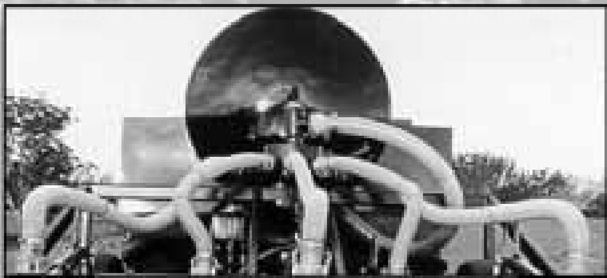
BIOSOLIDS recycling



Tasmanian Biosolids Reuse Guidelines

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Tasmania

DEPARTMENT of PRIMARY INDUSTRIES, WATER and ENVIRONMENT

Environment, Planning and Scientific Services Division

Acknowledgements

Document prepared by David Dettrick and John McPhee

David Dettrick may be contacted at:
Environment, Planning and Scientific Services Division
Department of Primary Industry, Water and Environment

John Mcphee may be contacted at:
Food, Agriculture and Fisheries Division
Department of Primary Industry, Water and Environment.

Comments may directed to David or John as appropriate to the issue.

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David Wright, Ian Bell, Claudia Russmann, Greg Dowson – DPIWE
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FOREWORD

These guidelines were produced as one element of a project which aims to progress the beneficial reuse of biosolids in Tasmania. The project was conducted between July 1997 and November 1999 by the Department of Primary Industries Water and Environment, with assistance from the Department of Health and Human Services, and the Local Government Association of Tasmania. Financial support was provided by a number of Councils, private enterprise, the Horticultural Research and Development Corporation and the Natural Heritage Trust through the National Landcare Program.

Many different sources of information have been used in preparing these guidelines, including the following:

A Global Atlas of Wastewater Sludge and Biosolids Use and Disposal, International Association on Water Quality, 1996.

Agricultural Recycling of Sewage Sludge and the Environment, S. R. Smith, 1996.

Code of Practice for Agricultural Use of Sewage Sludge, UK Department of Environment, 1989.

Draft Environmental Guidelines for the Management of Biosolids, Victorian Environmental Protection Agency, 1997.

Environmental Management Guidelines - Use and Disposal of Biosolids Products, NSW Environmental Protection Agency, October 1997.

Guidelines for Sewerage Systems - Biosolids Management, ARMCANZ, Occasional Paper WTC No 1/95, October 1995.

Part 503 - Standards for the Use or Disposal of Sewage Sludge, US Environmental Protection Agency, 1993.

The guidelines are intended to provide a framework to allow beneficial reuse of biosolids to proceed in a manner which is practical and safe for agriculture, the environment and the public. In addition, they should allow this to happen in a manner consistent with industry standards and environmental best management practice.

1. INTRODUCTION

Adherence to these guidelines will allow the safe and practical beneficial use of biosolids arising from the treatment of municipal wastewater in Tasmania. The guidelines are intended to assist the implementation of ecologically sustainable beneficial re-use activities by those involved in biosolids production, processing and land application.. The principles and management practices may also be applicable to sludges from other treatment processes or industries.

Land application of biosolids for beneficial reuse is not waste disposal. Beneficial re-use aims to use the true value of a neglected resource. Before beneficial re-use can proceed, analytical information about the material to be used and the land to which it is to be applied is required, so that sustainable application rates can be determined. Beneficial re-use requires the useful resources in biosolids (e.g. organic matter and nutrients) to be identified and utilised within limits that ensure adequate protection of the environment and its ecosystems, soil quality, human and animal health.

This document is a Guideline - it is not a design and operations manual. Technical and scientific issues associated with biosolids management can be complex and may require the integrated efforts of a range of people with differing skills. Those involved in beneficial re-use operations may need to seek advice from consultants and relevant Government authorities in relation to appropriate application techniques and management practices for specific situations.

