ENVIRONMENT ACT

ACT's Environmental Standards:

Assessment & Classification of Liquid & Non-liquid Wastes

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URBAN SERVICES

Australian Capital Territory Government

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SECTION 1 INTRODUCTION

1.1 Background

ACT is a small jurisdiction with limited industry whose hazardous waste management needs are primarily served by organisations based interstate, principally in NSW. For this reason, the ACT Government has chosen to model its waste assessment and classification system on the system used in NSW. Changes from the NSW model have been made only where necessary for particular ACT conditions.

1.2 Structure of these standards

The figure on the next page shows you how to use these standards. They are structured as follows:

SECTION 2:

- Guides those generating, storing and handling wastes in assessing these wastes to determine whether the liquid waste they are handling is regarded as hazardous, Group A, Group B, Group C or non-controlled aqueous liquid and whether the 'solid'/'non-liquid' waste they are handling is inert, solid, industrial or hazardous. This will enable them to determine whether a licence is required and what their associated environmental management obligations are.
- Outlines the two main ways of classifying liquid and non-liquid wastes.
- Outlines two different assessment processes—one for liquid waste and the other for non-liquid waste. This is supported by more detailed technical advice in Technical Appendix 1.

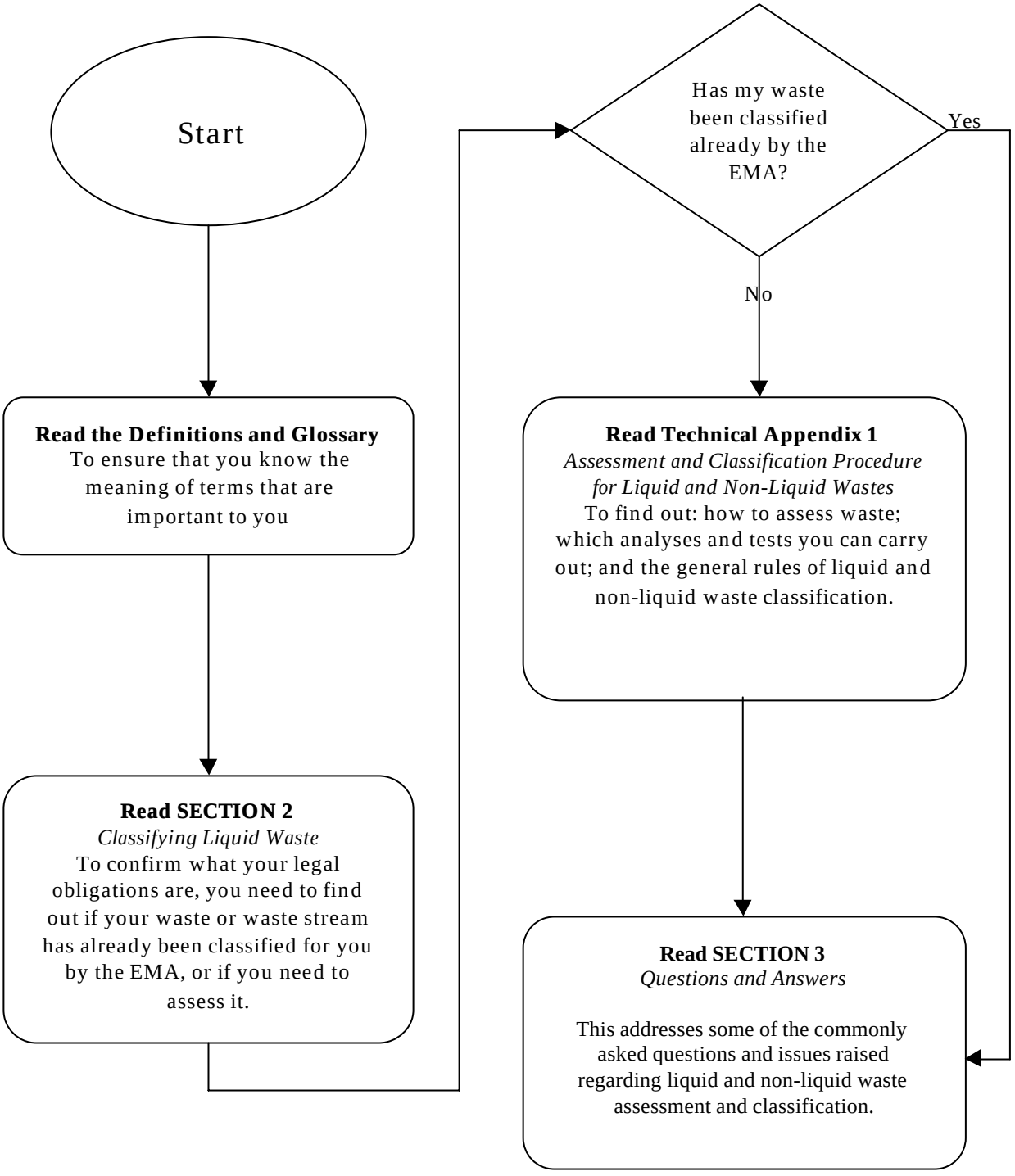
SECTION 3:

- Deals with the common questions and answers about classifying and managing different wastes
- Draws out some of the implicit and explicit issues/linkages between the various aspects of waste regulation
- Discusses links between waste regulation and other aspects of environmental regulation.

Definitions and glossary:

- Provides a guide to unfamiliar terms.
- Lists contacts for further information.

How do I use this document?



SECTION 2 CLASSIFYING WASTES

2.1 Differentiating non-liquid and liquid wastes

All waste is classified into one of three categories: non-liquid, liquid or gaseous.

For waste to be considered *non-liquid* it must meet **all** of the following requirements:

- it has an angle of repose of greater than five degrees (5°)
- it has no free liquids when tested in accordance with the USEPA Paint Filter Liquids Test—Method 9095 (USEPA 1986)
- it liberates no free liquids when transported
- it does not become free flowing at or below 60°C or when transported
- it is spadeable.

All other waste that is not gaseous is considered to be *liquid waste*.

2.2 Classifications of non-liquid and liquid wastes

The classifications of *inert waste, solid waste* and *industrial waste* apply only to non-liquid wastes.

The classification of *hazardous waste* can apply to both to liquid and non-liquid wastes.

The classifications of Group A, Group B and Group C waste apply only to liquid wastes. In other words:

Types of liquid waste:

- hazardous
- Group A
- Group B
- Group C
- non-controlled aqueous liquid

Types of non-liquid waste:

- hazardous
- industrial
- solid
- inert

Table 1 lists wastes that are already classified as inert.

Table 2 lists wastes that are already classified as solid.

Table 3 lists wastes that are already classified as industrial.

Table 4 lists wastes that are already classified as hazardous.

Table 5 lists Group A, Group B and Group C wastes.

Note that the non-liquid wastes listed in Table 1, Table 2, Table 3 and Table 4, and the liquid wastes listed in Table 4 and Table 5 (with the exception of controlled aqueous liquid wastes), do not have to be assessed according to the methods described in Technical Appendix 1.

A liquid classified in Group B or C will not be classified as Group A unless that liquid is contaminated with other waste(s). For example, liquid grease-trap wastes where, in some cases, the percentage of grease exceeds 20% of the total liquids will always be Group B. On the other hand, if the liquid grease-trap waste is contaminated with, say, chemicals, solvents or mineral oils, then it may be classified as Group A.

Table 1: Non-liquid waste types that are classified as inert waste

Waste type or stream
'Virgin excavated natural material (eg clay, gravel, sand, soil and rock) that is not mixed with any other waste and that: (a) has been excavated from areas that are not contaminated, as a result of industrial, commercial, mining or agricultural activities, with manufactured chemicals and that does not contain sulphidic ores or soils, or (b) consists of excavated natural materials that may be approved by the EMA.'
'Building and demolition waste (eg bricks, concrete, paper, plastics, glass, metal and timber[1]), being material resulting from the demolition, erection, construction, refurbishment or alteration of buildings or from the construction, repair or alteration of infrastructure-type development such as roads, bridges, dams, tunnels, railways and airports, and which: (a) is not mixed with any other type of waste, and (b) does not contain any asbestos waste.'
'Asphalt waste (eg resulting from road construction and water proofing works).'
'Biosolids categorised as Unrestricted Use, or as Restricted Use 1, in accordance with the criteria set out in the Biosolids Guidelines.'
'Used, rejected or unwanted tyres (including shredded tyres or tyre pieces).'
'Office and packaging waste (eg paper, plastics, glass, metal and timber) that is not mixed with any other type of waste.'
Note: 1. Includes treated timber such as copper chrome arsenate (CCA), high temperature creosote (HTC), pigmented emulsified creosote (PEC) and light organic solvent preservative (LSOP) treated timber.

Table 2: Non-liquid waste types that are classified as solid waste

Waste type or stream
'Municipal waste, being waste consisting of: (a) household domestic waste that is set aside for kerb side collection or delivered by the householder directly to a waste facility, or (b) other types of domestic waste (eg domestic clean-up and residential garden waste), or (c) local council generated waste (eg waste from street sweeping, litter bins and parks).'
'Biosolids categorised as Restricted Use 2 or 3 in accordance with the criteria set out in the Biosolids Guidelines, manure and night soil.'
'Cleaned pesticide, biocide, herbicide or fungicide containers.' [1]
'Drained and mechanically crushed oil filters, and rags and oil absorbent materials (not containing free liquids) from automotive workshops.'
'Disposable nappies, incontinence pads and sanitary napkins.'
'Food waste.'
'Vegetative waste generated from agriculture or horticulture.'
'Non-chemical waste generated from manufacturing and services (including metal, timber, paper, ceramics, plastics, thermosets and composites).'
Note: 1. The cleaning method used should be as good as or better than the triple-rinsing method developed by AVCARE and reproduced in Technical Appendix 3.

Table 3: Non-liquid waste types that are classified as industrial waste

Waste type or stream
'Stabilised asbestos waste in bonded matrix.'
'Asbestos fibre and dust waste (eg waste resulting from the removal of thermal or acoustic insulating materials or from processes involving asbestos material, and dust from ventilation collection systems).'

Table 4: Non-liquid and liquid waste types that are classified as hazardous

Waste type or stream
'Any waste that meets the criteria for assessment as dangerous goods under the *Australian Code for the Transport of Dangerous Goods by Road and Rail*, and categorised as one of the following: (a) explosives, (b) gases (compressed, liquefied or dissolved under pressure), (c) flammable solids (excluding organic waste, and all physical forms of carbon such as activated carbon and graphite), (d) flammable liquids, (e) substances liable to spontaneous combustion (excluding organic waste, and all physical forms of carbon such as activated carbon and graphite), (f) substances which in contact with water emit flammable gases, (g) oxidising agents and organic peroxides, (h) toxic substances, (i) corrosive substances.'
'Pharmaceuticals and poisons (being waste generated by activities carried out for business or other commercial purposes and that consists of pharmaceutical or other chemical substances specified in the Poisons List under the *Poisons and Therapeutic Goods Act 1966 (NSW)*).'
'Clinical waste.'
'Cytotoxic waste.'
'Sharps waste.'
'Quarantine waste.'

Table 5: Classification of liquid waste types

Hazardous waste:	**'Group A waste:**	**'Group B waste:**	**'Group C waste:**
Wastes (liquid) that are classified as hazardous (as reproduced in Table 4 of these standards).	(a) Non-aqueous liquid waste[1]. (b) Controlled aqueous liquid waste[2].'	(a) Liquid food waste[1]. (b) Liquid grease-trap waste resulting from the preparation or manufacturing of food.'	Liquid waste from human waste storage facilities or waste treatment devices[1] (within the meaning of these standards), including pump-out waste and septage.'

Notes:

1. For definitions of these terms see: Definitions and Glossary.
2. See Section 2.3 below and Part 4 of Technical Appendix 1.

2.3 Classifying and assessing liquid wastes

2.3.1 Introduction

Liquids that cannot be lawfully discharged directly into waters and cannot be or are not discharged to the sewer may be subject to authorisation under the ***Environment Protection Act 1997*.**

Approval to discharge waste to sewer should be obtained by contacting ACTEW on 6242 1111.

Summary of classification options

Once it is clear that a waste is liquid, it needs to be classified in order to establish how it is allowed to be managed.

There are two possible approaches to classifying liquid wastes:

Scenario 1: The liquid waste is clearly listed as hazardous waste (Table 4), or in Group A, Group B or Group C (Table 5), and an immediate decision can be made about storage, treatment, reprocessing or disposal, based on the regulations.

Scenario 2: The liquid waste is not listed in Table 4 or Table 5 and must be assessed.

If the waste is assessed as a *controlled aqueous liquid waste*, it is classified as a Group A waste.

Liquid wastes can range from almost true liquids to wastes that contain significant quantities of solids and only just miss out on being classified as *non-liquid* (perhaps because they contain some free liquids or fail to pass the 5° minimum angle of repose requirement). Where possible, such wastes should be separated into liquid and non-liquid fractions, and each component should be assessed, classified and managed separately according to the relevant provisions in these standards.

To help waste generators to classify their liquid wastes, the following five distinct groupings may be useful:

1. Water containing larger quantities of filtrable and / or non-filtrable solids.

   This grouping is most likely to be *non-controlled aqueous liquids*, which are usually not subject to authorisation as waste activities or waste facilities. Examples are dredge spoil, mine tailings, inert power station ash slurries and other slurries, provided that none of them is contaminated with suspended or dissolved chemicals to an extent that would lead them to be assessed as *controlled aqueous liquid wastes.* (See Section 2.3) Water separated from such liquids (after the settlement of solids) can usually be discharged into the environment, and this is often carried on according to the conditions of an environmental authorisation under the *Environment Protection Act 1997.*

2. Water containing larger quantities of dissolved chemical substances.

   These need to be assessed and classified according to this Section and Technical Appendix 1 unless:

   - the mixture is already classified as hazardous according to Table 4, or
   - the mixture satisfies the definition of non-aqueous liquid waste and is therefore classified as Group A waste, or

- the generator of the liquid waste decides (without testing) to obtain an authorisation and manage the waste as if it were a Group A waste.

3. Water containing larger quantities of nutrients.

   - Waste water satisfying the definition of '**effluent**', which 'means:

     (a) waste water from sewage collection or treatment plants, or

     (b) waste water from collection or treatment systems that are ancillary to processing industries involving livestock, agriculture, wood, paper or food, being waste water that is conveyed from the place of generation by means of a pipe, canal or other conventional method used in irrigation (but not by means of a tanker or truck), or

     (c) waste water from collection or treatment systems that are ancillary to intensive livestock, aquaculture or agricultural industries, being waste water that is released by means of a pipe, canal or other conventional method used in irrigation as part of day-to-day farming operations.'

     is not considered as a 'waste' when determining whether an authorisation is required for the irrigation (disposal to land) of these liquids.

     In circumstances where the same liquids in (b) and (c) above do not satisfy the definition of effluent (because they are not directly irrigated), the information provided below should be considered.

   - Other types of nutrient-rich waste water that do not satisfy the definition of effluent are likely to be Group B (for example, liquid grease-trap wastes and liquid wastes from the food industry) or Group C wastes (for example, septage and pump-out wastes). (For details see Table 5.)

4. Non-aqueous liquids.

   These will belong to Group A liquid wastes. (See Table 5.) Examples are oils, solvents, and solvent-containing liquids such as **uncured** solvent-based coatings and paints.

5. Combinations of two or more of the above groupings.

   These also need to be assessed and classified according to this Section and Technical Appendix 1 unless:

   - the mixture is already classified as hazardous according to Table 4, or
   - the mixture satisfies the definition of non-aqueous liquid waste and is therefore classified as Group A waste, or
   - the generator of the liquid waste decides (without testing) to obtain a licence and manage the waste as if it were a Group A waste.

