – **Solids prescribed industrial waste** generated from the treatment of solid, sludge and liquid PIW. This waste is generated by waste treatment facilities and sent to landfill.

To calculate **S_{out}** the following equation was used:

$$S_{out} = (1 \times S_{in}) + (0.8 \times P_{in}) + (0.1 \times L_{in})$$

where,

S_{in} - **Solid prescribed industrial waste**

streams - Solid PIW sent to waste treatment facilities is treated. An assumption is made that the waste undergoes no volume decrease though treatment, and 100 per cent of the original volume of solid waste is sent to PIW landfill.

L_{in} - **Liquid prescribed industrial waste**

streams - Liquid PIW sent to waste treatment facilities is treated to remove or neutralise contaminants. The major proportion of this treated waste is then discharged to sewer, while a small proportion of solid contaminants are filtered, removed, and then chemically fixed. It is assumed that the treatment of liquid PIW generates solid residues that are 10 per cent of the original liquid volume. These solid residues are sent to PIW landfill.

P_{in} - **Sludge prescribed industrial waste**

streams – Sludge PIW streams sent to waste treatment facilities are treated to

remove or immobilise contaminants and may be dewatered. A small proportion of liquid from this waste stream is removed, neutralised and then discharged to sewer, while the major solid proportion of the waste stream is immobilised. An assumption is made that sludge PIW generates solid residues that are 80 per cent of the original sludge volume which, in turn, is on-sent to PIW landfill.

The above calculation takes into account bulking agents such as lime and cement, and the use of wastes as reagents in the treatment process.

- As above, industry sectors generating low hazard organic PIW were eliminated from this analysis (for example, takeaway food retailers) as the PIW these industry sectors generate are unlikely to be sent to long-term containment.
- From this analysis of the two sets of data, industry sectors sending PIW direct to PIW landfill and those sending PIW via waste treatment facilities to PW landfill, were combined to provide an overall approximation of the industry sectors currently sending waste to PIW landfill, and therefore likely to send PIW to long-term containment.

4 FACTORS INFLUENCING LONG-TERM CONTAINMENT

EPA has performed an analysis of the PIW sent to PIW landfill in 2002, and the industry sectors responsible for generating these wastes. Below are a number of factors that will influence the quantities of PIW requiring long-term containment. This is not an exhaustive list, but rather, an attempt to identify critical aspects that will affect PIW quantities.

4.1 Policy drivers - waste reduction

EPA is currently working on cleaner production initiatives with major generators of PIW, as well as implementing landfill bans on certain PIWs. It is anticipated that these programs will contribute to significant reductions and diversion of PIW to reuse and recycling options, reducing the amount of PIW requiring long-term containment.

4.2 Economic drivers

4.2.1 Waste reduction

The increasing price of acceptance of PIW at a containment facility, along with the expected increase in treatment costs due to stricter standards, is expected to drive changes and improvements in the processes generating PIW, such as increased focus on cleaner production opportunities. Such improvements are likely to decrease the volumes of PIW generated and the volume of PIW requiring long-term containment.

4.2.2 Hazard reduction

Sending wastes to best practice municipal landfills is expected to be cheaper than sending wastes to

containment. Under the hazard classification framework (EPA Publication 922) generators have the opportunity to treat Category B wastes so that they can be accepted at best practice municipal landfill, if done so in accordance with stringent standards set by EPA. It is expected that it would only be possible for a limited range of Category B waste to be treated so that it could be accepted at best practice municipal landfill.

Some processes capable of treating Category B waste to Category C may be so expensive that the overall price of management in a best practice municipal landfill may be higher than containment and hence this option may not be pursued.

Category A wastes cannot be treated so as to be accepted at best practice municipal landfill.

4.3 Large PIW generators

The copper, silver, lead and zinc smelting and refining industry sector is primarily composed of secondary metal refiners. The residual PIW streams generated by this sector are sent directly to PIW landfill and form a large percentage of the total PIW sent to PIW landfill. These wastes have significant potential to be diverted to alternative reuse and recycling options in future, due to residual metals content, and so the total amount of PIW for long-term containment may decrease substantially.

4.4 Segregation and improved treatment standards

An opportunity exists to further segregate PIW streams accepted at treatment facilities. The waste treatment processes currently applied in Victoria produce a range of wastes of varying hazard that are

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generally mixed together. It is expected that it will become more financially favorable for the low hazard wastes to be segregated as Category C wastes and to be sent to options other than long-term containment, such as best practice municipal landfill.

4.5 Improved treatment processes

Improved treatment standards and processes may change the amount of PIW generated from treatment facilities. This may include changes to the amount of treatment material used (for example cement or lime), or reductions in the moisture content of wastes.