1.1 Objectives, Scope and Applicability of the Guidelines

The Guidelines outline the obligations of producers, reprocessors, appliers and users of biosolids and related products. The specific objectives of the Guidelines are:

- to set quality standards and management practices which adequately protect the environment, soil quality and human and animal health, whilst providing practical options for the use of biosolids.

- to encourage the use of best management practices which will lead to sustainable, practical and safe beneficial re-use operations for biosolids.

- to detail the statutory obligations of those involved in the biosolids industry to ensure that relevant regulations are met.

- to ensure that monitoring, reporting and auditing systems are adequate.

- to establish a continual improvement in biosolids quality by encouraging industry to improve the quality of waste discharged to sewers.

1.1.1 Classification Requirements

The Guidelines present a biosolids classification system based on the concentrations of chemical contaminants, and on the treatment processes that have been used to reduce pathogens, vector attractants and odour. The beneficial re-use options permitted for each class of biosolids are listed along with relevant management practices and site restrictions.

1.1.2 Monitoring and Reporting Requirements

The Guidelines set out requirements for the sampling, testing and classification of biosolids products, and for recording and reporting relevant information.

1.1.3 People/Organisations

The Guidelines are relevant to the following groups:

- *Producers* - owners, operators, or contractors of waste water treatment plants and associated on-site and off-site biosolids storage facilities.
- *Reprocessors* - owners, operators, or contractors of biosolids processing facilities, e.g. composters, chemical stabilisers, etc.
- *Appliers* - owners, operators, or contractors of application operations who apply biosolids to land.
- *Final users* - farmers, mining companies, foresters, landscaping contractors, etc. who use biosolids products.

1.1.4 Products

The Guidelines apply, but are not limited, to the following products:

1. Liquid biosolids from digesters or sewage lagoons
2. Dewatered biosolids
3. Chemically stabilised biosolids
4. Dried biosolids (including sun dried, pelletised, etc.)
5. Composted biosolids products
6. Products which contain biosolids
7. Domestic septic tank wastes

The Guidelines do not apply to the following products:

1. Trade waste discharges.
2. Grease trap wastes.
3. Screenings, grit and scum.
4. Sewer silt and stormwater waste.
5. Industrial waste
6. Drinking water treatment sludges.

Septic tank sludge (septage) and night soil are dealt with in a dedicated section of these Guidelines as some requirements for their reuse differ from the requirements for biosolids derived from municipal wastewater treatment works. Advice regarding the management of materials excluded from the Guidelines should be sought from the relevant authorities.

1.2 How to Use the Guidelines

There are two steps to using the Guidelines:-

1. Classify biosolids products by establishing the "Contaminant Grade" and "Stabilisation Grade". The classification achieved is used to determine the permitted beneficial use options. Classification procedures are detailed in Section 4 and sampling procedures are detailed in Section 5.

2. The classification (see Section 4) will determine the permissible end uses for the product. In the case of land application, Section 3 and Section 6 provide best management practices and activity constraints. A determination of maximum allowable application rate can be made once background information from the site has been collected (Section 7 and Appendix B).

1.3 Revision of the Guidelines

This edition of the Guidelines has been produced as the result of several drafts. They are intended to be a working document and should not be treated as "cast in stone". The Guidelines will be reviewed not more than 4 years after the date of publication to take into account the experiences and knowledge gained as a result of biosolids application activities, and to incorporate new research data.

2. THE BENEFICIAL USE OF BIOSOLIDS IN AGRICULTURE

2.1 Biosolids - the material

Biosolids are a by-product of municipal wastewater treatment. The nutrients and organic matter in biosolids are of value to farmers and can help reduce fertiliser costs and improve the structure and fertility of soils. Biosolids contain useful amounts of nitrogen, phosphorus and organic matter, and limited quantities of potassium and trace elements. Biosolids may also contain lime if this is added during treatment. The availability of these nutrients and the amount of organic matter present depend on the treatment process used at the wastewater treatment plant.