2.3.2 The liquid-waste-assessment process

In some cases the composition of a particular liquid waste may not be known, or the waste does not appear on the list of hazardous wastes (see Table 4) or Group A, Group B or Group C liquid wastes (see Table 5). In these cases, the waste generator will need to do a waste assessment to establish how the waste should be handled. If a waste stream is of a fairly constant composition a one-off assessment to determine the characteristics and classification may be sufficient. If the waste stream is subject to variation (from one batch to another) an ongoing assessment program may be required.

Details about the assessment process are given in Technical Appendix 1, including:

- the steps to be taken in assessment
- sampling
- which contaminants to test for
- details of the tests to be applied.

The test used to assess the waste, the *Specific Contaminant Concentration (SCC)* test, is one that determines the concentration in mg/kg of each contaminant in the liquid-waste sample. The measure mg/kg, rather than mg/L, is used, since some liquid wastes can have significant quantities of solids present. The standards set different maximum levels for the concentration of individual contaminants; if these levels are exceeded for any contaminant, the waste will be assessed as *controlled aqueous liquid waste* and, therefore, classified as Group A liquid waste.

2.3.3 Rules for assessing and classifying liquid waste

The general rules set out below must be considered before assigning a final classification to the liquid waste:

- Liquid waste must be classified as one of the following categories: hazardous, Group A, Group B, Group C liquid waste or *non-controlled aqueous liquid waste*.
- Liquid waste classified as hazardous in Table 4 or as Group A, Group B or Group C waste in Table 5 cannot be reclassified as *non-controlled aqueous liquid waste* (using this assessment procedure), unless it has been treated to reduce or remove those characteristics that were responsible for the original classification.
- The person doing the assessment must decide which of the chemical contaminants listed in Table A 1 are present in the liquid waste and assess each contaminant against the given criteria.
- If the liquid waste contains potentially toxic and/or ecotoxic contaminants not listed in Table A 1, the person doing the assessment must ask the EMA to provide assessment criteria for these contaminants and assess the waste against these criteria as well.
- Even if only one out of many chemical contaminants present exceeds its respective criterion in Table A 1, the liquid waste must be assessed as *controlled aqueous liquid waste* and, therefore, classified as Group A waste.

See Technical Appendix 1 for a full description of the liquid-waste-assessment process.

2.4 Classifying and assessing non-liquid wastes

2.4.1 Introduction

For the generator (and in some cases the storer) of wastes there are two possible scenarios associated with identifying or classifying non-liquid wastes.

Scenario 1: The waste is clearly listed (See Table 1, Table 2, Table 3 and Table 4) as inert, solid, industrial or hazardous and an immediate decision can be made about storage, treatment, reprocessing or disposal.

Scenario 2: The waste is not listed (See Table 1, Table 2, Table 3 and Table 4), and there is a need to assess it to identify its components so that the appropriate management requirements can be determined.

After waste is disposed of to land, it can undergo environmentally significant (physical, chemical or biological) changes. As a result the following potential environmental impacts need to be considered and managed:

- the release of greenhouse gases such as methane and carbon dioxide
- the release of nutrient-rich liquid (leachate), which, if allowed to contaminate ground water or surface waters, can encourage the formation of environmentally harmful algal blooms
- the release of liquids (leachates) containing chemical contaminants such as heavy metals and human-made chemicals, which, if allowed to contaminate soil, ground water or surface waters, can have undesirable effects on the health of humans, animals, plants or other living organisms.

In line with the potential environmental impacts discussed above, non-liquid waste is classified in the following order, ranging from the least harmful to the most harmful to the environment:

- *inert*—this waste type is the least likely to undergo environmentally significant transformations; therefore, it should not release significant quantities of greenhouse gases or leachates contaminated with nutrients and / or chemicals
- *solid*—this waste type can include putrescible waste and is considered to pose a higher environmental risk than inert waste, and consequently needs to be managed with greater care
- *industrial*—this waste type can contain somewhat higher (four times) levels of the contaminants than solid waste, and needs to be managed with more stringent environmental controls than solid waste
- *hazardous*—this waste type contains contaminants at levels high enough to require treatment to render them safe before disposal.

2.4.2 The non-liquid assessment process

In some cases the composition of a particular non-liquid waste may not be known, or the waste will not appear on the lists of inert, solid, industrial or hazardous wastes (See Table 1, Table 2, Table 3 and Table 4). In these cases the waste generator will need to do a waste assessment. If a waste stream is of a fairly constant composition, a one-off assessment to determine the characteristics and classification may be sufficient. If the waste stream is subject to variation (from one batch to another) an ongoing assessment program may be required.

The classification process for non-liquids focuses on the potential for the waste to release chemical contaminants into the environment through contact with liquids (leachates). Details about the assessment process are given in Technical Appendix 1, including:

- the steps to be taken in assessment
- sampling
- which contaminants to test for
- details of the tests to be applied.

The principal test used for assessing non-liquid waste is the *Toxicity Characteristics Leaching Procedure (TCLP)*, which estimates the potential for the waste to release chemical contaminants into a leaching liquid. This property is called the *leachable concentration* in this document. The standards set different maximum levels for the *leachable concentration* of each contaminant in order for waste to be classified as *inert* (≤ TCLP1), *solid* (≤ TCLP2) and *industrial* (≤ TCLP3). If the level exceeds TCLP3 the waste is classified as *hazardous*.

The standard pH for the leaching solutions used must be either 4.93 ± 0.05 if the pH of the waste sample is less than 5.0, or 2.88 ± 0.05 if the pH of the waste sample is greater than 5.0. In specific instances the EMA may permit the use of leachants of a pH other than those specified above. The EMA's written authorisation for using an alternative leachant must be sought in writing, with justification for the proposed variation. The testing of a non-putrescible waste type for disposal into a monofill or monocell that can be shown not to be subject to penetration by acidic leachate or ground water is an example of a situation in which such written authorisation may be granted by the EMA. (See Section 2.4.2 below.)

EMA approval may be obtained to use an alternative leachant for assessing and classifying waste for monocell or monofill disposal. To seek this approval, documentation must be provided to the EMA describing all alternative options to disposal that have been considered and the reasons for their rejection.

The second test used to complete the assessment of waste, the *Specific Contaminant Concentration (SCC)* test, is one that determines the *total concentration* of each contaminant in the waste sample. The standards set different maximum levels for the *total concentration* of each contaminant in order for waste to be classified as *inert* (≤ SCC1), *solid* (≤ SCC2) and *industrial* (≤ SCC3). If the level exceeds SCC3 the waste is classified as *hazardous*.

The use of *total concentration (SCC)* limits is a precaution against a scenario where, in the presence of a high concentration of a contaminant, the TCLP test gives a low result because of interference by certain other non-permanent factors in the waste, such as high alkalinity. There is a potential for these non-permanent factors to change with time, resulting in a much greater release rate for such contaminants. (See also the discussion of *immobilisation* below.)

The *contaminant threshold (CT)* values used in Table A 3 were calculated from the corresponding *leachable concentration (TCLP)* values by multiplying them by 20. This is because for every gram (g) of waste subjected to extraction in the TCLP test, 20 millilitres (mL) of leachant are used. This means that if 20 mg / kg of a contaminant is present in the waste and is completely leached out in the test, the TCLP test result will be 1 mg / L. Thus if the *total concentration* for a contaminant is less than or equal to a particular *contaminant threshold* (CT1, CT2 or CT3) limiting value, then it is certain that if the *leachable concentration* value were to be determined for that contaminant, it can be only less than or equal to the corresponding *leachable concentration* (TCLP1, TCLP2 or TCLP3) limiting value.

Both the TCLP and SCC criteria must be satisfied before a waste can be classified as *inert, solid* or *industrial* unless the *immobilisation* of each contaminant exceeding the *total concentration* limit (SCC1, SCC2 or SCC3) is approved by the EMA (see section 2.4.4).

2.4.3 Rules for assessing and classifying non-liquid waste

Table 6 summarises the criteria used in the waste assessment process. The general rules given below must be considered before assigning a final classification to the waste:

(a) Waste must be classified in one of the following categories in ascending order: inert, solid, industrial or hazardous waste.

(b) Waste classified as solid, industrial or hazardous in See Table 1, Table 2, Table 3 and Table 4 in Section 2.2 cannot be reclassified into a lower category using this procedure, unless it has been treated to reduce or remove its hazardous characteristics.

(c) Only waste meeting all of the criteria of *non-liquid* may be classified using this procedure.

(d) In addition to meeting other requirements set out in this section, waste classified as inert waste using this procedure must also satisfy the criteria of *not capable of environmentally significant physical, chemical or biological transformation.* (See Definitions and Glossary.)

(e) The person doing the assessment must decide which of the chemical contaminants listed in Table A 3 and Table A 4 are present in the waste, and must then assess each contaminant against the given criteria.

(f) If the waste contains potentially toxic and / or ecotoxic contaminants not listed in Table A 3 and Table A 4, the person doing the assessment must ask the EMA to provide assessment criteria for these contaminants and then must assess the waste against these criteria as well.

(g) The waste must be classified according to the highest category listed in (a) as a result of the assessment for all contaminants in (e) and (f); for example, if all but one of the contaminants meets the requirements for solid waste, and the final contaminant meets only the requirements of industrial waste, the waste must be classified as industrial waste.

Table 6: Summary of criteria for chemical contaminants in waste classification

Waste classification[1]	Criteria[2] for classification (any of the alternative options given)	Comments
Inert	1. **SCC test values** ≤ CT1.	TCLP test not required.
	2. **TCLP test values** ≤ TCLP1 and **SCC test values** ≤ SCC1.	
	3. **TCLP test values** ≤ TCLP1 and **SCC test values** > SCC1 and immobilisation[3] is EMA-approved.	Without EMA approval of immobilisation, classify as solid, industrial or hazardous.
Solid	1. **SCC test values** ≤ CT2.	TCLP test not required.
	2. TCLP1 < **TCLP test values** ≤ TCLP2 and **SCC test values** ≤ SCC2.	
	3. TCLP1 < **TCLP test values** ≤ TCLP2 and **SCC test values** > SCC2 and theimmobilisation[3] is EMA-approved.	Without EMA approval of immobilisation, classify as industrial or hazardous.
Industrial	1. **SCC test values** ≤ CT3.	TCLP test not required.
	2. TCLP2 < **TCLP test values** ≤ TCLP3 and **SCC test values** ≤ SCC3.	
	3. **TCLP test values** ≤ TCLP3 and SCC2 < **SCC test values** ≤ SCC3.	
	4. TCLP2 < **TCLP test values** ≤ TCLP3 and **SCC test values** > SCC3 and immobilisation[3] is EMA-approved.	Without EMA approval of immobilisation, classify as hazardous.
Hazardous	1. **TCLP test values** > TCLP3.	Store or treat waste as appropriate.
	2. **TCLP test values** ≤ TCLP3 and **SCC test values** > SCC3 and immobilisation is not EMA-approved.	Store or treat waste as appropriate.

Notes:

1. See also the general rules relating to waste classification (in Section 2.4.3) for other criteria that must be satisfied before the waste can be classified.
2. These criteria apply to each toxic and ecotoxic contaminant present in the waste. (See Table A 3 and Table A 4.)
3. In certain cases the EMA will consider specific conditions, such as the segregation of such waste from all other types of waste in a monofill or a monocell, in order to achieve a greater margin of safety against a possible failure of the immobilisation in the future. Information about the construction and operation of a monofill / monocell is available in the *Draft Environmental Guidelines for Industrial Waste Landfilling*, (NSW EPA 1998a).

See Technical Appendix 1 for a full description of the non-liquid-waste-assessment process.

2.4.4 Immobilisation of chemical contaminants

The immobilisation of a contaminant in waste may be the result of a specific treatment process that the waste has been subjected to, or it may simply be a natural property of that type of waste. From a protection of the environment perspective, the key issue is whether this immobilisation (that is, resistance to being leached out of the waste) is likely to last in the long term.

It is critical that the immobilisation of the contaminant is sustained over time; otherwise the rate of release of the contaminant could exceed the rate at which the local environment can cope with it or safely mineralise it.

The EMA may approve the immobilisation of specified contaminant(s) contained in a particular type of waste. Approvals of the immobilisation of contaminants may be given in the following ways:

- the EMA can issue general approvals which would apply to all waste generated that has the properties specified in the approval, or
- for a specific waste as a result of an individual application received by the EMA.

In either case, an approval is subject to such conditions determined by the EMA, and remains in force until such time as it is revoked by the EMA.

Approvals of immobilisation may specify conditions relating to the subsequent storage, treatment or disposal of the waste. For example, in certain cases the EMA will consider specific conditions (such as the segregation of such waste from all other types of waste in a monofill or a monocell) in order to achieve a greater margin of safety against a possible failure of the immobilisation in the future. These conditions must not be contravened, otherwise a penalty may be imposed.

The following conditions apply in respect of 'Immobilisation of contaminants in waste':

- Approvals may be issued for immobilisation and have the effect of enabling the waste to which the approval relates to be assessed and classified in accordance with the procedures set out in Technical Appendix 1 of these standards.
- An application for an approval must:

  —identify the contaminants to be immobilised

  —be accompanied by such evidence as may be required by the EMA for the purposes of ascertaining whether the identified contaminants in the waste will be immobilised and will remain immobilised after disposal of the waste.
- The EMA may impose conditions to any approval, such as:

  —disposal of the waste to which the approval relates

  —record-keeping requirements

  —the immobilisation of the contaminants concerned.
- An approval may be amended or revoked by the EMA by way of written notice given to the responsible person.
- If an approval is given, the responsible person must comply with the conditions to which the approval is subject; otherwise they will have committed an offence.

For details on how to make applications for approvals of immobilisation, see Technical Appendix 2.

Table A 5 (on the last page of Technical Appendix 2) shows the waste types to which the EMA is already planning to grant approval in respect of the immobilisation of specific contaminants; it also specifies the conditions relevant to each approval.

It is important to note that wherever EMA approval has been given for the immobilisation of the contaminant(s), the waste can be classified according to its TCLP test results alone. If the immobilisation of a contaminant for which TCLP limits are not specified in the standards is approved, the EMA will advise on the management options that are available for such materials.

SECTION 3 COMMON QUESTIONS AND ANSWERS

3.1 To what extent is the generator responsible for the assessment and classification of waste?

The waste assessment processes documented in these standards will make the criteria for classifying liquid and non-liquid waste transparent, and will enable waste generators / owners State-wide to:

- assess their waste consistently
- ensure that their waste is reused, recycled, processed, reprocessed, transported, treated, stored or disposed of lawfully
- make significant improvements in their waste generation and management practices.

The generator or owner is responsible for producing documentation that conveys the correct classification of the waste to the waste transporter and the waste management facility receiving the waste.

3.2 How often does the generator need to test waste to demonstrate that it is assessed and classified with due diligence?

There are no specified legal requirements in relation to sampling and testing.

It may not be necessary to test the waste at all if the generator knows the process(es) that led to the production of the waste and the maximum possible levels of contaminants in the waste, and is certain that the waste can be classified without testing.

Liquid wastes

The generator may decide after initial testing of a particular liquid waste stream that he / she wishes to treat **all** waste in that stream as being *controlled aqueous liquid wastes*. In this case no further testing will be necessary unless the controlled waste facility that receives such liquid waste requires test data.

There may be situations in which frequent testing for an initial period may show sufficient consistency in the characteristics of a liquid waste stream to give the generator confidence that all waste in that stream can be classified as *non-controlled aqueous liquid waste* and that the frequency of testing can be reduced significantly.