5 CONCLUDING REMARKS

Based on this review of 2002 PIW data, it is estimated that approximately 60,000 tonnes (manufacturing waste) of waste would have required long-term containment in 2002. Some contaminated soil would also have required long-term containment. It is anticipated that the amount of waste requiring long-term containment will reduce due to the factors outlined in Section 4. EPA Publication 946 *Wastes Likely to Require Long-term Containment* provides further information on waste types and industry sectors likely to contribute waste to long-term containment.

6 FURTHER INFORMATION

Performance Requirements for Long-term Containment Facilities, EPA Publication 941 (March 2004)

Draft Performance Requirements for Long-Term Containment Facilities – Explanatory Document, EPA Publication 925 (October 2003)

Draft Guidelines for Hazard Classification of Solid Prescribed Industrial Wastes, EPA Publication 922 (October 2003)

The above documents and further information including broader programs on PIW and overall implementation of the policy are available for download on the EPA website at:

www.epa.vic.gov.au/Waste/

If you wish to obtain further information on this topic, please contact

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APPENDIX 1⁶

Table 3.1 Waste types sent directly to Tullamarine and Lyndhurst⁷ (Pathway 1 as illustrated in Figure 2)

| Waste Type | Waste Amount (tonnes) |
|---|-----------------------|
| B150 Hydrofluoric acid | <10 |
| C130 Caustic neutralised wastes containing metallic constituents | 2,000 |
| C140 Other alkaline waste (inorganic) | 500 |
| D110 Inorganic fluorine compounds | <10 |
| D120 Mercury and mercury compounds | <10 |
| D121 Equipment and articles containing mercury | <10 |
| D140 Chromium compounds | <10 |
| D141 Tannery wastes containing chromium | 1,200 |
| D150 Cadmium and cadmium compounds | <10 |
| D220 Lead and lead compounds | 6,500 |
| D230 Zinc compounds | <10 |
| D300 Non-toxic salts (eg. sodium chloride, calcium chloride) | 400 |
| D330 Inorganic sulfur containing compounds | <10 |
| D400 Smelter waste containing prescribed waste | 2,000 |
| F100 Aqueous-based (non flammable vapours) paints, lacquers.. | 600 |
| F110 Aqueous-based (non flammable) glues, resins.. | 200 |
| F120 Solvent-based (FP>60.5C -combustible) paints, inks... | 200 |
| F130 Solvent-based (FP>60.5C -combustible) glues, resins... | <10 |
| F160 Solvent-based (FP<60.5C -combustible) paints, inks.. | <10 |
| F190 Cured adhesives or resins, n.o.s. | 300 |
| J160 Tars and tarry residues | 600 |
| K140 Tannery wastes not containing chromium | 100 |
| K180 Abattoir effluent | <10 |
| K190 Wool scouring wastes | <10 |
| L140 Textile effluent and residues, n.o.s. | <10 |
| M110 Equipment containing PCBs/ PBBs | <10 |
| N100 Drums containing waste that is a prescribed waste | 1,600 |
| N110 Containers containing a waste that is a prescribed waste | 3,600 |
| N130 Spent catalysts (must specify contaminants) | 100 |
| N150 Fly ash | 200 |
| N160 Prescribed industrial wastes that are encapsulated | 200 |
| N170 Prescribed industrial wastes that are chemically-fixed | 600 |
| N180 Prescribed industrial wastes that are solidified/polymerised | 2,700 |
| N190 Filter cake | 5,400 |
| N205 Industrial waste treatment plant sludges and residues, n.o.s | 700 |
| N210 Residues from pollution control operations, n.o.s. | 600 |
| N230 Ceramic-based fibres similar to those of asbestos | 100 |
| T130 Inert sludges or slurries eg. clay, ceramic suspensions | 300 |
| T160 Foundry sands containing a waste that is a prescribed waste | 100 |

⁶ Waste amounts sent to landfill are measured and reported in tonnes, while waste sent to waste treatment facilities is measured and reported in cubic metres (m³).

⁷ Includes contaminated soil, and excludes waste sent from waste treatment facilities to PIW landfill.