Biosolids in liquid form have dry solids contents ranging from 2 to 7%. If the liquid is undigested, about 35% of the total nitrogen is available in the first year after application. Digested liquid has a high ammonia content, and about 60% of the total nitrogen is available in the first year after application. In both cases, the remaining nitrogen acts as a slow release fertiliser over the subsequent 2 to 3 years.

The dry solids content of biosolids can be increased to 20 - 35% by de-watering, and drying processes can increase this to 50 - 90% dry solids. Most of the soluble nutrients are lost during de-watering and drying. De-watered and dried biosolids are good sources of phosphorus and organic matter, but are very slow acting in regard to nitrogen, as only about 20% of the total nitrogen is available in the first year after application.

Biosolids are generally high in phosphorus, of which about 50% is available in the first year. Phosphorus availability is largely unaffected by treatment processes.

A limited survey of biosolids in liquid form from Tasmanian treatment plants showed that the total nitrogen content is about 5%, expressed as a percentage of dry solids. The range was 2 - 9%. Total phosphorus content averaged about 1%, with a range of 0.5 - 2.5%.

2.2 Beneficial components of biosolids

2.2.1 Nitrogen

The nitrogen content of biosolids can vary greatly depending on the source of the material. Liquid biosolids with a high ammonia content are a quick acting source of nitrogen particularly suited for use on grass pastures. The nitrogen in dewatered biosolids is released slowly and crops with short growing seasons will use only about half of the nitrogen applied in the biosolids. The residual nitrogen will be available to subsequent crops.

The nitrogen in liquid biosolids is not leached from soil as readily as artificial fertiliser. In terms of effective nitrogen use, autumn applications of biosolids can be made to orchards, while for grass pastures, applications in autumn or spring are preferred. However, autumn applications of biosolids to fallow cropping land should be avoided, as nitrogen losses can be high due to leaching during winter.

2.2.2 Phosphorus

Many sources of biosolids can supply all the phosphorus requirements for grass and cereal crops. However, crops such as potatoes will require additional fertiliser depending on the phosphorus status of the soil.

2.2.3 Potassium

All biosolids are low in potassium and farmers should apply the standard recommended rates from other sources.

2.2.4 Lime

Some treatment processes add lime to produce lime amended biosolids, which can be an effective liming material for soil pH adjustment, if required. The amount of lime available will depend on the treatment process, but would normally be in the range of 50 - 100 kg of lime per tonne of dewatered biosolids.

2.2.5 Organic Matter

Biosolids applied regularly will increase soil organic matter levels slowly, although research in other places has shown that a single application of 30 dry t/ha (about 100 t/ha of dewatered material) can rapidly improve soil conditions for crop growth and increase water holding capacity. The maximum long term benefit will be obtained with regular applications, within the constraints of return frequency and agronomic loading rates.

2.3 Application Rates

In general, application rates should not exceed the nitrogen demand of the crop. The available nitrogen in the soil and the biosolids should be determined to calculate application rate. The available nitrogen content of biosolids is very dependent on the treatment processes used. Notwithstanding this variation, information collected about biosolids in Tasmania suggests that, as a general guide, an application rate of 5 dry t/ha would apply about 100 kg/ha of available nitrogen. This would be equivalent to about 20 t/ha of dewatered biosolids or 130 t/ha in liquid form. It must be emphasised that these are generalised figures, and analysis of soil and biosolids is necessary to match application rates to crop requirements.

2.4 Application frequency

There are no rules regarding the best frequency for biosolids application on a given site, but more frequent applications will usually lead to a gradual reduction in application rate. The nutrients in biosolids are not all readily available for plant use. For example, 20 - 60% of the nitrogen is available in the first year after application, compared to 100% of nitrogen applied as urea. Therefore, at the end of the first year, there will be residual nitrogen in the soil which will gradually become available for use by plants. This residual nitrogen has to be taken into account when calculating the rate of the next application of biosolids, and will usually mean that if the second application follows after only one growing season, it will likely be at a lower rate. For this reason, when biosolids are applied at the agronomic rate (i.e. able to satisfy the full nitrogen requirements of the crop), it is common practice to have a delay of 2 - 3 years between applications. This may not be the case if biosolids are applied at rates lower than the agronomic rate.