On the other hand, some waste streams could show such large variations in properties that every load of waste would need to be carefully sampled and tested before classification. This would apply only if the waste generator wanted to be able to manage loads that are *liquid waste not requiring a licence* differently from those that do require the use of *licensed transporters* and that must be delivered to *licensed waste facilities* or *licensed mobile waste processors.*

Non-liquid wastes

There may be situations in which frequent testing for an initial period can show sufficient consistency in the characteristics of the waste stream to give the generator confidence to be able to reduce the frequency of testing significantly.

On the other hand, some waste streams could show such large variations in properties that every load of waste would need to be carefully sampled and tested before classification.

Sampling

The aim of sampling is to get a sample population that truly represents the average levels of contaminants present in the waste. This document contains some guidance on sampling (see Technical Appendix 1); however, help from an expert is advisable in some cases.

3.3 Do transporters, mobile waste processors and waste facility operators need to assess the waste they receive?

Transporters, mobile waste processors and waste facility operators should be able to rely on the assessment and classification process of the waste generator. It is important for the waste industry to have proper commercial agreements with waste generators and to insist that written documentation concerning each load of waste is received from generators. It may be an advantage to conduct occasional random audits on waste received, in order to ensure that the waste has been classified correctly by the generator.

Documenting the movement of waste will also enable waste generators and transporters to demonstrate that the waste has been delivered to a facility that is licensed or that can otherwise lawfully receive the waste.

3.4 What other documents can I read?

3.4.1 ACT Legislation

- *Environment Protection Act 1997* and the *Environment Protection Regulations* are important documents to be familiar with when reading these standards.

3.4.2 ACT Standards and Documents

- Number of Environment Protection Policies have been approved by the ACT Government and are relevant to waste management. These are:
  - General Environment Protection Policy;
  - Water Pollution Environment Protection Policy; and
  - Air Environment Protection Policy.

3.4.3 NSW Environment Protection Authority standards and documents

Landfill environmental issues are dealt with in:

- *Environmental Guidelines: Solid Waste Landfills* (1996)
- *Environmental Guidelines: Industrial Waste Landfilling* (under preparation—draft version available).

Contaminated site and soil management issues are dealt with in:

- *Contaminated Sites: Guidelines for Assessing Service Station Sites* (1994)

- *Contaminated Sites: Guidelines for the Vertical Mixing of Soil on Former Broad-acre Agricultural Land* (1995)
- *Contaminated Sites: Sampling Design Guidelines* (1995)
- *Guidelines for Consultants Reporting on Contaminated Sites* (1997)
- *Guidelines for the NSW Site Auditor Scheme* (1998)
- *Guidelines on Significant Risk of Harm from Contaminated Land and the Duty to Report* (1999)
- *Discussion Paper: Assessment of Orchard and Market Garden Contamination Sites* (1995).

Biosolids management issues are dealt with in:

- *Environmental Guidelines: Use & Disposal of Biosolids Products* (1997).

3.4.4 Commonwealth Government legislation and documents

- *Australian Code for the Transport of Dangerous Goods by Road and Rail* (6th edition, National Road Transport Commission 1998).
- Radiation Health Series No.13, *Code of Practice for the Disposal of Radioactive Wastes by the User* (National Health and Medical Research Council, 1985)
- *National Environment Protection (Movement of Controlled Wastes between States and Territories) Measure* made under the *National Environment Protection Council Act 1994* of the Commonwealth on 26 June 1998.

3.5 Where can I get copies of these other documents?

3.5.1 Printed copies

These standards, Environment Protection Policies and other ACT documents can be obtained by contacting Environment ACT at 12 Wattle Street, LYNEHAM ACT. Environment ACT's postal address is PO Box 144, LYNEHAM ACT 2602.

Environment ACT can be contacted by phone on (02) 6207 9777 or fax on (02) 6207 6084.

You can get NSW EPA standards and other documents by telephoning the NSW EPA's Pollution Line on 131 555 (NSW callers only) or (02) 9733 5000.

Get copies of NSW publications from the Government Information Service NSW—phone 1800 463 955 (free call) or (02) 9743 7200.

Copies of Commonwealth Acts, Regulations, Codes and other documents are available from the Commonwealth Government Info Shop, 10 Mort Street, Canberra City—phone (02) 6247 7211.

3.5.2 Access via the Internet

The following are useful Internet site addresses for information that you may need:

- Environment ACT's web page with links to other sites:

  — http://www.act.gov.au/environ/

- Email messages can be sent to Environment ACT at:

  — EnvironmentACT@act.gov.au

- the NSW EPA's web page:
  —http://www.epa.nsw.gov.au
- Australasian Legal Information Institute:
  —Acts and Regulations for all States and the Commonwealth: http://www.austlii.edu.au/
- Environment Australia, Environment Protection Group (formerly CEPA):
  —http://www.erin.gov.au/index.html
- Commonwealth *Worksafe* issues:
  —http://www.worksafe.gov.au/~wsa1/index.htm
- Commonwealth transport-of-dangerous-goods issues:
  —http://www.dot.gov.au/programs/fors/dgoodsum.htm

The advantages of gaining access to legislative documents via the Internet are:

- documents are updated very soon after Parliament makes changes to them
- you can get the information you need very quickly
- you can conduct searches on the document to locate the parts of specific interest to you
- you can print out only those parts that you require, and save resources.

TECHNICAL APPENDIX 1: ASSESSMENT AND CLASSIFICATION PROCEDURES FOR LIQUID AND NON-LIQUID WASTES

Part 1 Introduction

Assessing and classifying liquid wastes

If aqueous liquid wastes (see Definitions and Glossary) are not classified as hazardous (see Table 4, Group B or Group C (see Table 5) wastes and are known to contain or suspected to contain chemical contaminants (such as industrial, commercial, mining or agricultural chemicals), they must be assessed chemically.

All non-aqueous liquid wastes (see Definitions and Glossary) have been classified as Group A liquid waste. (See Table 5.)

There is no need to test and assess the following types of liquid wastes:

- wastes that have already been classified in Table 4 and Table 5 in SECTION 3

Table A 1 lists the maximum Specific Contaminant Concentration values for chemical contaminants (the same chemicals as in Table A 3 and Table A 4 for non-liquid wastes) for aqueous liquid wastes to be assessed as *non-controlled aqueous liquid waste.* Liquid waste must be classified as *controlled aqueous liquid waste* even if only one out of many chemical contaminants present exceeds its respective criterion in Table A 1.

The majority of the above maximum values are numerically the same (but expressed as mg/kg) as the *USEPA final rule for TCLP levels* (see ref: USEPA 1990a) for these chemical contaminants. Consult the notes to Table A 1 for references to the origin of most of the values in the Table. As a **rule of thumb**, many of the values would be about 100 times larger than the maximum values for such chemical contaminants in drinking water standards (assuming a dilution attenuation factor of 100 in the case of accidental spillage).

Assessing and classifying non-liquid wastes

There is no need to do chemical assessment and subsequent classification of the following types of non-liquid wastes:

- non-liquid waste types classified in the regulations, as listed in Table 1, Table 2, Table 3 and Table 4 in SECTION 3
- gaseous emissions, since these are regulated elsewhere in the *Environment Protection Act 1997*

Table A 3 lists the *contaminant threshold* values (CT), while Table A4 lists the *leachable concentration* (TCLP) and *total concentration* values for chemical contaminants used in the assessment of non-liquid wastes as *inert, solid, industrial* or *hazardous waste.* The assessment of non-liquid wastes is more complicated than that of liquid wastes; it is described in detail in Part 5 of this appendix.

Part 2 Frequency of testing; sampling; and precision

There are no specified legal requirements in relation to sampling and testing. It may not be necessary to test the waste at all if the generator knows the process(es) that led to the production of the waste, and the maximum possible levels of contaminants in the waste, and is certain that the waste can be classified without testing.

Frequency of testing

Liquid wastes

The generator may decide after initial testing of a particular liquid waste stream that he/she wishes to treat **all** waste in that stream as being *controlled aqueous liquid wastes* and, therefore, to classify it as Group A liquid waste. In this case no further testing will be necessary unless the waste facility that receives the liquid waste requires test data.

There may be situations in which frequent testing for an initial period may show that the characteristics of a liquid waste stream are consistent enough to give the generator confidence to classify all waste in that stream as *non-controlled aqueous liquid waste,* and to reduce the frequency of testing significantly.

On the other hand, some waste streams may show such large variations in properties that every load of waste would need to be carefully sampled and tested before classification. This would apply only if the waste generator wanted to be able to manage loads that are *non-controlled aqueous liquid waste* differently from those that are *controlled aqueous liquid waste.*

Non-liquid wastes

There may be situations in which frequent testing of non-liquid wastes for an initial period may show that the characteristics of the waste are consistent enough to give the generator confidence to reduce the frequency of testing.

On the other hand, some non-liquid waste streams may show such large variations in properties that every load of waste would need to be tested before classification.

Sampling

Sampling is done to determine the average levels of contaminants in the waste that is to be assessed. It is important to recognise that most incorrect chemical assessments of waste are due to poor or incorrect sampling.

Generalised sampling recommendations are not possible, since they depend on how consistent any tested property is throughout the batch of waste.

Liquid wastes

If the property is highly consistent (homogeneous liquids), sampling is relatively straightforward.

It becomes much more difficult to sample waste that either consists of many different types of waste materials, or that has contamination that is not evenly distributed throughout the batch. In such situations, keeping different waste types separate, or separating portions of liquid waste that contain high levels of contaminants from the rest, can be of great benefit.

For guidance on sampling techniques see the following Australian/New Zealand Standards:

- AS / NZS 5667.1:1998—*Part 1: Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples*
- AS / NZS 5667.10:1998—*Part 10: Guidance on sampling of waste waters*
- AS / NZS 5667.11:1998—*Part 11: Guidance on sampling of groundwaters.*

In certain cases you may need to get help from an expert in sampling and testing.

Non-liquid wastes

Where the property is highly consistent (homogeneous), sampling is relatively straightforward, and useful guidance can be found in the following Australian Standards:

- AS 1199–1988: *Sampling Procedures and Tables for Inspection by Attributes*
- AS 1399–1990: *Guide to AS 1199.*

The Australian Standard AS 1141*: Methods for Sampling and Testing Aggregates* is likely to be useful for sampling wastes such as aggregates, foundry sand, furnace slag or mining waste.

It becomes much more difficult to sample waste that either consists of many different types of waste materials or has contamination that is not evenly distributed throughout the batch. In such situations, keeping different waste types separate, or separating portions of waste that contain high levels of contaminants from the rest, can be of great benefit.

The NSW EPA has provided some guidance for the sampling of soils; see *Contaminated Sites: Sampling Design Guidelines* (1995)

In certain cases you may need to get help from an expert in sampling and testing.

Precision in chemical analyses

It is important that the test methods and instruments used are capable of measuring the concentration of each chemical contaminant with a sufficient degree of confidence to assure correct classification.

It is recommended that the upper limit of the combined confidence interval of sampling and analysis (at a probability of 95%) is used for comparison with the maximum values specified in Table A 1, Table A 3 and Table A 4. This approach should give the assessor a sufficient degree of confidence that a correct classification has been made.

Part 3 Which contaminants should I test for?

Table A 1 lists the chemical contaminants that are used in the assessment and classification of liquid waste, while Table A 3 and Table A 4 list those used for the assessment and classification of non-liquid wastes. If your waste contains chemical contaminants that are not in these tables, you should contact the EMA for advice.

If you have inadequate knowledge of chemistry or waste assessment, you are likely to require some expert help, either from a laboratory that specialises in waste analysis or from a person specialising in such waste management issues, or both. The advice of an expert will probably help you avoid the need (and costs) of testing for contaminants that are unlikely to be present in your liquid or non-liquid wastes. The following headings may provide you with some useful ideas for your type of waste.

Waste generated from businesses where chemicals are used

You should make an inventory of materials that you use and ensure that you have Materials Safety Data Sheets for all of these. Materials Safety Data Sheets should list the constituent chemical components and should help you to draw up a list of potential contaminants.

If you operate a process that involves chemical changes, then you need to add to the above list of chemicals the products and by-products of such processes.

Suspected contaminated soil

Contact the EMA to identify the likely contaminants. Knowledge of the type of activity previously carried out on the site can give some clues as to the nature of potential contaminants present.

Unused agricultural chemicals

Take great care when handling chemicals, especially if they are known to be dangerous or if their hazards are unknown. If in doubt, enlist help from an expert. Note or estimate the date of manufacture of the chemical, then contact the supplier or manufacturer in order to narrow the range of chemical contaminants that were in use at the time of manufacture. You can also contact your peak organisation or association for help.

Waste of unknown origin

This type of waste may already have been on the property at the time of purchase or have been dumped on the site (as 'orphan waste'). Take great care when handling chemicals, especially if you do not know their hazards. If in doubt, enlist help from an expert. Look for any clues present in the waste that may indicate its origin. An idea of the type of activity from which the waste arose can give some clues as to the nature of potential contaminants present. Take care in attempting to identify unknown wastes. Avoid handling open, corroding or leaking containers, or wastes not in a container.

Waste received from a generator

Transporters, waste storage facilities, processors, reprocessors, recyclers, mobile waste processors and treatment facilities should be able to rely on assessments carried out by the generators or owners of the waste. If they wish to audit waste they receive from time to time, they should request information relating to the nature of the waste from its generator or owner. This should narrow down the list of chemical contaminants that need analysis.

Part 4 Chemical assessment and classification procedures for liquid wastes

Who can do the chemical analysis?

It is strongly recommended that you use analytical laboratories accredited by the National Association of Testing Authorities (NATA) to perform these analyses and tests.

Methods of analysis

If the liquid waste contains a **low fraction of solids**, then analytical procedures suitable for **liquids** may be suitable.

If the liquid waste contains a **high fraction of solids**, then analytical procedures suitable for **solids** may be suitable.

In some instances, however, in order to obtain reliable analytical results for a **mixture of liquids and solids**, it may be necessary to:

- separate the aqueous phase from the solid phase
- determine the concentrations of the contaminants present in each phase, and
- calculate the average contaminant concentrations in the original waste mixture using weighted averages.

For the reference test method for determining the concentration of chemical contaminants in aqueous liquids, see *Standard Methods for the Examination of Water and Wastewater* (APHA 1995).

The reference test method for determining the concentration of chemical contaminants for solids (if any) separated from a mixture is as described in the Office of Solid Waste and Emergency Response, United States Environmental Protection Agency (USEPA) document *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*, SW–846: Third Edition, 1986 and Updates I and II (revised July 1992).

Rules for chemical assessment and classification

You must consider the general rules given below before assigning a final classification to the waste:

- Liquid waste must be classified as one of the following categories: hazardous, Group A, Group B, Group C liquid waste or *non-controlled aqueous liquid waste*.
- Liquid waste classified as hazardous in Table 4 or as Group A, Group B or Group C waste in Table 5 cannot be reclassified as *non-controlled aqueous liquid waste* (using this assessment procedure) unless it has been treated to reduce or remove those characteristics that were responsible for the original classification.
- The person doing the assessment must decide which of the chemical contaminants listed in Table A 1 are present in the liquid waste and assess each contaminant against the given criteria.
- If the liquid waste contains potentially toxic and / or ecotoxic contaminants not listed in Table A 1, the person doing the assessment must ask the EMA to provide assessment criteria for these contaminants and assess the waste against these criteria as well.
- Even if only one out of many chemical contaminants present exceeds its respective criterion in Table A 1 the liquid waste must be assessed as *controlled aqueous liquid waste* and, therefore, classified as Group A waste.