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| | |
|---|---------------|
| T190 Waste, other than already specified which pose an env hazard | 2,000 |
| SUBTOTAL - MANUFACTURING WASTE | 32,800 |
| N120 Contaminated soils levels exceeding Table 3 of Pub 448 | 34,200 |
| N121 Contaminated soils (low level) | 22,100 |
| N220 Asbestos (all forms) | 800 |
| SUBTOTAL - SOILS AND ASBESTOS | 57,100 |
| TOTAL | 89,900 |

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Table 3.2 Industry sectors sending waste directly to Tullamarine and Lyndhurst⁸ (Pathway 1 as illustrated in Figure 2)

| Industry Type | Waste Amount (tonnes) |
|---|-----------------------|
| 1200 Oil and Gas Extraction | 400 |
| 1400 Other Mining | 300 |
| 2111 Meat Processing | <10 |
| 2173 Seafood Processing | 100 |
| 2179 Food Manufacturing n.e.c. | 200 |
| 2211 Wool Scouring | 400 |
| 2212 Synthetic Fibre Textile Manufacturing | <10 |
| 2222 Textile Floor Covering Manufacturing | <10 |
| 2229 Textile Product Manufacturing n.e.c. | 100 |
| 2261 Leather Tanning and Fur Dressing | 1,800 |
| 2321 Plywood and Veneer Manufacturing | 200 |
| 2331 Pulp, Paper and Paperboard Manufacturing | 200 |
| 2339 Paper Product Manufacturing n.e.c. | <10 |
| 2412 Printing | 300 |
| 2413 Services to Printing | <10 |
| 2510 Petroleum Refining | 600 |
| 2520 Petroleum and Coal Product Manufacturing n.e.c. | <10 |
| 2532 Industrial Gas Manufacturing | 300 |
| 2533 Synthetic Resin Manufacturing | <10 |
| 2534 Organic Industrial Chemical Manufacturing n.e.c. | 300 |
| 2535 Inorganic Industrial Chemical Manufacturing n.e.c. | 400 |
| 2542 Paint Manufacturing | 1,400 |
| 2543 Medicinal and Pharmaceutical Product Manufacturing | <10 |
| 2544 Pesticide Manufacturing | 200 |
| 2545 Soap and Other Detergent Manufacturing | <10 |
| 2546 Cosmetic and Toiletry Preparation Manufacturing | <10 |
| 2547 Ink Manufacturing | 100 |
| 2549 Chemical Product Manufacturing n.e.c. | 2,300 |
| 2551 Rubber Tyre Manufacturing | 100 |
| 2559 Rubber Product Manufacturing n.e.c. | 500 |
| 2562 Plastic Extruded Product Manufacturing | 300 |
| 2564 Plastic Product, Rigid Fibre Reinforced, Manufactu | <10 |
| 2610 Glass and Glass Product Manufacturing | 500 |
| 2621 Clay Brick Manufacturing | <10 |
| 2622 Ceramic Product Manufacturing | <10 |
| 2623 Ceramic Tile and Pipe Manufacturing | 100 |
| 2635 Concrete Product Manufacturing n.e.c. | 100 |
| 2640 Non-Metallic Mineral Product Manufacturing n.e.c. | 100 |
| 2712 Iron and Steel Casting and Forging | 600 |
| 2722 Aluminium Smelting | 3,900 |
| 2723 Copper, Silver, Lead and Zinc Smelting, Refining | 6,400 |
| 2742 Architectural Aluminium Product Manufacturing | <10 |

⁸ Includes industry sectors generating contaminated soil, but not major waste treatment facilities.

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| | |
|--|--------|
| 2751 Metal Container Manufacturing | <10 |
| 2762 Spring and Wire Product Manufacturing | 300 |
| 2763 Nut, Bolt, Screw and Rivet Manufacturing | 100 |
| 2764 Metal Coating and Finishing | 1,100 |
| 2765 Non-Ferrous Pipe Fitting Manufacturing | 100 |
| 2769 Fabricated Metal Product | 1,900 |
| 2811 Motor Vehicle Manufacturing | 700 |
| 2812 Motor Vehicle Body Manufacturing | <10 |
| 2819 Automotive Component Manufacturing n.e.c. | 600 |
| 2822 Boatbuilding | <10 |
| 2824 Aircraft Manufacturing | <10 |
| 2831 Photographic and Optical Good Manufacturing | 100 |
| 2849 Electronic Equipment Manufacturing n.e.c. | <10 |
| 2854 Electric Light and Sign Manufacturing | <10 |
| 2859 Electrical Equipment Manufacturing n.e.c | <10 |
| 2861 Agricultural Machinery Manufacturing | <10 |
| 2864 Machine Tool and Part Manufacturing | 400 |
| 2866 Pump and Compressor Manufacturing | <10 |
| 2921 Wooden Furniture and Upholstered Seat Manufacturing | <10 |
| 2949 Manufacturing n.e.c. | <10 |
| 3610 Electricity Supply | 100 |
| 3620 Gas Supply | 200 |
| 3701 Water Supply | <10 |
| 3702 Sewerage and Drainage Services | <10 |
| 4110 Building Construction | 2,100 |
| 4112 Residential Budding Construction n.e.c. | <10 |
| 4121 Road and Bridge Construction | 400 |
| 4210 Site Preparation Services | 42,300 |
| 4259 Construction Services n.o.s. | 100 |
| 4523 Chemical Wholesaling | <10 |
| 5321 Automotive Fuel Retailing | 5,400 |
| 5329 Automotive Repair and Services n.e.c. | 200 |
| 6110 Road Freight Transport | 200 |
| 6200 Rail Transport | <10 |
| 6403 Non-Scheduled Air and Space Transport | <10 |
| 6509 Transport n.e.c. | <10 |
| 6611 Parking Services | 200 |
| 6622 Water Transport Terminals | <10 |
| 6709 Storage n.e.c. | <10 |
| 7120 Telecommunication Services | <10 |
| 7810 Scientific Research | <10 |
| 8111 Central Government Administration | 400 |
| 8113 Local Government Administration | 100 |
| 8200 Defence | 100 |
| 8600 Medical Various | 100 |
| 8611 Hospitals (Except Psychiatric Hospitals) | 100 |
| 8634 Community Health Centres | <10 |
| 9210 Libraries | <10 |