2.5 Application of biosolids

Liquid biosolids are usually surface spread or injected under the soil surface. Solids are usually surface spread and may be incorporated, depending on circumstances. Injection and incorporation reduces odour problems, vector attraction, nitrogen loss through volatilisation and surface run-off. On the other hand, surface spreading, particularly in fine, dry weather, exposes the biosolids to UV radiation, which is a very effective way of killing any remaining pathogens in the biosolids, and only poses a risk if rain falls immediately after an application. Table 2.1 lists some of the features of different application techniques for liquids.

TABLE 2.1 DIFFERENCES BETWEEN INJECTION AND SURFACE APPLICATION

Injection	Surface Application
Advantages • odour control • avoids loss of nitrogen by volatilisation • vector control • avoids surface contamination of pasture • provides physical barrier between injected biosolids and grazing livestock • no surface run-off if rain follows application • provides a tillage operation • well suited to fallow land, although can be done in pasture with minimal disturbance with appropriate machinery	***Advantages*** • low cost • UV disinfection of pathogens
Disadvantages • requires specialised equipment leading to increased capital and operating costs • disturbance of pasture if equipment or soil conditions not optimal • not suited to very dry soil conditions due to penetration and coverage problems	***Disadvantages*** • surface contamination of pasture • run-off risk if rain falls soon after application • often done with road tankers, which is undesirable with respect to soil compaction

Biosolids should be spread evenly to ensure maximum agronomic benefit is obtained. Very little, if any, biosolids should be visible on the surface after injection or incorporation. Damage to the land should be minimised, and in particular, sites should not be compacted or smeared as a result of application operations.

It is important that biosolids application operations are undertaken in a manner which maintains credibility with farmers, neighbours and the general public.

2.6 The economic value of biosolids

It is difficult to put an accurate value on the nutrients in biosolids because of the variation in the composition of the material. Based on Tasmanian information, the nutrient value could range from $1 - $100/dry t, with $45/dry t being a reasonably common figure. This would represent a value of about $9/t in dewatered form and a little over $2/t in liquid form. Once again, these figures are open to considerable variation depending on the source of the biosolids. In addition, no estimate has been made of the value of the organic matter contained in biosolids, but it may be one of the more important components of the material, particularly in the context of improving soil quality.

2.7 Site characteristics

The soil and landform characteristics of an application site, along with the prevailing weather conditions, have a significant effect on the success of biosolids application. Some of the problems that can arise with poorly managed biosolids application sites include: runoff into streams or dams; infiltration of nitrates into groundwater; transmission of disease to livestock; odour nuisance to neighbours. However, it is relatively simple to avoid these problems by proper site selection and management during and after application. Details of desirable site characteristics and management practices are included in Section 6 and Appendix A of the Guidelines. In general terms, biosolids application sites should have the characteristics listed in Table 2.2.

TABLE 2.2 FAVOURABLE CHARACTERISTICS FOR BIOSOLIDS APPLICATION SITES

The best sites	The next best sites
• slope less than 6% • moderately permeable soil • seasonal water table depth of greater than 90 cm • no restrictive layer in the top 90 cm of the soil • pH over 6	• slope 6 - 12% • slowly permeable or highly permeable soils • seasonal water table depth 60 - 90 cm • no restrictive layer in the top 60 - 90 cm of the soil • pH over 5.5

This does not mean that sites without these characteristics are not suited to biosolids application, but sites with less favourable characteristics will need more attention to management during and after application.

2.8 Biosolids Quality

2.8.1 Chemical contaminants

There is much debate in the scientific world about acceptable limits for contaminants in biosolids. Most jurisdictions adopt a conservative approach to ensure that the risks of long term environmental or public health problems associated with biosolids reuse are minimal. This is the approach taken in these Guidelines. While this approach may make it more difficult for some biosolids to be reused, it should engender public confidence and help to ensure that the reputation of Tasmania's agricultural produce is not compromised.