Table A 1: Maximum values for chemical contaminants[1] for aqueous liquid wastes to be classified as *non-controlled aqueous liquid wastes*

Contaminant	Maximum specific contaminant concentration (mg/kg)	CAS registry number
Arsenic	1.0[10]	
Benzene	0.5[2]	71-43-2
Benzo(a)pyrene[3]	0.04[4]	50-32-8
Beryllium	1.0[5]	
Cadmium	1.0[2]	
Carbon tetrachloride	0.5[2]	56-23-5
Chlorobenzene	100[2]	108-90-7
Chloroform	6[2]	67-66-3
Chromium (VI)[7]	5[2]	
m-Cresol	200[2]	108-39-4
o-Cresol	200[2]	95-48-7
p-Cresol	200[2]	106-44-5
Cresol (total)	200[2]	1319-77-3
Cyanide (amenable)[8]	1.0[10]	
Cyanide (total)	1.0[11]	
2,4-D	10[2]	94-75-7
1,2-Dichlorobenzene	4.3[2]	95-50-1
1,4-Dichlorobenzene	7.5[2]	106-46-7
1,2-Dichloroethane	0.5[2]	107-06-2
1,1-Dichloroethylene	0.7[2]	75-35-4
Dichloromethane	8.6[2]	75-09-2
2,4-Dinitrotoluene	0.13[2]	121-14-2
Ethylbenzene	30[6]	100-41-4
Fluoride	20[10]	
Lead	5[2]	
Mercury	0.03[10]	
Methyl ethyl ketone	200[2]	78-93-3
Molybdenum	200[10]	
Nickel	3[10]	

Contaminant	Maximum specific contaminant concentration (mg/kg)	CAS registry number
Nitrobenzene	2[2]	98-95-3
C6-C9 petroleum hydrocarbons[12]	32	–
C10-C36 petroleum hydrocarbons[12]	500	–
Phenol (non-halogenated)	15[9]	108-95-2
Polychlorinated biphenyls	2	1336-36-3
Polycyclic aromatic hydrocarbons(total)[14]	5	–
Scheduled chemicals[11]	1	Refer to Appendix 5
Selenium	5	
Silver	5.0[2]	
Styrene (vinyl benzene)	3[6]	100-42-5
1,1,1,2 – Tetrachloroethane	10[2]	630-20-6
1,1,2,2 – Tetrachloroethane	1.3[2]	79-34-5
Tetrachloroethylene	0.7[2]	127-18-4
Toluene	15[9]	108-88-3
1,1,1-Trichloroethane	30[2]	71-55-6
1,1,2-Trichloroethane	1.2[2]	79-00-5
Trichloroethylene	0.5[2]	79-01-6
2,4,5-Trichlorophenol	10[10]	95-95-4
2,4,6-Trichlorophenol	2[2]	88-06-2
Vinyl chloride	0.2[2]	75-01-4
Xylenes (total)	50[13]	1330-20-7

Notes to Table A 1:

1. For organic and inorganic chemical contaminants not listed in this Table, contact the EMA for requirements. Note that aluminium, barium, boron, cobalt, chromium (0 and III oxidation states), copper, iron, manganese, vanadium and zinc have deliberately not been listed in this table and need not be tested for.
2. USEPA final rule for TCLP levels (USEPA 1990a).
3. There may be a need for the laboratory to concentrate the sample to achieve the limit value for benzo(a)pyrene with confidence.
4. Calculated from: Hazardous Waste: Identification and Listing; Proposed Rule (USEPA 1995)

5. Calculated from: DiMarco & Buckett (1996); Imray & Langley (1996).
6. Calculated from: *Australian Drinking Waters Guidelines* (NHMRC 1994).
7. This limit applies to chromium in the +6 oxidation state only.
8. Analysis for cyanide (amenable) is the established method to assess the potentially leachable cyanide. Other methods may be considered by the EMA if it can be demonstrated that these methods yield the same information.
9. Proposed level for phenol and toluene (USEPA 1990b).
10. Sydney Water Trade Waste Discharge Limit.
11. Refer to Technical Appendix 5 for a list of chemicals regulated under the Scheduled Chemical Wastes Chemical Control Order 1994.
12. Approximate range of petroleum hydrocarbon fractions: petrol C6-C9, kerosene C10-C18, diesel C12-C18, and lubricating oils above C18. Laboratory results are reported as four different fractions: C6-C9, C10-C14, C15-C28, C29-C36. The results of total petroleum hydrocarbons (C10-C36) analyses are reported as a sum of the relevant three fractions.
13. Calculated from *Guidelines for Drinking-Water Quality* (World Health Organisation 1993).
14. Polycyclic aromatic hydrocarbons (total) is assessed as the total concentration of 16 USEPA Priority Pollutant PAHs, as follows:

PAH name	CAS Registry No.	PAH name	CAS Registry No.
Acenaphthene	83-32-9	Chrysene	218-01-9
Acenaphthylene	208-96-8	Dibenzo(a,h)anthracene	53-70-3
Anthracene	120-12-7	Fluoranthene	206-44-0
Benzo(a)anthracene	56-55-3	Fluorene	86-73-7
Benzo(a)pyrene	50-32-8	Indeno(1,2,3-cd)pyrene	193-39-5
Benzo(b)fluoranthene	205-99-2	Naphthalene	91-20-3
Benzo(ghi)perylene	191-24-2	Phenanthrene	85-01-8
Benzo(k)fluoranthene	207-08-9	Pyrene	129-00-0

Part 5 Chemical assessment procedure for non-liquid wastes

Who can do the chemical analysis and leaching tests?

It is strongly recommended that you use analytical laboratories accredited by the National Association of Testing Authorities (NATA) to perform these analyses and tests. If accredited laboratories are unavailable locally, contact the EMA office for advice.

Introduction to chemical analysis and leaching tests

The two measurable properties of chemical contaminants in samples of non-liquid waste used for subsequent waste classification are:

- the *total concentration* of any chemical contaminant in the waste (expressed as mg / kg), called *Specific Contaminant Concentration (SCC)* in these standards
- the *leachable concentration* of any chemical contaminant (expressed as mg / L), obtained by subjecting a sample from the waste to the *leaching test*, named the *Toxicity Characteristics Leaching Procedure (TCLP)* in these standards, and the subsequent chemical analysis of that leachate.

The *leachable concentration (TCLP)* for any contaminant gives an indication of whether that contaminant is likely to leach out from the non-liquid waste once it is disposed of in a landfill. This test procedure forms the basis for the assessment process. (*See* Table A 4 in this Technical Appendix.)

The *total concentration (SCC)* of any contaminant in the waste is used for three different purposes:

- for classification without determining leachable concentration *(TCLP)* (S*ee* Table A 3 in this Technical Appendix.)
- for classification **together with** leachable concentration *(TCLP)* (S*ee* Table A 4 in this Technical Appendix.)
- when the *total concentration* for any contaminant is **high** (exceeding maximum values in Table A 4), it is used as a *trigger* for the waste generator to examine whether that contaminant is *permanently immobilised.* (For details see Section 2.4.4 and Technical Appendix 2.)

The *concentration threshold (CT)* values were calculated from the *leachable concentration (TCLP)* values by multiplying them by 20 (for example, CT1 = 20 x TCLP1). (See Table A3 in this Technical Appendix.) This formula was used since if the waste sample has a *total concentration (SCC)* of 20 mg / kg of a contaminant that fully leached in the test, then the *leachable concentration (TCLP)* value would be 1 mg / L, due to the way in which the test is performed. Only when the *total concentration (SCC)* of any contaminant exceeds the *concentration threshold (CT)* value, must the *leachable concentration (TCLP)* for that contaminant also be determined in order to be able to classify the waste in that category using both criteria. (S*ee* Table A4 in this Technical Appendix.)

Methods for chemical analysis and leaching tests

The reference test methods for determining both *total concentration [Specific Contaminant Concentration (SCC)]* and *leachable concentration [Toxicity Characteristics Leaching Procedure (TCLP)]* values are as described in the Office of Solid Waste and Emergency Response, United States Environmental Protection Agency (USEPA) document *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846,* Third Edition, 1986 and Updates I and II (revised July 1992*).*

It is recommended that you use the procedures described in the new series of Australian Standards for leachate preparation. This new series comprises: AS 4439–1997*: Wastes, Sediments and Contaminated Soils*; AS 4439.2–1997: *Wastes, Sediments and Contaminated Soils, Part 2: Preparation of Leachates—Zero Headspace Procedure*; and AS 4439.3–1997: *Wastes, Sediments and Contaminated Soils Part 3: Preparation of Leachates—Bottle Leaching Procedure.*

The standard pH for the leaching solutions used must be either 4.93 ± 0.05 if the pH of the waste sample is less than 5.0, or 2.88 ± 0.05 if the pH of the waste sample is greater than 5.0. To determine the pH of the waste sample, use the test method specified in Clause 7.5 (*Selection of Leaching Fluid*) of AS 4439.3–1997: *Wastes, Sediments and Contaminated Soils Part 3: Preparation of Leachates—Bottle Leaching Procedure*. In specific instances the EMA may permit the use of leachants of a pH other than those specified above, but the EMA's authorisation for using an alternative leachant must be sought in writing with justification for the proposed variation. The testing of a non-putrescible waste type for disposal into a monofill or monocell that can be shown not to be subject to penetration by acidic leachate or ground water is an example of a situation in which such written authorisation may be granted by the EMA.

There is the opportunity to secure EMA approval to use an alternative leachant for assessing and classifying waste for monocell or monofill disposal. To seek this approval documentation must be provided to the EMA describing all alternative options to disposal that have been considered and justifying the reasons for their rejection.

Precision of chemical analyses and leaching tests

It is important that the test methods and instruments used are capable of measuring the concentration of each chemical contaminant with a sufficient degree of confidence to assure correct classification.

It is recommended that the upper limit of the combined confidence interval of sampling and analysis (at a probability of 95%) is used for comparison with the maximum values specified in Table A 3 and Table A 4. This approach should give the assessor a sufficient degree of confidence that a correct classification has been made.

Practical quantitation limits (PQLs) achievable for both *total concentration (SCC)* and *leachable concentration (TCLP)* can be an important measure of the achievable accuracy of testing, and consequently of this degree of confidence. The lower the practical quantitation limit for a chemical contaminant, as compared with the actual concentration being measured, the greater is the degree of confidence in the test result. Practical quantitation limits achieved in the past in the NSW EPA's own laboratories both for *total concentration (SCC)* and *leachable concentration (TCLP)* are listed for your information in Technical Appendix 4. In some instances, low practical quantitation limits (such as those obtained by the NSW EPA) are not essential for a sufficient degree of confidence, but as a **rule of thumb**, practical quantitation limits should be an order of magnitude smaller than the maximum values (specified in Table A 3 and Table A 4) with which the results are being compared.

Rules for chemical assessment and classification of non-liquid wastes

This part is reproduced from Section 2.4.3.

The general rules given below must be considered before assigning a final classification to the waste:

(a) Waste must be classified in one of the following categories in ascending order: inert, solid, industrial or hazardous waste.

(b) Waste classified as solid, industrial or hazardous in Table 1, Table 2, Table 3 and Table 4 in Section 2.2 cannot be reclassified into a lower category using this procedure unless it has been treated to reduce or remove its hazardous characteristics.

(c) Only waste meeting all of the criteria of *non-liquid* may be classified using this procedure.

(d) In addition to meeting other requirements set out in this section, waste classified as inert waste using this procedure must also satisfy the criteria of *not capable of environmentally significant physical, chemical or biological transformation.* (See Definitions and Glossary.)

(e) The person doing the assessment must decide which of the chemical contaminants listed in Table A 3 and Table A 4 are present in the waste, and must then assess each contaminant against the given criteria.

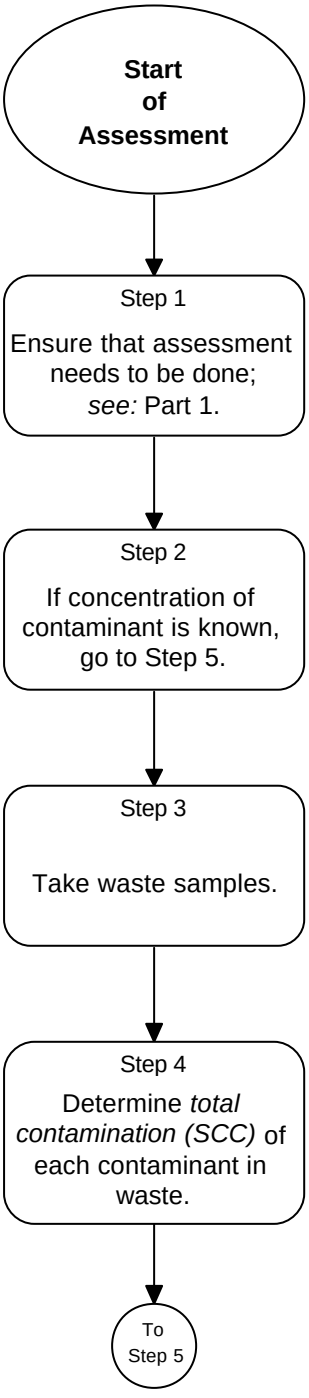
(f) If the waste contains potentially toxic and / or ecotoxic contaminants not listed in Table A 3 and Table A 4, the person doing the assessment must ask the EMA to provide assessment criteria for these contaminants and then must assess the waste against these criteria as well.

(g) The waste must be classified according to the highest category listed in (a) as a result of the assessment for all contaminants in (e) and (f); for example, if all but one of the contaminants meets the requirements for solid waste, and the final contaminant meets only the requirements of industrial waste, the waste must be classified as industrial waste.

Step by step chemical assessment and classification of non-liquid wastes

Stage 1: Sampling & Testing

Tip:
At this point you should have a waste that is a *non-liquid* (this process does not apply to liquids), and you should follow the process steps from Step 1 to Step 19. Other tips in this Part of the Technical Appendix will provide you with information to help you understand the procedure better.



Step 1:
Ensure that the waste type is not included in one of the categories in Part 1 of this Technical Appendix for which chemical assessment is not needed.

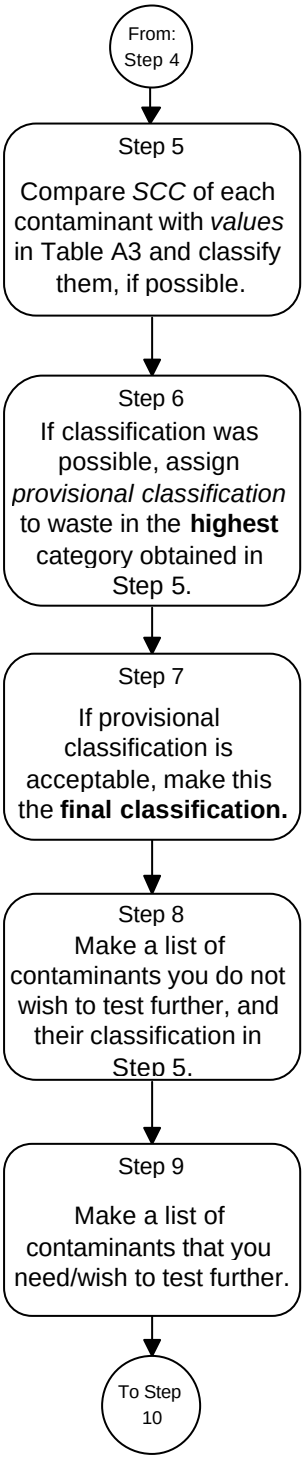
Step 2:
If the concentration of contaminants present in the waste is already known, proceed to step 5.

Step 3:
Obtain a sample population that is representative of the waste to be assessed.

Step 4:
Determine the *total concentration (SCC)* of each contaminant in the waste.