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| | |
|---|---------------|
| 9524 Funeral Directors, Crematoria and Cemeteries | <10 |
| 9631 Police Services | <10 |
| 9634 Waste Disposal Services | 5,500 |
| Unallocated data | 4,500 |
| TOTAL | 89,900 |

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Table 4 Wastes sent from treatment facilities to PIW landfill (Pathway 2 as illustrated in Figure 2)

| Waste Type | Waste Amount (tonnes) |
|---|------------------------------|
| F100 Aqueous-based (non flammable vapours) paints, lacquers. | <10 |
| F110 Aqueous-based (non flammable) glues, resins. | <10 |
| F190 Cured adhesives or resins, n.o.s. | <10 |
| N100 Drums containing waste that is a prescribed waste | 1,100 |
| N110 Containers containing a waste that is a prescribed waste | 100 |
| N170 Prescribed industrial wastes that are chemically-fixed | 50,700 |
| N180 Prescribed industrial wastes that are solidified/polymerised | 200 |
| N190 Filter cake | 100 |
| T190 Waste, other than already specified which pose an env hazard | <10 |
| TOTAL | 52,100 |

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Table 5.1 – Waste types sent to major treatment facilities⁹ (Pathway 3 as illustrated in Figure 2)

| Waste Type | Waste Amount (m ³) |
|---|--------------------------------|
| A100 Cyanide waste resulting from treatment of metals & plastics | <10 |
| B100 Sulfuric acid | 6,200 |
| B110 Hydrochloric acid | 11,300 |
| B120 Nitric acid | 400 |
| B130 Phosphoric acid | 100 |
| B140 Chromic acid | 800 |
| B150 Hydrofluoric acid | <10 |
| B160 Sulfuric/hydrochloric acid mixtures | 100 |
| B170 Other mixed acids (inorganic) | 2,000 |
| B180 Organic acids | <10 |
| C100 Alkaline cleaners, potash, caustic soda | 8,700 |
| C110 Ammonium hydroxide | <10 |
| C120 Waste lime and cement (not containing metallic constituents) | 500 |
| C130 Caustic neutralised wastes containing metallic constituents | 2,000 |
| C140 Other alkaline waste (inorganic) | 1,500 |
| C150 Other alkaline waste (organic) | 200 |
| D110 Inorganic fluorine compounds | <10 |
| D120 Mercury and mercury compounds | 100 |
| D121 Equipment and articles containing mercury | <10 |
| D130 Arsenic and arsenic compounds | <10 |
| D140 Chromium compounds | 400 |
| D141 Tannery wastes containing chromium | <10 |
| D150 Cadmium and cadmium compounds | <10 |
| D170 Antimony and antimony compounds | <10 |
| D190 Copper compounds | <10 |
| D200 Cobalt and cobalt compounds | <10 |
| D210 Nickel compounds | 100 |
| D220 Lead and lead compounds | 300 |
| D230 Zinc compounds | 200 |
| D260 Silver and silver compounds | <10 |
| D261 Photographic waste containing silver | <10 |
| D280 Alkali metals and alkali metal containing compounds, n.o.s. | <10 |
| D290 Barium and barium compounds | <10 |
| D300 Non-toxic salts (eg. sodium chloride, calcium chloride) | 600 |
| D310 Boron and boron compounds | <10 |
| D320 Phosphorus and phosphorus compounds | <10 |
| D330 Inorganic sulfur containing compounds | 400 |
| D340 Other inorganic compounds and complexes | <10 |
| D350 Chlorates | <10 |
| D360 Phosphorus and phosphorus compounds | <10 |
| D380 Inorganic isocyanates | <10 |
| D390 Inorganic chemicals, n.o.s. | 400 |
| D400 Smelter waste containing prescribed waste | 400 |

⁹ Includes liquid solid and sludge waste for treatment and contaminated soil.