Permissible concentrations of contaminants such as heavy metals and organic pollutants are detailed in the Guidelines. It is the responsibility of the waste water treatment plant operator to sample and analyse the biosolids for nutrient and contaminant concentrations, and this information must be made available to appliers and end users so that maximum application rates can be calculated. Most of the heavy metal contaminants that occur in biosolids are also trace elements which are important for healthy plant growth.

2.8.2 Pathogens

All biosolids will contain some level of pathogens, although treatment processes can be used to bring these down to levels suited to unrestricted garden use. From an agricultural perspective, it is not necessary for biosolids to be highly processed and pathogen free, as the agricultural environment is very effective at reducing pathogen numbers and management practices can be used to minimise risks of disease transfer. The most effective means of managing pathogen risk in agricultural biosolids application include surface spreading in fine weather to allow UV desiccation, direct injection to provide a physical barrier over the biosolids, and withholding periods associated with various agricultural practices. Details on withholding periods are given in Table 6.4 of the Guidelines.

3. BEST MANAGEMENT PRACTICES

The adoption of Best Management Practices will help operators meet environmental performance objectives and increase public acceptance of the beneficial use of biosolids.

3.1 Environmental Management Objectives

The basic principles for land application of biosolids are:
- The build up of any substance in the soil, or changes to the soil structure, should not preclude sustainable use of the land in the long term;
- The use of biosolids is not detrimental to the vegetative cover;
- Any runoff to surface waters or percolation to groundwater should not compromise the agreed environmental values;
- No gaseous emissions to cause nuisance odour.

3.2 Biosolids Producers and Contaminant Minimisation

While the suitability of biosolids for reuse is contingent on meeting the classification standards in Section 4, operators of WWTP's should take appropriate steps to ensure that the sources feeding the treatment system are involved in waste minimisation activities. This will minimise contaminant levels in the final product. This may require the implementation of trade waste policies which require continual improvement in effluent quality, or arranging treatment at the source before discharge to the sewer.

3.3 Product Quality

Operators in the biosolids recycling industry need to be clear about the value of the nutrients in the product. Biosolids are not balanced fertilisers. If end users are promised growth responses that do not eventuate, they are unlikely to try the product again and this information will be passed on to other potential users. Foreign material such as plastics, glass, blades and sharp objects should not be present in biosolids destined for reuse.

Composted biosolids produced for the retail market should meet accepted industry standards, such as the Australian Standard for Composts, Soil Conditioners and Mulches (AS 4454).

3.4 Site Selection, Assessment, Application and Management

Selection of a site for biosolids application should include consideration of its proximity to residences, recreational areas, industrial sites, sensitive areas and other environmental factors such as depth to groundwater etc. Application of biosolids to land at the correct time is important for successful agricultural use. The following measures and practices are suggested for optimal results:

- biosolids should be applied to fallow land as close as possible to the time of sowing to avoid nitrogen losses.

- avoid application in winter, as low crop demand for nitrogen, and increased rainfall and drainage, increases the risk of nitrate leaching, particularly on sandy soils. Spring application generally provides the most efficient use of nitrogen, although autumn application may be suitable for orchards and pastures.

- ensure moderate soil moisture levels at the time of application. Do not apply biosolids during periods of rain or when the ground is saturated, as this increases the risk of run-off. Conversely, very dry conditions may make incorporation difficult. Direct injection into pasture when soil is dry can lead to pasture die-off.

Field staff should understand the calibration requirements of application equipment and how to determine application rates, particularly with respect to the requirements of the Guidelines. Details of soil related constraints are presented in Section 6 and Appendix A.

3.5 Transport of Biosolids

Biosolids products must be transported and applied to land in ways that avoid public nuisance, particularly with respect to odour. Transport routes and site access should be chosen to minimise public nuisance, in both rural and urban areas.