Stage 2: Classification without using *leachable concentration* (TCLP)

Tip:
The determination of *total concentration (SCC)* is usually cheaper than the determination of *leachable concentration (TCLP)*. It is possible sometimes to classify the waste without determining the TCLP, as shown below.
The lists of the assessments for individual contaminants, namely List A at Step 8, List B at Step 14 and List C at Step 17, are combined at Step 19 in order to ensure that the highest assessment value will be used to determine the final classification of the waste [*see:* general rules in Part 5 of this Technical Appendix].



Step 5:
Compare the *total concentration (SCC)* of each contaminant to the *maximum values for classification without TCLP* in Table A3 for *Inert Waste, Solid Waste or Industrial Waste,* and assign a classification for each contaminant (i.e. if the *total concentration* is less than or equal to CT1, then it's *Inert*; if the *total concentration* is less than or equal to CT2, then it's *Solid*; and if the *total concentration* is less than or equal to CT3 then it's Industrial).

Step 6:
If classification was possible in step 5 for all contaminants present, provisionally classify the waste in the highest category assigned to any contaminant (*see:* general rules in Part 5 of this Technical Appendix).

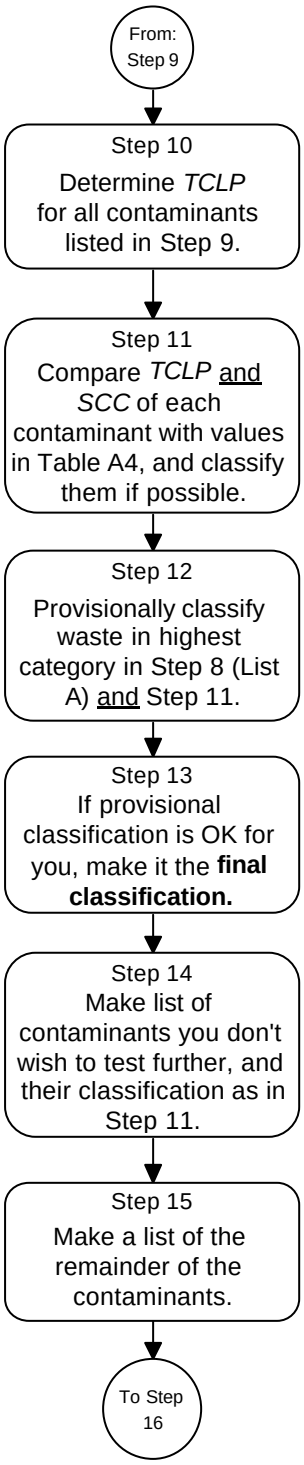
Step 7:
If this provisional classification is acceptable to you, make it the final classification. Otherwise go to step 8.

Step 8:
Make a list of the contaminants (**List A**) that you do not wish to test further and their respective classifications, as determined in step 5.

Step 9:
Make a list of the remainder of the contaminants, and go to step 10 to continue the assessment and classification process.

Stage 3: Classification using *leachable concentration (TCLP)* and *total concentration (SCC)*

Tip:
The need to use *leachable concentration (TCLP)* and *total concentration (SCC)* is **either**:
(i) **unavoidable** if one or more contaminant in step 5 exceeded CT3, **or**
(ii) **optional** if any *total concentration (SCC)* value lies between the CT and the SCC maximum values for either Inert Waste or Solid Waste in Table A4 since it may enable a lower classification to be made.



Step 10:
Determine the *leachable concentration (TCLP),* using the representative sample obtained in step 3 for all those contaminants listed in step 9.

Step 11:
Compare the *leachable concentration (TCLP)* and *total concentration (SCC)* of each contaminant with the *maximum values for leachable concentration and total concentration when used together* in Table A4 for *Inert Waste, Solid Waste or Industrial Waste,* and assign a classification for each contaminant.(i.e. if the *TCLP* is less than or equal to TCLP1 and the *SCC* is less than or equal to SCC1, then it's *Inert*; if the *TCLP* is less than or equal to TCLP2 and the *SCC* is less than or equal to SCC2, then it's *Solid*; if the *TCLP* is less than or equal to TCLP3 and the *SCC* is less than or equal to SCC3, then it's *Industrial;* and if the *TCLP* is greater than TCLP3 and/or the *SCC* is greater than SCC3 then it's *Hazardous*)

Step 12:
Provisionally classify the waste in the highest category assigned to any contaminant in step 8 and step 11 (*see:* general rules in Part 5 of this Technical Appendix).

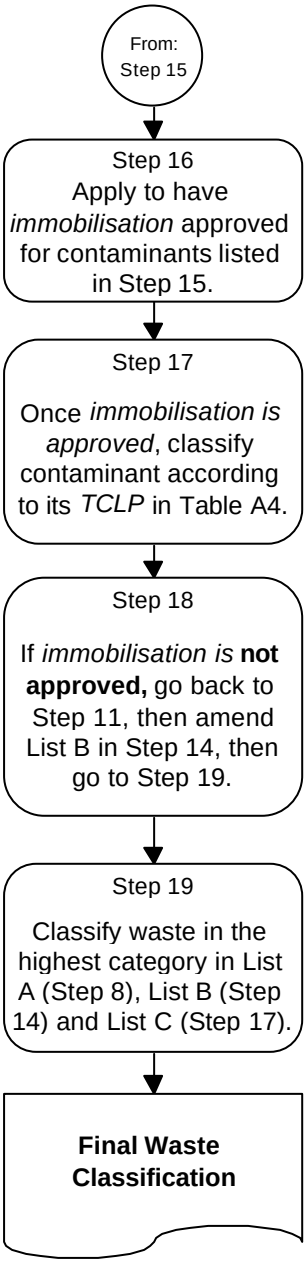
Step 13:
If the provisional classification made in step 12 is acceptable to you, make it the final classification. Otherwise proceed to step 14.

Step 14:
Make a list of the contaminants (**List B**) that you do not wish to assess further, and their respective classifications as determined in step 11.

Step 15:
Make a list of the remainder of the contaminants, and go to step 16 to continue the assessment and classification process.

Stage 4: Classification using *immobilisation* and *leachable concentration (TCLP)*

Tip:
If the *total concentration (SCC)* of any contaminant exceeds the maximum values SCC1, SCC2 or SCC3 in Table A4, while the corresponding *leachable concentration (TCLP)* is less than or equal to TCLP1, TCLP2 or TCLP3, it is possible to apply to the EMA to have the *immobilisation* of that contaminant approved for that particular waste type.
Once the EPA has approved the *immobilisation* (of that contaminant for that particular waste type), the waste may be classified as outlined below. For example: approved *immobilisation* may allow a waste type with a *total concentration (SCC)* of a contaminant exceeding SCC3 but having a corresponding *leachable concentration (TCLP)* less than or equal to TCLP2 to be classified as *solid waste*. A fuller discussion of *immobilisation* may be found in Section 2.4.4 and Technical Appendix 2.



Step 16:
Unless already approved, apply to the EMA to have the *immobilisation* of all those contaminants listed in step 15 approved for that particular waste type.

Step 17:
Once the *immobilisation* of a contaminant is approved, classify that contaminant according to its *leachable concentration (TCLP)* in Table A4 (i.e. if the *leachable concentration* is less than or equal to TCLP1, then it's *Inert*; if the *leachable concentration* is less than or equal to TCLP2, then it's *Solid*; if the *leachable concentration* is less than or equal to TCLP3, then it's *Industrial;* and if the *leachable concentration* is greater than TCLP3 then it's *Hazardous*).
Make a list of these classifications (**List C**).

Step 18:
If the *immobilisation* of one or more contaminant is not approved, go back to step 11 to classify them, and then amend List B in step 14 before going to step 19.

Step 19:
Classify the waste in the highest category assigned to any contaminant in step 8, step 14 and step 17 (i.e. Lists A, B and C combined) (*see:* general rules in Part 5 of this Technical Appendix).

You have now arrived at the final classification for your waste!

Table A 2: Summary of criteria for chemical contaminants in non-liquid waste classification (See also Table 6 in Section 2.4.3)

Waste classification[1]	Criteria[2] for classification (any of the alternative options given)	Comments
Inert	1. **SCC test values** ≤ CT1.	TCLP test not required.
	2. **TCLP test values** ≤ TCLP1 and **SCC test values** ≤ SCC1.	
	3. **TCLP test values** ≤ TCLP1 and **SCC test values** > SCC1 and immobilisation[3] is EMA approved.	Without EMA approval of immobilisation, classify as solid, industrial or hazardous.
Solid	1. **SCC test values** ≤ CT2.	TCLP test not required.
	2. TCLP1 < **TCLP test values** ≤ TCLP2 and **SCC test values** ≤ SCC2.	
	3. TCLP1 < **TCLP test values** ≤ TCLP2 and **SCC test values** > SCC2 and theimmobilisation[3] is EMA approved.	Without EMA approval of immobilisation, classify as industrial or hazardous.
Industrial	1. **SCC test values** ≤ CT3.	TCLP test not required.
	2. TCLP2 < **TCLP test values** ≤ TCLP3 and **SCC test values** ≤ SCC3.	
	3. **TCLP test values** ≤ TCLP3 and SCC2 < **SCC test values** ≤ SCC3.	
	4. TCLP2 < **TCLP test values** ≤ TCLP3 and **SCC test values** > SCC3 and immobilisation [3] is EMA approved.	Without EMA approval of immobilisation, classify as hazardous.
Hazardous	1. **TCLP test values** > TCLP3.	Store or treat waste as appropriate.
	2. **TCLP test values** ≤ TCLP3 and **SCC test values** > SCC3 and immobilisation is not EMA approved.	Store or treat waste as appropriate.

Notes:

1. See also the general rules relating to waste classification (listed earlier in Part 5) for other criteria that must be satisfied before the waste can be classified.
2. These criteria apply to each toxic and ecotoxic contaminant present in the waste (see Tables A3 and A4).
3. In certain cases the EMA will consider specific conditions, such as the segregation of such waste from all other types of waste in a monofill or a monocell, in order to achieve a greater margin of safety against a possible failure of the immobilisation in the future. Information about the construction and operation of a monofill / monocell is available in the *Draft Environmental Guidelines for Industrial Waste Landfilling,* (NSW EPA 1998a).

Worked examples of this assessment and classification process are given later in this part of the Appendix.

Table A 3: Contaminant threshold values for waste classification of non-liquid wastes without doing the leaching test[1]

	Maximum values of t*otal concentration* for classification **without** TCLP.			
Contaminant	**Inert waste**	**Solid waste**	**Industrial waste**	**CAS registry number**
	CT1 (mg/kg)	CT2 (mg/kg)	CT3 (mg/kg)	
Arsenic	10	100	400	
Benzene	1	10	40	71-43-2
Benzo(a)pyrene[2]	0.08	0.8	3.2	50-32-8
Beryllium	2	20	80	
Cadmium	2	20	80	
Carbon tetrachloride	1	10	40	56-23-5
Chlorobenzene	200	2000	8000	108-90-7
Chloroform	12	120	480	67-66-3
Chromium (VI)[3]	10	100	400	
m-Cresol	400	4000	16000	108-39-4
o-Cresol	400	4000	16000	95-48-7
p-Cresol	400	4000	16000	106-44-5
Cresol (total)	400	4000	16000	1319-77-3
Cyanide (amenable)[4]	7	70	280	
Cyanide (total)	32	320	1280	
2,4-D	20	200	800	94-75-7
1,2-Dichlorobenzene	8.6	86	34.4	95-50-1
1,4-Dichlorobenzene	15	150	600	106-46-7
1,2-Dichloroethane	1	10	40	107-06-2
1,1-Dichloroethylene	1.4	14	56	75-35-4
Dichloromethane	17.2	172	688	75-09-2
2,4-Dinitrotoluene	0.26	2.6	10.4	121-14-2
Ethylbenzene	60	600	2400	100-41-4
Fluoride	300	3000	12000	
Lead	10	100	400	
Mercury	0.4	4	16	
Methyl ethyl ketone	400	4000	16000	78-93-3
Molybdenum	10	100	400	
Nickel	4	40	160	
Nitrobenzene	4	40	160	98-95-3
C6-C9 petroleum hydrocarbons	N/A[6]	N/A[6]	N/A[6]	–

	Maximum values of t*otal concentration* for classification **without** TCLP.			
Contaminant	**Inert waste**	**Solid waste**	**Industrial waste**	**CAS registry number**
	CT1 (mg/kg)	CT2 (mg/kg)	CT3 (mg/kg)	
C10-C36 petroleum hydrocarbons	N/A[6]	N/A[6]	N/A[6]	–
Phenol (non-halogenated)	28.8	288	1152	108-95-2
Polychlorinated biphenyls[5]	N/A[6]	N/A[6]	N/A[6]	1336-36-3
Polycyclic aromatic hydrocarbons (total)[5]	N/A[6]	N/A[6]	N/A[6]	–
Scheduled chemicals[5]	N/A[6]	N/A[6]	N/A[6]	Refer to Appendix 3
Selenium	2	20	80	
Silver	10	100	400	
Styrene (vinyl benzene)	6	60	240	100-42-5
1,1,1,2-Tetrachloroethane	20	200	800	630-20-6
1,1,2,2-Tetrachloroethane	2.6	26	104	79-34-5
Tetrachloroethylene	1.4	14	56	127-18-4
Toluene	28.8	288	1152	108-88-3
1,1,1-Trichloroethane	60	600	2400	71-55-6
1,1,2-Trichloroethane	2.4	24	96	79-00-5
Trichloroethylene	1	10	40	79-01-6
2,4,5-Trichlorophenol	800	8000	32000	95-95-4
2,4,6-Trichlorophenol	4	40	160	88-06-2
Vinyl chloride	0.4	4	16	75-01-4
Xylenes (total)	100	1000	4000	1330-20-7

Notes to Table A 3:

1. For organic and inorganic chemical contaminants not listed in Table A 3, contact the EMA for disposal requirements. Note that aluminium, barium, boron, chromium (0 and III oxidation states), cobalt, copper, iron, manganese, vanadium and zinc have deliberately not been listed in this table and need not be tested for.
2. There may be a need for the laboratory to concentrate the sample to achieve the TCLP limit value for benzo(a)pyrene with confidence.
3. These limits apply to chromium in the +6 oxidation state only.
4. Analysis for cyanide (amenable) is the established method used to assess potentially leachable cyanide. Other methods may be considered by the EMA if it can be demonstrated that these methods yield the same information.
5. Scheduled chemicals, polycyclic aromatic hydrocarbons and polychlorinated biphenyls are assessed by using SCC1, SCC2 and SCC3. No TCLP analysis is required.
6. N/A means not applicable, but, see Table A 4 for SCC criteria.