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| | |
|---|--------|
| E100 Oxidising agents | <10 |
| E110 Reducing agents | <10 |
| E130 Highly reactive chemicals, n.o.s. | <10 |
| F100 Aqueous-based (non flammable vapours) paints, lacquers.. | 5,700 |
| F110 Aqueous-based (non flammable) glues, resins.. | 5,300 |
| F120 Solvent-based (FP>60.5C -combustible) paints, inks... | 600 |
| F130 Solvent-based (FP>60.5C -combustible) glues, resins... | 100 |
| F140 Aqueous-based (flammable vapours) paints, inks... | 200 |
| F150 Aqueous-based (flammable vapours) glues, resins... | 100 |
| F160 Solvent-based (FP<60.5C -combustible) paints, inks.. | 300 |
| F170 Solvent-based (FP<60.5C -combustible) glues, resins.. | <10 |
| F180 Paint residues, n.o.s. | 100 |
| F190 Cured adhesives or resins, n.o.s. | 300 |
| F200 Uncured adhesives or resins, n.o.s. | 400 |
| G110 Non-halogenated organic solvents (FP>60.5C -combustible) | <10 |
| G120 Non-halogenated organic solvents (FP<60.5C -flammable) | 100 |
| G130 Halogenated organic solvents (FP > 60.5C - combustible) | <10 |
| G140 Halogenated organic solvents (FP < 60.5C - flammable) | <10 |
| G150 Halogenated solvents (non comb/non flammable vapours) | <10 |
| G160 Wastes from production and formulation of organic solvents | <10 |
| G170 Solvent recovery residues | <10 |
| G180 Other organic solvents, solvent residues | <10 |
| H100 Inorganic, organo-metallic pesticides/mercury pesticides | <10 |
| H120 Nitrogen containing pesticides | <10 |
| H130 Halogen containing pesticides/Organochlorine pesticides | <10 |
| H160 Mixed pesticide residue | <10 |
| H170 Copper-Chrome-Arsenic (CCA) | <10 |
| J100 Waste oils unfit for their original intended use | 1,400 |
| J110 Waste hydrocarbons | 800 |
| J120 Waste oil/water, hydrocarbons/water (mainly oil/hydrocarbon) | 10,900 |
| J130 Waste oil/water, hydrocarbons/water (mainly water) | 18,000 |
| J140 Transformer fluids (excluding PCB's) | <10 |
| J150 Other (cutting oils, soluble oils) | 2,400 |
| J160 Tars and tarry residues | 600 |
| K100 Animal effluent and residues (Poultry and fish wastes) | 100 |
| K101 Scallop processing residues | <10 |
| K110 Grease interceptor trap waste - domestic | 200 |
| K120 Grease interceptor trap waste-industrial | 11,800 |
| K130 Bacterial sludge (septic tank) | 900 |
| K132 Sewerage sludge and residues | <10 |
| K140 Tannery wastes not containing chromium | <10 |
| K150 Vegetable oils and derivatives | 200 |
| K160 Vegetable, fruit processing effluent | 100 |
| K170 Animal oils and derivatives (eg. Tallow) | <10 |
| K180 Abattoir effluent | <10 |
| K190 Wool scouring wastes | 900 |
| K200 Food processing effluent, n.o.s. | 6,800 |
| L100 Truck, machinery washwaters with or without detergents | 7,200 |