To minimise the risk of spillage, vehicles used to transport dewatered and alkaline biosolids products which have a solids content of 15% or greater should:

- be fitted with grain locks
- have water tight seals on rear tailgates
- have the load covered with a waterproof cover (e.g. tarpaulin)

Liquid biosolids should be transported in fully enclosed tankers. Transport vehicles must not be used for backloading foodstuffs for animal or human consumption.

Truck tailgates and tyres should be cleaned prior to leaving the sewage treatment plant and the application site to ensure biosolids are not spilt on roadways. Cleaning of vehicles is not necessary for dry Class 1 products.

3.6 Incident Management Plans

An incident management plan should be developed to ensure rapid clean up of spills both en route and at the end use site. It is important that the local council in the area of the application operation has input into the incident management plan. The local Council and the local office of DPIWE should be informed in the event of a spill. A dry clean up for spills is preferred.

3.7 Occupational Health and Safety

In consultation with Workplace Standards Authority and the Department of Health and Human Services, operators in the biosolids recycling industry should ensure workers handling biosolids are adequately protected and informed. The following points should provide adequate protection for workers:

- always wash hands before eating, drinking or smoking

- cover cuts and abrasions with waterproof dressings
- do not eat or drink while working with biosolids or related products
- protective clothing, including eye and dust protection (where appropriate) should be worn when working with biosolids or related products
- promptly clean body areas that become contaminated

3.8 Public Acceptance

The acceptance of land application of biosolids by the community is integral to the success of reuse activities. There are many cases in which misunderstanding and public opposition has resulted in unfavourable media attention and jeopardised recycling operations. Opposition usually arises where affected people, such as nearby residents, have not been adequately informed or consulted.

The end users in land application programs need to know their responsibilities under the guidelines and their role in the application operation. Application of biosolids products may affect neighbouring properties due to truck movements and potential odours. Informing neighbours prior to delivery helps reduce concerns about the environmental and health consequences and minimise potential conflict. Farmers and other land holders usually have an existing relationship with their neighbours and are generally the best people to make the initial notification of their intention to apply biosolids.

Biosolids for reuse need to meet certain standards with regard to contaminant concentrations and stabilisation (Section 4), and in-field operations need to meet certain operational guidelines (Section 6). Reuse of biosolids which fail to meet standards, or failure to observe site, activity and management guidelines, will erode public confidence in beneficial reuse operations and endanger the future viability and acceptance of reuse proposals.

4. BIOSOLIDS CLASSIFICATION SYSTEM

Biosolids intended for beneficial re-use are to be classified on the basis of analysis of representative samples of the product. See Section 5 for sampling requirements.

The classification system comprises 2 classes and is used to determine the permissible end uses for biosolids products. Two steps are involved in the classification process. It is necessary to determine the:

- Contaminant grade - based on the concentration of chemical contaminants.

- Stabilisation grade - based on the degree of reduction of pathogens, vector attraction and odour.

If assessments of the contaminant and/or stabilisation grades are not undertaken, the product is automatically classified as Class 3, and is not suited for beneficial reuse within the scope of these Guidelines. However, it may be possible to obtain advice from DPIWE regarding the conditions under which Class 3 material may be used.

4.1 Contaminant Grading

Contaminant grading of biosolids products is established by determining the "Biosolids Adjusted Contaminant Concentration" for each contaminant in the product, and comparing these with the "Contaminant Acceptance Concentration Thresholds" listed in Table 4.1. It is important to note that for a batch of biosolids to be accepted for reuse, it is not sufficient for the mean concentrations in the analysed samples to be less than the concentrations listed in Table 4.1. Determination of contaminant grading requires historical and current details of biosolids quality so that the Biosolids Adjusted Contaminant Concentration can be calculated (see Section 4.1.2).

4.1.1 Contaminant Acceptance Thresholds

Each contaminant is graded A, B or C by the method detailed in Section 4.1.2. Biosolids achieving Grade A contaminant grade are the highest quality (lowest level of contaminants), while Grade C is the lowest quality (highest level of contaminants). The contaminant grade for a biosolids product is determined by the lowest grade for any one contaminant. For example, if most of the contaminant concentrations in a biosolids product passed Contaminant Grade A, but one contaminant was Grade B, then the entire product would be classified as Contaminant Grade B. All biosolids products are assumed to be Contaminant Grade C until proven otherwise.