Table A 4: Leachable concentration (TCLP) and total concentration (SCC) values for non-liquid waste classification[1]

	Maximum values for *leachable concentration* **and** t*otal concentration* when used **together.**						
	Inert waste		**Solid waste**		**Industrial waste**		
Contaminant	Leachable concentration	Total concentration	Leachable concentration	Total concentration	Leachable concentration	Total concentration	**CAS registry number**
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)	TCLP3 (mg/L)	SCC3 (mg/kg)	
Arsenic	0.5	500	5.0[2]	500	20	2000	
Benzene	0.05	18	0.5[2]	18	2	72	71-43-2
Benzo(a)pyrene[3]	0.004[3]	1	0.04[4]	10	0.16	23	50-32-8
Beryllium	0.1	100	1.0[5]	100	4	400	
Cadmium	0.1	100	1.0[2]	100	4	400	
Carbon tetrachloride	0.05	18	0.5[2]	18	2	72	56-23-5
Chlorobenzene	10	3600	100[2]	3600	400	14400	108-90-7
Chloroform	0.6	216	6[2]	216	24	864	67-66-3
Chromium (VI)[7]	0.5	1900	5[2]	1900	20	7600	
m-Cresol	20	7200	200[2]	7200	800	28800	108-39-4
o-Cresol	20	7200	200[2]	7200	800	28800	95-48-7
p-Cresol	20	7200	200[2]	7200	800	28800	106-44-5
Cresol (total)	20	7200	200[2]	7200	800	28800	1319-77-3
Cyanide (amenable)[8,9]	0.35	300	3.5[8]	300	14	1200	
Cyanide (total)[8]	1.6	5900	16[8]	5900	64	23600	
2,4-D	1	360	10[2]	360	40	1440	94-75-7
1,2-Dichlorobenzene	0.43	155	4.3[2]	155	17.2	620	95-50-1
1,4-Dichlorobenzene	0.75	270	7.5[2]	270	30	1080	106-46-7
1,2-Dichloroethane	0.05	18	0.5[2]	18	2	72	107-06-2
1,1-Dichloroethylene	0.07	25	0.7[2]	25	2.8	100	75-35-4
Dichloromethane	0.86	310	8.6[2]	310	34.4	1240	75-09-2
2,4-Dinitrotoluene	0.013	4.68	0.13[2]	4.68	0.52	18.7	121-14-2
Ethylbenzene	3	1080	30[6]	1080	120	4320	100-41-4
Fluoride	15	10000	150[6]	10000	600	40000	
Lead	0.5	1500	5[2]	1500	20	6000	
Mercury	0.02	50	0.2[2]	50	0.8	200	
Methyl ethyl ketone	20	7200	200[2]	7200	800	28800	78-93-3

	Maximum values for *leachable concentration* **and** t*otal concentration* when used **together.**						
	Inert waste		**Solid waste**		**Industrial waste**		
Contaminant	Leachable concentration	Total concentration	Leachable concentration	Total concentration	Leachable concentration	Total concentration	**CAS registry number**
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)	TCLP3 (mg/L)	SCC3 (mg/kg)	
Molybdenum	0.5	1000	5[6]	1000	20	4000	
Nickel	0.2	1050	2[6]	1050	8	4200	
Nitrobenzene	0.2	72	2[2]	72	8	288	98-95-3
C6-C9 petroleum hydrocarbons[14]	N / A[14]	650	N / A[14]	650	N / A[14]	2600	–
C10-C36 petroleum hydrocarbons[14]	N / A[14]	5000	N / A[14]	10000	N / A[14]	40000	–
Phenol (non-halogenated)	1.44	518	14.4[10]	518	57.6	2073	108-95-2
Polychlorinated biphenyls [11]	N / A[11]	2	N / A[11]	<50	N / A[11]	<50	1336-36-3
Polycyclic aromatic hydrocarbons(total)[11,12]	N / A[11]	200	N / A[11]	200	N / A[11]	800	-
Scheduled chemicals[11, 13]	N / A[11]	1	N / A[11]	<50	N / A[11]	<50	Refer to Appendix 3
Selenium	0.1	50	1[2]	50	4	200	
Silver	0.5	180	5.0[2]	180	20	720	
Styrene (vinyl benzene)	0.3	108	3[6]	108	12	432	100-42-5
1,1,1,2 – Tetrachloroethane	1	360	10[2]	360	40	1440	630-20-6
1,1,2,2-Tetrachloroethane	0.13	46.8	1.3[2]	46.8	5.2	187.2	79-34-5
Tetrachloroethylene	0.07	25.2	0.7[2]	25.2	2.8	100.8	127-18-4
Toluene	1.44	518	14.4[10]	518	57.6	2073	108-88-3
1,1,1-Trichloroethane	3	1080	30[2]	1080	120	4320	71-55-6
1,1,2-Trichloroethane	0.12	43.2	1.2[2]	43.2	4.8	172.8	79-00-5
Trichloroethylene	0.05	18	0.5[2]	18	2	72	79-01-6
2,4,5-Trichlorophenol	40	14400	400[2]	14400	1600	57600	95-95-4
2,4,6-Trichlorophenol	0.2	72	2[2]	72	8	288	88-06-2
Vinyl chloride	0.02	7.2	0.2[2]	7.2	0.8	28.8	75-01-4
Xylenes (total)	5	1800	50[15]	1800	200	7200	1330-20-7

Notes to Table A 4:

1. For organic and inorganic chemical contaminants not listed in Table A 4, contact the EMA for disposal requirements. Note that aluminium, barium, boron, chromium (0 and III oxidation states), cobalt, copper, iron, manganese, vanadium and zinc have deliberately not been listed in this table and need not be tested for.
2. USEPA final rule for TCLP levels (USEPA 1990a).
3. There may be a need for the laboratory to concentrate the sample to achieve the TCLP limit value for benzo(a)pyrene with confidence.
4. Calculated from: *Hazardous Waste: Identification and Listing; Proposed Rule* (USEPA 1995).
5. Calculated from: DiMarco & Buckett (1996); Imray & Langley (1996).
6. Calculated from: *Australian Drinking Waters Guidelines* (NHMRC 1994).
7. These limits apply to chromium in the +6 oxidation state only.
8. *Land Disposal Restrictions for Newly Identified and Listed Hazardous Wastes and Hazardous Soil; Proposed Rule* (USEPA 1993)
9. Analysis for cyanide (amenable) is the established method used to assess the potentially leachable cyanide.
   Other methods may be considered by the EMA if it can be demonstrated that these methods yield the same information.
10. Proposed level for phenol and toluene (USEPA 1990b).
11. Scheduled chemicals, polychlorinated biphenyls and polycyclic aromatic hydrocarbons are assessed by using SCC1, SCC2 and SCC3. No TCLP analysis is required.
12. Polycyclic aromatic hydrocarbons (total) is assessed as the total concentration of 16 USEPA Priority Pollutant PAHs, as follows:

PAH name	CAS Registry No.	PAH name	CAS Registry No.
Acenaphthene	83-32-9	Chrysene	218-01-9
Acenaphthylene	208-96-8	Dibenzo(a,h)anthracene	53-70-3
Anthracene	120-12-7	Fluoranthene	206-44-0
Benzo(a)anthracene	56-55-3	Fluorene	86-73-7
Benzo(a)pyrene	50-32-8	Indeno(1,2,3-cd)pyrene	193-39-5
Benzo(b)fluoranthene	205-99-2	Naphthalene	91-20-3
Benzo(ghi)perylene	191-24-2	Phenanthrene	85-01-8
Benzo(k)fluoranthene	207-08-9	Pyrene	129-00-0

13. Refer to Technical Appendix 3 for a list of chemicals regulated under the Scheduled Chemical Wastes Chemical Control Order 1994.
14. Petroleum hydrocarbons are assessed only by total concentration (SCC1, SCC2 or SCC3). Approximate range of petroleum hydrocarbon fractions: petrol C6-C9, kerosene C10-C18, diesel C12-C18, and lubricating oils above C18. Laboratory results are reported as four different fractions: C6-C9, C10-C14, C15-C28, C29-C36. The results of total petroleum hydrocarbons (C10-C36) analyses are reported as a sum of the relevant three fractions.
15. Calculated from *Guidelines for Drinking-Water Quality* (World Health Organisation 1993).

Worked examples of non-liquid-waste assessment and classification

The examples below assume that you either know or have determined the *total concentration* of each chemical contaminant in your waste. In other words, you are at Step 5 or beyond in the flow diagram shown earlier in this part of the Appendix. The tables show the test results that you have to hand.

Legend for all tables

N / D means not determined.

N / A means not applicable.

Example 1

You have waste that has been tested and you have the following results:

Chemical contaminant	***Total concentration (SCC)*** (mg / kg)	***Leachable concentration (TCLP)*** (mg / L)	**Is *immobilisation* of contaminant EMA-approved?** (yes / no)	**Provisional classification**
Cadmium	1.2	N / D	N / A	Inert
Lead	3.2	N / D	N / A	Inert

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, then
- if your waste meets all of the criteria of being *non-liquid*, and
- if your waste meets all of the criteria of not capable of environmentally significant physical, chemical and biological transformation (see Definitions and Glossary),

then your waste can have a final classification of *inert waste*.

Example 2

Let us assume that nickel is also present in your waste:

Chemical contaminant	***Total concentration (SCC)*** (mg / kg)	***Leachable concentration (TCLP)*** (mg / L)	**Is *immobilisation* of contaminant EMA-approved?** (yes / no)	**Provisional classification**
Cadmium	1.2	N / D	N / A	Inert
Lead	3.2	N / D	N / A	Inert
Nickel	25.3	N / D	N / A	Solid

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the total concentration of nickel is greater than its CT1 maximum value of 4 but less than its CT2 maximum value of 40 in Table A 3, your provisional classification can be solid.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, and
- if your waste meets all of the criteria of being *non-liquid*,

then your waste can have a final classification of *solid waste*.

However, if you would like to be able to see if you may classify your waste as *inert waste*, then you need to determine the *leachable concentration* of nickel. (S*ee* Examples 3 and 4.)

Example 3

This is the same as example 2, except that you chose to determine the leachable concentration (TCLP) for nickel and you got a value of 0.16:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.16	N/A	Inert

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is less than its TCLP1 maximum value of 0.2 and the total concentration of nickel is less than its SCC1 maximum value of 1050 in Table A 4, your provisional classification can be inert.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, then
- if your waste meets all of the criteria of not capable of environmentally significant physical, chemical and biological transformation (see Definitions and Glossary), and
- if your waste meets all of the criteria of being *non-liquid*,

then your waste can have a final classification of *inert waste.*

Example 4

This is the same as example 2, except that you chose to determine the leachable concentration (TCLP) for nickel, and this time you got a value of 0.25:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.25	N/A	Solid

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is greater than its TCLP1 maximum value of 0.2 but less than its TCLP2 maximum value of 2, and the total concentration of nickel is less than its SCC2 maximum value of 1050 in Table A 4, your provisional classification can be solid.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, and
- if your waste meets all of the criteria of being *non-liquid*,

then your waste can have a final classification of *solid waste*.

Example 5

This is the same as example 3, except that your waste is soil and now you also have 2325 mg/kg arsenic present, with a leachable concentration of 0.11 mg/L:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.16	N/A	Inert
Arsenic	2325	0.11	Yes	Inert

Since the total concentration of cadmium is less than its CT1 value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is less than its TCLP1 maximum value of 0.2 and the total concentration of nickel is less than its SCC2 maximum value of 1050 in Table A 4, your provisional classification can be inert.

Although the total concentration of arsenic exceeds its SCC3 maximum value in Table A 4, its immobilisation is EMA-approved, and therefore you may classify it according to its leachable concentration of 0.11, which is less than its TCLP1 maximum value in Table A 4, so your provisional classification is inert.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, then
- if your waste meets all of the criteria of not capable of environmentally significant physical, chemical and biological transformation (see Definitions and Glossary), and
- if your waste meets all of the criteria of being *non-liquid*,

then your waste can have a final classification of *inert waste*.

Example 6

Same as example 5, except that your leachable concentration result for arsenic is 4.3 mg/L:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.16	N/A	Inert
Arsenic	2325	4.3	Yes	Solid

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is less than its TCLP1 maximum value of 0.2 and the total concentration of nickel is less than its SCC2 maximum value of 1050 in Table A 4, your provisional classification can be inert.

Although the total concentration of arsenic exceeds its SCC3 maximum value in Table A 4, its immobilisation is EMA-approved, and therefore you may classify it according to its leachable concentration of 4.3, which is greater than its TCLP1 maximum value of 0.5 but less than its TCLP2 maximum value of 5.0 in Table A 4, so your provisional classification is solid.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, and
- if your waste meets all of the criteria of being *non-liquid*,

then your waste can have a final classification of *solid waste*.

Example 7

Same as example 5, except that your leachable concentration result for arsenic is 6.2 mg/L:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.16	N/A	Inert
Arsenic	2325	6.2	Yes	Industrial

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is less than its TCLP1 maximum value of 0.2 and the total concentration of nickel is less than its SCC1 maximum value of 1050 in Table A 4, your provisional classification can be inert.

Although the total concentration of arsenic exceeds its SCC3 maximum value in Table A 4, its immobilisation is EMA-approved, and therefore you may classify it according to its leachable concentration of 6.2, which is greater than its TCLP2 maximum value of 5.0 but less than its TCLP3 maximum value of 20 in Table A 4, so your provisional classification is industrial.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, and
- if your waste meets all of the criteria of being *non-liquid*,

then your waste can have a final classification of *industrial waste*.

Example 8

Same as example 5, except that your leachable concentration result for arsenic is 26.3 mg/L:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.16	N/A	Inert
Arsenic	2325	26.3	Yes	Hazardous

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is less than its TCLP1 maximum value of 0.2 and the total concentration of nickel is less than its SCC1 maximum value of 1050 in Table A 4, your provisional classification can be inert.

Although the total concentration of arsenic exceeds its SCC3 maximum value in Table A 4, its immobilisation is EMA-approved, and therefore you may classify it according to its leachable concentration of 26.3, which, however, is greater than its TCLP3 maximum value of 20 in Table A 4, so your provisional classification is hazardous.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants,

then your waste must have a final classification of *hazardous waste*.

Example 9

Same as example 4, except that you have mercury as well:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.25	N/A	Solid
Mercury	5.7	N/D	N/A	Industrial

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is greater than its TCLP1 maximum value of 0.2 but less than its TCLP2 maximum value of 2, and the total concentration of nickel is less than its SCC2 maximum value of 1050 in Table A 4, your provisional classification can be solid.

Since the total concentration of mercury is greater than its CT2 maximum value of 4 and is less than its CT3 maximum value of 16 in Table A 3, your provisional classification can be industrial.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, and
- if your waste meets all of the criteria of being *non-liquid*,

then your waste can have a final classification of *industrial waste*.

However, if you would like to be able to see if you are able to classify your waste as *solid waste*, then you need to determine the *leachable concentration* of mercury. (See examples 10, 11 and 12.)

Example 10

Same as example 9, except that you have determined the leachable concentration of mercury and got 0.17:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.25	N/A	Solid
Mercury	5.7	0.17	N/A	Solid

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is greater than its TCLP1 maximum value of 0.2 but less than its TCLP2 maximum value of 2, and the total concentration of nickel is less than its SCC2 maximum value of 1050 in Table A 4, your provisional classification can be solid.

Since the leachable concentration of mercury is greater than its TCLP1 maximum value of 0.02 but less than its TCLP2 maximum value of 0.2, and the total concentration of mercury is less than its SCC2 maximum value of 50 in Table A 4, your provisional classification can be solid.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, and
- if your waste meets all of the criteria of being *non-liquid*,

then your waste can have a final classification of *solid waste*.

Example 11

Same as example 10, except that you have determined the leachable concentration of mercury and got 0.22:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.25	N/A	Solid
Mercury	5.7	0.22	N/A	Industrial

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is greater than its TCLP1 maximum value of 0.2 but less than its TCLP2 maximum value of 2, and the total concentration of nickel is less than its SCC2 maximum value of 1050 in Table A 4, your provisional classification can be solid.

Since the leachable concentration of mercury is greater than its TCLP2 maximum value of 0.2 but less than its TCLP3 maximum value of 0.8, and the total concentration of mercury is less than its SCC2 maximum value of 50 in Table A 4, your provisional classification can be industrial.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants, and
- if your waste meets all of the criteria of being *non-liquid*,

then your waste can have a final classification of *industrial waste*.

Example 12

Same as example 4, except that you have selenium, and you have determined its leachable concentration and got 5.1:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.25	N/A	Solid
Selenium	146	5.1	N/A	Hazardous

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is greater than its TCLP1 maximum value of 0.2 but less than its TCLP2 maximum value of 2, and the total concentration of nickel is less than its SCC2 maximum value of 1050 in Table A 4, your provisional classification can be solid.