WASTES LIKELY TO REQUIRE LONG-TERM CONTAINMENT

| | |
|---|----------------|
| L101 Car washwater with or without detergents | 700 |
| L110 Boiler blowdown sludge | 500 |
| L120 Cooling tower washwaters | 900 |
| L130 Fire washwaters | 500 |
| L140 Textile effluent and residues, n.o.s. | 100 |
| L150 Industrial plant washwaters | 17,200 |
| M120 Solvents and materials contaminated with PCB/PBBs | <10 |
| M130 Non-halogenated organic chemicals, n.o.s. | <10 |
| M140 Heterocyclic organic compounds | <10 |
| M150 Phenols & phenol compounds including chlorophenols | <10 |
| M160 Halogenated organic compounds, n.o.s. | 100 |
| M200 Organic sulfur compounds | <10 |
| M220 Organic isocyanates | <10 |
| M230 Amines & other Nitrogen compounds (Aliphatic) | 100 |
| M240 Amines & other Nitrogen compounds (Aromatic) | <10 |
| M250 Detergents and surface active agents (surfactants) | 200 |
| M260 Highly odorous organic chemicals eg. mercaptans, acrylate | <10 |
| M280 Other organic chemicals | 200 |
| N100 Drums containing waste that is a prescribed waste | 1,000 |
| N110 Containers containing a waste that is a prescribed waste | 2,200 |
| N120 Contaminated soils levels exceeding Table 3 of Pub 448 | 6,100 |
| N121 Contaminated soils (low level) | 800 |
| N130 Spent catalysts (must specify contaminants) | 2,200 |
| N150 Fly ash | 400 |
| N160 Prescribed industrial wastes that are encapsulated | <10 |
| N170 Prescribed industrial wastes that are chemically-fixed | <10 |
| N180 Prescribed industrial wastes that are solidified/polymerised | 600 |
| N190 Filter cake | 3,800 |
| N200 Ion-exchange column residues | <10 |
| N205 Industrial waste treatment plant sludges and residues, n.o.s | 2,900 |
| N210 Residues from pollution control operations, n.o.s. | 400 |
| N220 Asbestos (all forms) | <10 |
| N230 Ceramic-based fibres similar to those of asbestos | 100 |
| R100 Clinical and related wastes (Biomedical waste) | <10 |
| R120 Waste from the use of pharmaceutical products | <10 |
| R130 Cytotoxic substances | <10 |
| R140 Waste from the production of pharmaceutical products | <10 |
| T100 Waste chemicals arising from R&D or teaching activities. | 100 |
| T110 Scrubber sludge | <10 |
| T120 Photographic waste not contain. silver | 1,100 |
| T130 Inert sludges or slurries eg. clay, ceramic suspensions | 3,100 |
| T140 Used tyres | 200 |
| T160 Foundry sands containing a waste that is a prescribed waste | <10 |
| T190 Waste, other than already specified which pose an env hazard | 1,000 |
| Unallocated data | <10 |
| Total | 159,400 |

WASTES LIKELY TO REQUIRE LONG-TERM CONTAINMENT

Table 5.2 Industry sectors sending waste to major treatment facilities¹⁰ (Pathway 3 as illustrated in Figure 2)

| Industry Type | Waste Amount (m3) |
|---|-------------------|
| 1100 Coal Mining | <10 |
| 1200 Oil and Gas Extraction | 500 |
| 1400 Other Mining | <10 |
| 1512 Petroleum Exploration Services | 200 |
| 1514 Mineral Exploration Services | <10 |
| 2111 Meat Processing | 400 |
| 2112 Poultry Processing | <10 |
| 2113 Bacon, Ham and Smallgood Manufacturing | <10 |
| 2121 Milk and Cream Processing | 6,100 |
| 2122 Ice Cream Manufacturing | <10 |
| 2129 Dairy Product Manufacturing n.e.c. | 200 |
| 2130 Fruit and Vegetable Processing | <10 |
| 2140 Oil and Fat Manufacturing | 200 |
| 2151 Flour Mill Product Manufacturing | <10 |
| 2171 Sugar Manufacturing | 200 |
| 2173 Seafood Processing | <10 |
| 2174 Prepared Animal and Bird Feed Manufacturing | <10 |
| 2179 Food Manufacturing n.e.c. | 1,400 |
| 2181 Soft Drink, Cordial and Syrup Manufacturing | 200 |
| 2182 Beer and Malt Manufacturing | 100 |
| 2211 Wool Scouring | 800 |
| 2212 Synthetic Fibre Textile Manufacturing | 400 |
| 2213 Cotton Textile Manufacturing | <10 |
| 2214 Wool Textile Manufacturing | 200 |
| 2215 Textile Finishing | 600 |
| 2221 Made-Up Textile Product Manufacturing | <10 |
| 2222 Textile Floor Covering Manufacturing | 300 |
| 2229 Textile Product Manufacturing n.e.c. | 200 |
| 2242 Women's and Girls' Wear Manufacturing | <10 |
| 2250 Footwear Manufacturing | <10 |
| 2261 Leather Tanning and Fur Dressing | 100 |
| 2262 Leather and Leather Substitute Product Manufacturi | <10 |
| 2311 Log Sawmilling | <10 |
| 2313 Timber Resawing and Dressing | 400 |
| 2321 Plywood and Veneer Manufacturing | 1,600 |
| 2322 Fabricated Wood Manufacturing | 100 |
| 2323 Wooden Structural Component Manufacturing | 100 |
| 2329 Wood Product Manufacturing n.e.c. | 200 |
| 2331 Pulp, Paper and Paperboard Manufacturing | 1000 |
| 2339 Paper Product Manufacturing n.e.c. | 200 |
| 2411 Paper Stationery Manufacturing | 100 |
| 2412 Printing | 1,200 |
| 2413 Services to Printing | 100 |
| 2421 Newspaper Printing or Publishing | 200 |

¹⁰ Includes industry sectors generating liquid, solid and sludge waste for treatment and contaminated soil.

WASTES LIKELY TO REQUIRE LONG-TERM CONTAINMENT

| | |
|---|-------|
| 2422 Other Periodical Publishing | <10 |
| 2510 Petroleum Refining | 4,900 |
| 2520 Petroleum and Coal Product Manufacturing n.e.c. | 200 |
| 2531 Fertiliser Manufacturing | <10 |
| 2532 Industrial Gas Manufacturing | 300 |
| 2533 Synthetic Resin Manufacturing | 900 |
| 2534 Organic Industrial Chemical Manufacturing n.e.c. | 1,700 |
| 2535 Inorganic Industrial Chemical Manufacturing n.e.c. | 1,100 |
| 2541 Explosive Manufacturing | 200 |
| 2542 Paint Manufacturing | 2,200 |
| 2543 Medicinal and Pharmaceutical Product Manufacturing | 100 |
| 2545 Soap and Other Detergent Manufacturing | 200 |
| 2546 Cosmetic and Toiletry Preparation Manufacturing | 200 |
| 2547 Ink Manufacturing | 900 |
| 2549 Chemical Product Manufacturing n.e.c. | 8,100 |
| 2551 Rubber Tyre Manufacturing | 700 |
| 2559 Rubber Product Manufacturing n.e.c. | 200 |
| 2561 Plastic Blow Moulded Product Manufacturing | <10 |
| 2562 Plastic Extruded Product Manufacturing | 100 |
| 2563 Plastic Bag and Film Manufacturing | <10 |
| 2564 Plastic Product, Rigid Fibre Reinforced, Manufactu | <10 |
| 2565 Plastic Foam Product Manufacturing | 1,400 |
| 2566 Plastic Injection Moulded Product Manufacturing | 300 |
| 2610 Glass and Glass Product Manufacturing | 400 |
| 2621 Clay Brick Manufacturing | <10 |
| 2622 Ceramic Product Manufacturing | 1,200 |
| 2623 Ceramic Tile and Pipe Manufacturing | 100 |
| 2631 Cement and Lime Manufacturing | 1,500 |
| 2632 Plaster Product Manufacturing | <10 |
| 2633 Concrete Slurry Manufacturing | 100 |
| 2634 Concrete Pipe and Box Culvert Manufacturing | <10 |
| 2635 Concrete Product Manufacturing n.e.c. | 100 |
| 2640 Non-Metallic Mineral Product Manufacturing n.e.c. | 100 |
| 2711 Basic Iron and Steel Manufacturing | 500 |
| 2712 Iron and Steel Casting and Forging | 1,200 |
| 2713 Steel Pipe and Tube Manufacturing | 1,500 |
| 2721 Alumina Production | 300 |
| 2722 Aluminium Smelting | 1000 |
| 2723 Copper, Silver, Lead and Zinc Smelting, Refining | 800 |
| 2729 Basic Non-Ferrous Metal Manufacturing n.e.c. | 100 |
| 2731 Aluminium Rolling, Drawing, Extruding | 500 |
| 2732 Non-Ferrous Metal Rolling, Drawing, Extruding n.e. | 900 |
| 2742 Architectural Aluminium Product Manufacturing | 100 |
| 2749 Structural Metal Product Manufacturing n.e.c. | <10 |
| 2751 Metal Container Manufacturing | 500 |
| 2759 Sheet Metal Product Manufacturing n.e.c. | 200 |
| 2761 Hand Tool and General Hardware Manufacturing | 100 |
| 2762 Spring and Wire Product Manufacturing | 2,200 |