Since the leachable concentration of selenium is greater than its TCLP3 maximum value of 4 (and in spite of the fact that the total concentration of selenium is less than its SCC3 maximum value of 200 in Table A 4), your provisional classification can be hazardous.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants,

then your waste can have a final classification of *hazardous waste*.

You must treat or store the waste.

Example 13

Same as example 10, except that you have beryllium as well:

Chemical contaminant	***Total concentration (SCC)*** (mg/kg)	***Leachable concentration (TCLP)*** (mg/L)	**Is *immobilisation* of contaminant EMA-approved?** (yes/no)	**Provisional classification**
Cadmium	1.2	N/D	N/A	Inert
Lead	3.2	N/D	N/A	Inert
Nickel	25.3	0.25	N/A	Solid
Mercury	5.7	0.17	N/A	Solid
Beryllium	423	0.89	No	Hazardous

Since the total concentration of cadmium is less than its CT1 maximum value of 2.0 in Table A 3, your provisional classification can be inert.

Since the total concentration of lead is less than its CT1 maximum value of 10 in Table A 3, your provisional classification can be inert.

Since the leachable concentration of nickel is greater than its TCLP1 maximum value of 0.2 but less than its TCLP2 maximum value of 2, and the total concentration of nickel is less than its SCC2 maximum value of 1050 in Table A 4, your provisional classification can be solid.

Since the leachable concentration of mercury is greater than its TCLP1 maximum value of 0.02 but less than its TCLP2 maximum value of 0.2, and the total concentration of mercury is less than its SCC2 maximum value of 50 in Table A 4, your provisional classification can be solid.

The leachable concentration of beryllium is greater than its TCLP1 maximum value of 0.1 and less than its TCLP2 maximum value of 1; however, since the total concentration of beryllium is greater than its SCC3 maximum value of 400 in Table A 4, and its immobilisation is not approved by the EMA, your provisional classification can be hazardous.

Now you must also apply the rules given earlier in this part of the Appendix, that is:

- you must classify the waste according to the highest classification given to any of the contaminants,

then your waste can have a final classification of *hazardous waste*.

You may now apply to the EMA with supporting technical documentation to have the immobilisation of beryllium approved. This can result in two possibilities:

- If the immobilisation of beryllium is approved by the EMA, then according to its leachable concentration it will be assessed as solid; therefore the waste sample may be classified as *solid waste* (since solid is the highest classification for any contaminant), as long as the waste meets the criteria of being *non-liquid.*
- If the immobilisation of beryllium is not approved by the EMA, the waste must be classified as *hazardous waste* and, therefore, must be treated or stored.

TECHNICAL APPENDIX 2: IMMOBILISATION

Part 1 Introduction

The immobilisation of a contaminant in waste may be the result of a specific treatment process that the waste has been subjected to, or it may simply be a natural property of that type of waste. From a protection-of-the-environment perspective the key issue is whether this immobilisation (that is, resistance to being leached out of the waste) is likely to last in the long term.

It is critical that the immobilisation of the contaminant is sustained over time, otherwise the rate of release of the contaminant could exceed the rate at which the local environment can cope with it or safely mineralise it.

The EMA may approve the immobilisation of specified contaminant(s) contained in a particular type of waste. Approvals of the immobilisation of contaminants may be given in the following ways:

- the EMA can issue general approvals which would apply to all waste generated that has the properties specified in the approval, or
- for a specific waste as a result of an individual application received by the EMA.

In either case, an approval is subject to such conditions determined by the EMA, and remains in force until such time as it is revoked by the EMA.

Approvals of immobilisation may specify conditions relating to the subsequent storage, treatment or disposal of the waste. For example, in certain cases the EMA will consider specific conditions (such as the segregation of such waste from all other types of waste in a monofill or a monocell) in order to achieve a greater margin of safety against a possible failure of the immobilisation in the future. These must not be contravened, otherwise a penalty may be imposed.

Table A5 (on the last page of this Technical Appendix) shows the waste types to which the EMA is planning to grant general approval in respect of the immobilisation of specific contaminants; it also specifies the conditions relevant to each approval. If the waste is not currently covered by a general approval, an application for a specific approval has to be made to the EMA.

Information to be provided for a waste that is already covered by a specific approval of immobilisation is covered in Part 3.

Part 2 Treatment of waste to achieve the immobilisation of contaminants

Unless the application for the approval of immobilisation relies on a natural property of the waste, some form of treatment/processing will be necessary to achieve the fixing of contaminants.

While avoidance, reuse, recycling or reprocessing of waste are preferred options for waste management, it is recognised that sometimes treatment, then disposal, is the only option. If treatment is unavoidable the EMA's preferred options for waste treatment involve the removal or destruction of the toxic or ecotoxic contaminants to achieve *total concentration (SCC)* levels of less than SCC2, and *leachable concentration* levels of less than TCLP2. If this preferred option is not feasible, the permanent immobilisation of inorganic contaminants by the use of physical and / or

chemical treatment processes is encouraged. Dilution without achieving the immobilisation of contaminants is not an acceptable waste treatment option.

Macroencapsulation as a treatment option

Macroencapsulation of *hazardous waste* is the least-preferred treatment option, since it merely places a physical barrier between the chemical contaminants in the waste and the surrounding environment. For example, macroencapsulation of mercury-containing batteries in cement will significantly reduce the degree of chemical attack on the batteries by landfill leachate, *but only while the cement casing is intact and free of cracks*. On the other hand, if the batteries were finely ground up, treated with appropriate chemicals and then mixed with cement and set into a solid block, the process would be *microencapsulation.*

Microencapsulation as a treatment option

When waste is microencapsulated, the availability of the immobilised chemical contaminants for release into the environment is low because of the chemical and / or physical interactions between them and the encapsulating material, so that even if the encapsulated material is finely ground up (it should be noted the normal TCLP test for microencapsulated wastes requires crushing of the solid block only to pieces no larger than 9 mm in any dimension before leaching—as specified in Technical Appendix 1, the leachable concentration test results (TCLP) for the chemical contaminants of concern would be significantly lower than those for the untreated waste.

Part 3 The process for approval of immobilisation

Direct all inquiries or applications for immobilisation approvals to the EMA.

In general the following steps need to be followed by applicants:

Step 1. Check whether there is a general approval for immobilisation

The applicant should check if the waste type is the same as one that is already the subject of a general approval of immobilisation.

If there is a general approval of immobilisation, and there are no additional chemical contaminants that require approvals of immobilisation, then the general approval may be used and there is no need to make an application to the EMA for a specific approval. The onus will be on the generator of the waste to ensure that the waste is the same as the waste type specified in the general approval and that it is handled according to conditions set in the approval.

If there is no general approval, or there are additional contaminants that require approval, then proceed to Step 2.

Step 2. Check if there is a similar specific approval that might apply to your waste

The applicant should check with the EMA if the waste in question or a similar waste stream has already been approved for immobilisation. Previous approvals can be considered only if the physical / chemical properties of waste and the contaminants of concern are identical.

If there is no previous approval—general or specific—then follow Step 3. If there is an existing approval go to Step 4.

Step 3. Information to be provided by to the EMA for consideration when applying for approval of immobilisation

When applying for the approval of the immobilisation of chemical contaminants in waste as a result of treatment, the applicant will need to demonstrate that avoidance, reuse, recycling or reprocessing of the waste is not feasible. If the application is for recognition of natural immobilisation, the above information will not be required.

For applications involving macroencapsulation, the applicant will also need to demonstrate that another treatment method including microencapsulation is not feasible for the hazardous waste. The application must include a detailed description of the process undertaken to identify other treatment options. If other options are discarded because of cost factors, an estimate of the costs must be supplied.

The applicant should include the following information in a submission seeking specific immobilisation approval:

- the quantity of waste requiring treatment and / or disposal
- background information of the waste (origin), including the history of the site and the source of contamination if the waste is contaminated soil
- a description of the chemical composition of the waste
- the physical / chemical nature of the untreated waste, with test results, including pH, solid / moisture content, concentrations of chemical contaminants and TCLP (or other relevant leaching test) test values.
- chemical contaminants of concern (to be approved as immobilised)
- a description of the immobilisation treatment method / process, if any, with a detailed account of the materials and methods used in the process
- scientific evidence / justification to support the immobilisation of the contaminants of concern. This should include a summary of the following as applicable:

  —the mechanism and / or chemistry of immobilisation

  —reliable evidence of the successful application of any treatment process (that is proposed to be used) for the immobilisation of the contaminant(s) in the waste, in Australia or overseas

  —copies of reputable scientific or engineering journal articles supporting the successful immobilisation of contaminants (either natural or as a result of using the proposed process).
- a treatability report, based on a trial / pilot program or a bench scale study. This treatability report should include:

  —leaching performance (based on TCLP or other acceptable relevant leaching tests) of the immobilised contaminants

  —physical / chemical properties of the waste (as is, or after treatment if it is processed):for example, pH and physical characteristics (solid / moisture content, and whether is it rigid, powdery or a paste)

  —evidence that the treated waste is likely to be stable in the long-term.

  Note: This aspect is especially relevant to the immobilisation of waste with **high concentrations of contaminants that are bonded within the matrix solely by physical means** (for example, in some cases of microencapsulation), where, for example, it is desirable for the treated waste to attain an unconfined compressive strength in excess of 350 kPa as an indicator of long-term stability; we can conclude that unconfined compressive strength is an important factor when the leachable concentrations of contaminants determined for treated waste that has been reduced to a fine powder are at least twice as large than those obtained by testing the

'coarse' sample (less than 9 mm in any dimension), which is normally used for the TCLP testing of encapsulated waste.

- information demonstrating that they can operate any treatment process involved reproducibly, and that they can consistently achieve test results similar to those of the treatability study upon which an approval is based (Include a description of the proposed quality assurance scheme for the treatment process.)

Step 4. Information to be provided by the applicant for types of waste already covered by a specific approval of immobilisation issued to another waste generator.

If the waste or similar waste stream has already been subject to a specific approval issued by the EMA to another waste generator but is not covered by a general approval, the applicant should submit the following information:

- the quantity of waste to be disposed of
- background information on the waste (origin), including the history of the site and the source of contamination if the waste is contaminated soil
- the physical / chemical nature of the untreated waste, with test results, including pH, solid / moisture content, concentrations of chemical contaminants and TCLP (or other relevant leaching test) test values
- a description of the chemical composition of the waste
- chemical contaminants of concern (to be approved as immobilised)
- a treatability report based on a trial / pilot program or a bench-scale study.

How the EMA is likely to assess applications

Unfortunately there is no single assessment criterion for measuring the performance of the immobilised waste. Since the chemistry of different waste types and / or of treatment processes used to fix chemical contaminants in waste can be very different, it is difficult to make hard and fast rules that will apply to the assessment of all wastes.

The EMA's primary concern is to ensure that the immobilisation of the contaminant is sustained over time, otherwise the rate of release of the contaminant could exceed the rate at which the local environment can cope with it or safely mineralise it. The thrust of the EMA's assessment of applications will be to determine if adequate information has been supplied to demonstrate that this is the situation. The EMA will consider information and test results supplied by applicants on both the physical and chemical nature of the immobilised waste while assessing the application. Depending on the waste, such test results and other information to be provided by the applicant may typically include:

- Toxicity Characteristics Leaching Procedure
- Multiple Extraction Procedure for highly alkaline waste (for example, cement / lime treated waste or waste with pH >11)
- a buffering capacity test to determine the ability of the immobilised waste to maintain a pH value when exposed to acidic or basic situations
- a test to determine whether unreacted treatment reagents are present in the chemically treated waste; if such reagents are present, then discuss whether they are toxic and / or bioavailable

- the likelihood of long-term stability, to determine the durability and or physical strength of the immobilised waste as discussed in Part 3, Step 3 above
- documentation showing that appropriate sampling and statistical procedures are used to ensure that the test result are representative of the whole of the waste being assessed / evaluated.

It is important for the applicant to demonstrate that the fixing of the contaminants works 'in principle'. It is equally important for the applicant to demonstrate that the waste stream for which the approval will apply is consistent in its characteristics from one batch to the next, irrespective of whether the waste is proposed to be treated or a natural immobilisation is involved. If the EMA requires additional information to be supplied by the applicant, the EMA will advise the applicant of this.

Part 4 How to assess waste once an approval of immobilisation is obtained

Wherever EMA approval has been given for the immobilisation of one or more of the contaminants that it contains, the waste can be classified according to the *leachable concentration* (TCLP) test results alone for the specifically nominated contaminants in the approval. In other words, the *total concentration* (SCC) of the contaminants specifically nominated in the approval may be ignored in the assessment of the waste. However, any contaminants not specifically nominated in the approval must still be assessed using both SCC and TCLP. (See Technical Appendix 1.) If the immobilisation of a contaminant for which TCLP limits are not specified in the standards is approved, the EMA will advise on the management options that are available for such materials.

Worked examples 5, 6, 7, 8 and 13 contained in Part 5 of Technical Appendix 1 demonstrate how approvals of immobilisation are used in the assessment and classification procedures for non-liquid wastes.

Table A 5: Waste types for which a general approval of immobilisation will apply[1]

Waste type	Immobilised contaminant(s)[2]	Specification of nature of immobilisation or treatment process
CCA-treated timber	Arsenic and chromium	Natural
Creosote-treated timber	Creosote	Natural
Cattle-dip-contaminated soil	Arsenic	Natural
Activated carbon	Contaminants in Table A4 (of Technical Appendix 1) **except:** chemicals or declared chemical wastes subject to Chemical Control Orders; and C_6-C_9 petroleum hydrocarbons.	Natural

Notes:

1. This means that *total* concentration (SCC1, SCC2 or SCC3) limits in Table A4 of Technical Appendix 1 do not apply to the contaminants listed in this table (in the same row as the waste type), and therefore these particular contaminants may be assessed according to their *leachable concentration* (TCLP) only. For contaminants not listed here, the normal assessment process applies.

TECHNICAL APPENDIX 3: SCHEDULED CHEMICAL WASTES

Table A 6 lists the chemicals controlled by the Scheduled Chemical Wastes Chemical Control Order 1994, under the *Environmentally Hazardous Chemicals Act 1985 (NSW).*

Wastes are considered to be scheduled chemical wastes if they contain one or more of the constituents in the following list, where the total concentration of those constituents is more than one milligram per kilogram.

Table A 6: Scheduled chemical wastes

Chemical	CAS registry No.	Chemical	CAS registry No.	Chemical	CAS registry No.
Aldrin	309-00-2	DDD	72-54-8	Hexachlorophene	70-30-4
Benzene, hexachloro	118-74-1	DDE	72-55-9	Isodrin	465-73-6
Benzene, pentachloronitro	82-68-8	DDT	50-29-3	Pentachlorobenzene	608-93-5
Alpha-BHC	319-84-6	Dieldrin	60-57-1	Pentachlorophenol	87-86-5
Beta-BHC	319-85-7	Endrin	72-20-8	1,2,4,5-tetrachlorobenzene	95-94-3
Gamma-BHC Lindane	58-89-9	Endrin aldehyde	7421-93-4	2,3,4,6-tetrachlorophenol	58-90-2
Delta-BHC	319-86-8	Heptachlor	76-44-8	1,2,4-trichlorobenzene	120-82-1
Chlordane	57-74-9	Heptachlor epoxide	1024-57-3	2,4,5-Trichlorophenoxy-acetic acid, salts and esters	93-76-5

TECHNICAL APPENDIX 4: PRACTICAL QUANTITATION LIMITS

The practical quantitation limits (PQLs) listed in Table A 7 are typical for solid wastes and TCLP leachates, and conform with United States Environmental Protection Agency and American Public Health Association methods. The PQLs that are attainable in any particular case depend on the capabilities of the analytical instrumentation employed, the instrumental stability, the complexity of the contaminant matrix and the specific analytical technique(s) employed.