WASTES LIKELY TO REQUIRE LONG-TERM CONTAINMENT

| | |
|---|--------|
| 2763 Nut, Bolt, Screw and Rivet Manufacturing | 2,100 |
| 2764 Metal Coating and Finishing | 13,500 |
| 2765 Non-Ferrous Pipe Fitting Manufacturing | 100 |
| 2769 Fabricated Metal Product | 6,000 |
| 2811 Motor Vehicle Manufacturing | 2,100 |
| 2812 Motor Vehicle Body Manufacturing | 100 |
| 2813 Automotive Electrical and Instrument Manufacturing | 100 |
| 2819 Automotive Component Manufacturing n.e.c. | 9,600 |
| 2821 Shipbuilding | 100 |
| 2824 Aircraft Manufacturing | 600 |
| 2829 Transport Equipment Manufacturing n.e.c. | 100 |
| 2831 Photographic and Optical Good Manufacturing | 800 |
| 2832 Medical and Surgical Equipment Manufacturing | <10 |
| 2841 Computer and Business Machine Manufacturing | <10 |
| 2849 Electronic Equipment Manufacturing n.e.c. | 200 |
| 2851 household Appliance Manufacturing | <10 |
| 2853 Battery Manufacturing | 2,900 |
| 2859 Electrical Equipment Manufacturing n.e.c | 200 |
| 2861 Agricultural Machinery Manufacturing | 300 |
| 2862 Mining and Construction Machinery Manufacturing | <10 |
| 2864 Machine Tool and Part Manufacturing | 600 |
| 2867 Commercial Space Heating and Cooling Equipment Man | <10 |
| 2869 Industrial Machinery and Equipment Manufacturing n | 400 |
| 2921 Wooden Furniture and Upholstered Seat Manufacturin | 100 |
| 2922 Sheet Metal Furniture Manufacturing | <10 |
| 2923 Mattress Manufacturing (Except Rubber) | <10 |
| 2941 Jewellery and Silverware Manufacturing | 200 |
| 2942 Toy and Sporting Good Manufacturing | <10 |
| 2949 Manufacturing n.e.c. | 3,500 |
| 3610 Electricity Supply | 2,000 |
| 3620 Gas Supply | 100 |
| 3701 Water Supply | 200 |
| 3702 Sewerage and Drainage Services | 200 |
| 4110 Building Construction | 1,700 |
| 4121 Road and Bridge Construction | 300 |
| 4210 Site Preparation Services | 6,500 |
| 4259 Construction Services n.o.s. | 500 |
| 4522 Metal and Mineral Wholesaling | <10 |
| 4523 Chemical Wholesaling | <10 |
| 5110 Supermarket and Grocery Stores | 100 |
| 5121 Fresh Meat, Fish and Poultry Retailing | <10 |
| 5122 Fruit and Vegetable Retailing | <10 |
| 5123 Liquor Retailing | <10 |
| 5125 Takeaway Food Retailing | 6,800 |
| 5126 Milk Vending | <10 |
| 5129 Specialised Food Retailing n.e.c. | <10 |
| 5210 Department Stores | <10 |
| 5223 Fabric and Other Soft Good Retailing | <10 |

WASTES LIKELY TO REQUIRE LONG-TERM CONTAINMENT

| | |
|---|-------|
| 5259 Retailing n.e.c. | <10 |
| 5311 Car Retailing | 100 |
| 5321 Automotive Fuel Retailing | 700 |
| 5322 Automotive Electrical Services | <10 |
| 5323 Smash Repairing | 100 |
| 5329 Automotive Repair and Services n.e.c. | 3,200 |
| 5710 Accommodation | 200 |
| 5730 Cafes and Restaurants | 1,600 |
| 6110 Road Freight Transport | 300 |
| 6121 Long Distance Bus Transport | <10 |
| 6200 Rail Transport | 600 |
| 6301 International Sea Transport | 200 |
| 6401 Scheduled International Air Transport | <10 |
| 6403 Non-Scheduled Air and Space Transport | 100 |
| 6509 Transport n.e.c. | 200 |
| 6611 Parking Services | 700 |
| 6622 Water Transport Terminals | 400 |
| 6644 Customs Agency Services | <10 |
| 6649 Services to Transport n.e.c. | 800 |
| 6709 Storage n.e.c. | 3,100 |
| 7112 Courier Services | 100 |
| 7120 Telecommunication Services | 4,300 |
| 7810 Scientific Research | <10 |
| 7829 Technical Services n.e.c. | 100 |
| 8111 Central Government Administration | 100 |
| 8112 State Government Administration | <10 |
| 8113 Local Government Administration | 200 |
| 8200 Defence | 1,400 |
| 8421 Primary Education | <10 |
| 8422 Secondary Education | <10 |
| 8423 Combined Primary and Secondary Education | <10 |
| 8424 Special School Education | <10 |
| 8431 Higher Education | <10 |
| 8432 Technical and Further Education | 900 |
| 8600 Medical Various | 200 |
| 8611 Hospitals (Except Psychiatric Hospitals) | 200 |
| 8613 Nursing Homes | <10 |
| 8621 General Practice Medical Services | <10 |
| 8623 Dental Services | <10 |
| 8631 Pathology Services | <10 |
| 8634 Community Health Centres | <10 |
| 8639 Health Services n.e.c. | <10 |
| 8640 Veterinary Services | <10 |
| 9220 Museums | <10 |
| 9231 Zoological and Botanic Gardens | <10 |
| 9239 Recreational Parks and Gardens | 200 |
| 9521 Laundries and Dry-Cleaners | 100 |
| 9522 Photographic Film Processing | 500 |

WASTES LIKELY TO REQUIRE LONG-TERM CONTAINMENT

| | |
|-------------------------------|----------------|
| 9529 Personal Services n.e.c. | 900 |
| 9631 Police Services | <10 |
| 9632 Corrective Centres | 400 |
| 9633 Fire Brigade Services | <10 |
| 9634 Waste Disposal Services | 9,100 |
| Unallocated data | 11,500 |
| TOTAL | 159,400 |