The lower the PQL for an analyte as compared with the actual concentration being measured, the greater is the precision to which its concentration can be estimated. Assuming that there is good homogeneity in the sample, the greater the precision of the determination, the smaller the variability of the results; hence the closer the estimated mean value for an analyte may lie to a particular limit while still maintaining a high degree of confidence that the actual value does not exceed the specified limit.

Table A 7: Practical quantitation limits

Chemical contaminant	Practical quantitation limits	
	for SCC (mg/kg)	for TCLP (mg/L)
Arsenic	50	0.5
Benzene	1	0.005
Benzo(a)pyrene	1	0.01
Beryllium	10	0.1
Cadmium	10	0.1
Carbon tetrachloride	1	0.005
Chlorobenzene	1	0.005
Chloroform	1	0.005
Chromium (VI)	20	0.2
o-Cresol	1	0.01
m-Cresol	1	0.01
p-Cresol	1	0.01
Cresol (total)	1	0.01
Cyanide (amenable)	0.5	0.05
Cyanide (total)	0.5	0.05
2,4-D	0.4	0.02
1,4-Dichlorobenzene	1	0.005
1,2-Dichlorobenzene	1	0.005

Chemical contaminant	Practical quantitation limits	
	for SCC (mg/kg)	for TCLP (mg/L)
1,2-Dichloroethane	1	0.005
1,1-Dichloroethylene	1	0.005
Dichloromethane	1	0.005
2,4-Dinitrotoluene	1	0.01
Ethylbenzene	1	0.005
Fluoride	10	0.5
Lead	50	0.5
Mercury	0.2	0.002
Methyl ethyl ketone	1	0.005
Molybdenum	20	0.2
Nickel	20	0.2
Nitrobenzene	1	0.01
C6–C9 petroleum hydrocarbons	1	–
C10–C36 petroleum hydrocarbons	1	–
Phenol (non-halogenated)	1	0.01
Polycyclic aromatic hydrocarbons (total)	1	–
Selenium	50	0.5
Silver	20	0.5
Styrene (vinyl benzene)	1	0.005
1,1,1,2- Tetrachloroethane	1	0.005
1,1,2,2-Tetrachloroethane	1	0.005
Tetrachloroethylene	1	0.005
Toluene	1	0.005
1,1,1-Trichloroethane	1	0.005
1,1,2-Trichloroethane	1	0.005
Trichloroethylene	1	0.005
2,4,6-Trichlorophenol	1	0.01
2,4,5-Trichlorophenol	1	0.01
Vinyl chloride	1	0.005
Xylenes (total)	1	0.005

DEFINITIONS

approved: Approved by the EMA from time to time.

aqueous liquid waste means any liquid waste in which water constitutes more than 80% of the volume of liquid present.

asbestos: A generic name for a group of naturally occurring mineral silicates of the amphibole or serpentine series that are characterised by fibres or bundles of fine single crystal fibrils. Naturally occurring asbestos fibres typically have length-to-width ratios of the order of 100 or higher. Included in the definition are the following minerals: chrysotile, crocidolite, amosite, anthophyllite, tremolite and actinolite.

asbestos waste means any waste that contains asbestos as defined in these standards .

AVCARE: National Association for Crop Protection and Animal Health Ltd.

becquerels: The activity of a radionuclide that decays at an average of one spontaneous nuclear transformation per second.

biosolids means the organic product that results from sewage treatment processes (namely, material referred to alternatively as sewage sludge).

Biosolids Guidelines' means the document called *Environmental Guidelines: Use and Disposal of Biosolids Products* issued by the NSW EPA and in force as at 31 December 1997.

building and demolition waste: (eg bricks, concrete, paper, plastics, glass, metal and timber), being material resulting from the demolition, erection, construction, refurbishment or alteration of buildings or from the construction, repair or alteration of infrastructure-type development such as roads, bridges, dams, tunnels, railways and airports, and which:

(a) is not mixed with any other type of waste, and

(b) does not contain any asbestos waste.

clinical waste means any waste which has been defined as such in the *Clinical Waste Act 1990*.

commercial and industrial waste: Inert, solid, industrial or hazardous wastes generated by businesses and industries (including shopping centres, restaurants and offices) and institutions (such as schools, hospitals and government offices), excluding building and demolition waste and municipal waste.

controlled aqueous liquid waste means aqueous liquid waste that is assessed and classified as controlled aqueous liquid waste in accordance with SECTION 2 and Technical Appendix 1 of these standards , but does not include any of the types of waste specified as hazardous, Group B or Group C liquid wastes in Table 4 and Table 5 in SECTION 2 of these standards).

cytotoxic waste means any substance contaminated with any residues or preparations that contain materials toxic to cells, principally through action on cell reproduction..

decomposition: The breakdown of organic waste materials by micro-organisms.

ecotoxic: Substances that, if released into the environment, will cause or may cause immediate or delayed adverse impacts to the environment by means of bioaccumulation and / or toxic effects upon biotic systems.

effluent means:

(a) waste water from sewage collection or treatment plants, or

(b) waste water from collection or treatment systems that are ancillary to processing industries involving livestock, agriculture, wood, paper or food, being waste water that is conveyed from the place of generation by means of a pipe, canal or other conventional method used in irrigation (but not by means of a tanker or truck), or

(c) waste water from collection or treatment systems that are ancillary to intensive livestock, aquaculture or agricultural industries, being waste water that is released by means of a pipe, canal or other conventional method used in irrigation as part of day-to-day farming operations.

EMA: Environment Management Authority

food waste means waste generated by any one or more of the following activities:

(a) the preparation or manufacturing of food (including beverages),

(b) the processing of meat, poultry or fish,

(c) the manufacturing of edible grocery products,

but does not include grease trap waste.

free liquids: Whether waste contains *free liquids* must be determined by testing in accordance with the USEPA *Paint Filter Liquids Test —Method 9095*. (See Bibliography: USEPA 1986.)

Group A waste:

(1) Non-aqueous liquid waste.

(2) Controlled aqueous liquid waste.

Group B waste:

(1) Liquid food waste.

(2) Liquid grease-trap waste resulting from the preparation or manufacturing of food.

Group C waste:

Liquid waste from human waste storage facilities or waste treatment devices (within the meaning of these standards) including pump-out waste and septage.

hazardous waste means any liquid or non-liquid waste that is:

(a) specified in Table 4 of SECTION 2 of these standards, or

(b) otherwise assessed and classified as hazardous waste in accordance with the procedures set out in Technical Appendix 1 of these standards .

human waste storage facility: A device for holding or disposing of human waste, such as a cesspit, pan, septic tank, septic closet, water closet, chemical closet, humus closet and combustion closet.

immobilisation: Immobilisation of a contaminant in waste is a measure of how securely that contaminant is *fixed* or *locked-up* in the waste for the long term.

incompatible wastes: Materials that, subsequent to their mixing:

- undergo violent chemical reactions or less vigorous chemical changes, producing different chemical species that are of a greater threat to human health and / or the environment than the original chemical species present, or
- become more difficult to reuse, recycle, process, treat, or dispose of than the original wastes before mixing.

industrial waste means any non-liquid waste that is:

(a) specified in Table 3 of these standards, or

(b) otherwise assessed and classified as industrial waste in accordance with the procedures set out in Technical Appendix 1 of these standards .

inert waste means any non-liquid waste that is:

(a) specified in Table 1 of these standards, or

(b) otherwise assessed and classified as inert waste in accordance with the procedures set out in Technical Appendix 1 of these standards .

landfill site means a waste facility used for the purpose of disposing of waste to land.

leachate: Liquid released by, or water that has percolated through, waste, and that contains dissolved and / or suspended liquids and / or solids and / or gases.

liquid: Any substance that does not meet all of the criteria of *non-liquid*, and that is not a gas.

mineralise: To turn contaminating substances that are deposited in the environment (such as chemicals or organic wastes) into harmless substances (for example, minerals) by means of the physical, chemical or biological processes occurring in nature.

mobile waste processing being the treatment, processing or reprocessing of hazardous waste, industrial waste or Group A waste (or any combination of those types of waste) by mobile plant and that is carried on for business or other commercial purposes.

monocell: A part of a landfill cell isolated from the rest of the cell by means of a leachate / gas barrier of low permeability for the disposal of one specific waste type. A monocell, one side of which must be at an edge of the landfill cell, may not have other types of waste either above or below it.

monofill: An isolated landfill unit for disposal of one specific waste type.

municipal waste being waste consisting of:

(a) household domestic waste that is set aside for kerb side collection or delivered by the householder directly to a waste facility, or

(b) other types of domestic waste (eg domestic clean-up and residential garden waste), or

(c) local council generated waste (eg waste from street sweeping, litter bins and parks).

night soil: The contents of a cesspit or pan.

non-aqueous liquid waste means any liquid waste in which a liquid other than water constitutes 20% or more of the volume of liquid present.

non-controlled aqueous liquid waste means aqueous liquid waste which:

(i) is not of a type which is specified as hazardous, Group B or Group C liquid wastes in Table 4 and Table 5 in SECTION 2 of these standards, and

(ii) is assessed as non-controlled aqueous liquid waste in accordance with SECTION 2 and Technical Appendix 1 of these standards.

non-liquid waste means any waste that:

(a) has an angle of repose of more than 5 degrees, and

(b) does not contain, or is not comprised of, any free liquids (as determined in accordance with these standards—see definition of **free liquids**), and

(c) does not contain, or is not comprised of, any liquids that are capable of being released when the waste is transported, and

(d) does not become free-flowing at or below 60 degrees Celsius or when it is transported, and

(e) is generally capable of being picked up by a spade or shovel.

not capable of environmentally significant biological transformation: In relation to organic waste materials, those:

- that have a specific oxygen uptake of less than 1.5 mg O_2 / hour / g total organic solids at 20°C, or
- in which, during composting (for the purposes of stabilisation), the mass of volatile solids in the organic waste has been reduced by at least 38%, or
- that have been treated by composting for at least 14 days, during which time the temperature of the organic waste must have been >40°C and the average temperature >45°C, or
- that have been subjected to and have met the requirements of EMA-approved alternative tests.

not capable of environmentally significant chemical transformation: In relation to waste materials, those that do not undergo chemical changes producing other chemical species that are significant environmental pollutants, when exposed to: air (oxygen), moisture, ground water, leachate, other waste types or any combination of these (for example: sulfidic soils or ores that undergo acid sulfate transformation *do not* satisfy this criterion).

not capable of environmentally significant physical transformation: In relation to waste materials, those that do not undergo significant physical changes when stored, transported, manipulated or landfilled (for example, solids that either release liquids or crumble, releasing fine particles capable of forming airborne dust or suspensions in water, *do not* satisfy this criterion).

NSW EPA: New South Wales Environment Protection Authority

on site—a reference to something being done in relation to waste on site is a reference to that thing being done only on the premises on which the waste was generated.

organic waste: Includes wood, garden, food, animal, vegetative and natural fibrous material wastes and biosolids.

orphan waste: Any waste that has been dumped by a person or persons unknown, and of which the generator / owner is not identifiable.

pan: Any movable receptacle kept in a closet and used for the reception of human waste.

physically solid: See: n**on-liquid**.

pharmaceuticals and poisons waste generated by activities carried out for business or other commercial purposes and that consists of pharmaceutical or other chemical substances specified in the Poisons List proclaimed under the *Poisons and Therapeutic Goods Act 1966 (NSW).*

practical quantitation limit (PQL): The lowest concentration that can be reproduced and measured in routine laboratory analyses irrespective of any interference caused by the presence of other substances, such as chemicals, during the analysis. The practical quantitation limit value of any analyte is significantly higher than its detection limit value (quantitation = quantification).

processing: Subjecting a substance to a physical, chemical or biological treatment or a combination of treatments.

pump-out waste: Treated or untreated human waste and / or sullage that is retained on the site of its generation in a human-waste-storage facility, holding tank, or collection well, before removal by a waste transporter.

putrescible waste means:

(a) food waste, or

(b) waste consisting of animal matter (including dead animals or animal parts), or

(c) biosolids categorised as Stabilisation Grade C in accordance with the criteria set out in the Biosolids Guidelines.

quantitation: Quantification. See: Practical quantitation limit.

quarantine waste: Examples are waste generated during an aircraft or ship journey outside Australia, and also materials that originate from Australia and are bought back into the country on the return journey. Quarantine waste also includes unwanted material that is attached to imported goods (for example, soil), as well as contaminated articles of clothing or other materials produced during the removal of the unwanted materials.

recycling of waste means the processing of waste into a similar non-waste product.

releases liquids: Whether waste *releases liquids* must be determined by testing in accordance with the USEPA *Liquid Release Test—Method 9096.* (See Bibliography: USEPA 1986.)

reprocessing of waste means the processing of waste into a non-waste product.

reuse: Waste reused with or without cleaning and / or repairing.

scheduled chemical wastes: Any waste liquid, sludge or solid (including waste articles and containers) that contain one or more of the constituents listed in Schedule A of the *Scheduled Chemical Wastes Chemical Control Order 1994* (NSW) where the total concentration of those constituents is more than one milligram per kilogram. (For a list of scheduled chemical wastes see Technical Appendix 3 of these standards.)

scum: The floatable materials that form an accumulating layer on the liquid surface inside a primary waste water treatment tank; includes oils, grease and soaps.

septage: Material removed from a waste-treatment device during desludging; contains partly decomposed scum, sludge and liquid.

sharps waste means any waste resulting from medical, nursing, dental, veterinary, pharmaceutical, skin penetration or other related clinical activity, and that contains instruments or devices:

(a) that have sharp points or edges capable of cutting, piercing or penetrating the skin (eg needles, syringes with needles or surgical instruments), and

(b) that are designed for such a purpose, and

(c) that have the potential to cause injury or infection,

sludge: Materials that have settled to the bottom of a waste treatment device.

solid waste means any non-liquid waste that is:

(a) specified in Table 2 of these standards, or

(b) otherwise assessed and classified as solid waste in accordance with the procedures set out in Technical Appendix 1 of these standards .

spadeable: A physical state of a material where the material behaves sufficiently like a solid to be moved by a spade at normal outdoor temperatures.

specific contaminant concentration (SCC) test: Provides a quantitative measure of both organic and inorganic chemical contaminants within a waste.

sullage: Liquid wastes from baths, showers, basins, laundries and kitchens, including floor wastes from these sources.

toxicity characteristics leaching procedure (TCLP) test: Estimates the potential for both organic and inorganic constituents to leach from a *non-liquid* waste type when it is deposited within a landfill. The test results indicate the environmental acceptability of disposing the non-liquid waste to landfill. It is recommended that procedures described in the following new series of Australian Standards for leachate preparation be followed, subject to the provisions outlined in Technical Appendix 1: AS 4439–1997: *Wastes, Sediments and Contaminated Soils*; AS 4439.2–1997: *Wastes, Sediments and Contaminated Soils, Part 2: Preparation of Leachates—Zero Headspace Procedure*; and AS 4439.3–1997: *Wastes, Sediments and Contaminated Soils Part 3: Preparation of Leachates—Bottle Leaching Procedure.*

treatment of waste means the processing of waste into a different type of waste.

USEPA: United States Environmental Protection Agency

virgin excavated natural material (eg clay, gravel, sand, soil and rock) that is not mixed with any other waste and that:

(a) has been excavated from areas that are not contaminated, as a result of industrial, commercial, mining or agricultural activities, with manufactured chemicals and that does not contain sulphidic ores or soils, or

(b) consists of excavated natural materials that meet such criteria as may be approved by the EMA.

waste treatment device: A device for treating human waste and / or sullage on the site of its generation (for example, a septic tank or aerated wastewater-treatment system).

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