A contaminant grade may be improved by blending with other acceptable materials. The blended product must be re-sampled, analysed and re-graded to determine the new contaminant grade for classification purposes.

TABLE 4.1 CONTAMINANT ACCEPTANCE CONCENTRATION THRESHOLDS FOR BIOSOLIDS. [1]

Contaminant	Grade A (mg/kg) [2]	Grade B (mg/kg)
Arsenic	20	20
Cadmium	3	20
Chromium (total) [3]	100	500
Copper	100	1,000
Lead	150	420
Mercury	1	15
Nickel	60	270
Selenium	5	50
Zinc	200	2,500
DDT/DDD/DDE	0.5	1.00
Aldrin	0.2	0.5
Dieldrin	0.2	0.5
Chlordane	0.2	0.5
Heptachlor	0.2	0.5
HCB	0.2	0.5
Lindane	0.2	0.5
BHC	0.2	0.5
PCBs	0.30	1.00

Notes:

1 Contaminant Acceptance Concentrations are not mean values. Refer to Section 4.1.2.

2 All values are expressed on dry weight basis.

3 If total Chromium concentrations do not meet acceptable reuse guidelines, biosolids producers may chose to do a combined CrVI/III analysis. Acceptable guidelines would then be: CrVI (Grade A and B) = 100 mg/kg; CrIII Grade A = 400 mg/kg; CrIII Grade B = 3000 mg/kg

4.1.2 Calculation of Biosolids Adjusted Contaminant Concentration

Contaminant concentrations in biosolids may vary over time depending on the composition of the wastewater received by the treatment plant and the treatment process. Samples of biosolids can provide quality data on only a portion of the total biosolids produced.

It is important that the classification procedure takes into account the potential for variation in biosolids quality that may not be detected by the sampling program. For this reason, the contaminant concentrations used in the grading process are not the contaminant concentrations measured from a single sample, but are derived from a consideration of the current sample in conjunction with variations in historical data.

The Biosolids Adjusted Contaminant Concentration, BACC, is defined as:

$$BACC = m + 2s,$$

where m = mean concentration of a given contaminant calculated from all samples (including historical data)

s = standard deviation of the mean concentration of a given contaminant calculated from all samples (including historical data)

For a batch of biosolids to be accepted for reuse, the BACC for each contaminant must not be greater than the relevant Contaminant Acceptance Concentration Threshold listed in Table 4.1. The use of this procedure is demonstrated by the following example:

Two sources of biosolids are analysed for the contaminants listed in Table 4.1. The Contaminant Acceptance Concentration Threshold for lead for Contaminant Grade A is 150 mg/kg and for Contaminant Grade B is 420 mg/kg (from Table 4.1). The lead concentrations measured in the most recent sample (no. 15 in the series in Table 4.2) are the same for both sources of biosolids, and so is the mean based on historical data (Table 4.2). However, because there is more variation in the lead concentration in the Source 2 biosolids, the standard deviation is greater, and the Biosolids Adjusted Contaminant Concentration, BACC, is higher. Since the BACC for Source 1 is 134 mg/kg, the biosolids would qualify for Contaminant Grade A, at least on the basis of lead concentration. However, the BACC for Source 2 is 184 mg/kg, so the biosolids would qualify for Contaminant Grade B on the basis of lead concentration. Similar calculations need to be undertaken for each contaminant.

TABLE 4.2 EXAMPLE OF VARIATIONS IN LEAD CONTAMINANT CONCENTRATIONS LEADING TO DIFFERENT VALUES OF BACC.

Sample no.	***Source 1***	***Source 2***
1 (earliest sample)	*123*	*153 **
2	*118*	*79*
3	*120*	*92*
4	*119*	*99*
5	*115*	*119*
6	*117*	*128*
7	*120*	*172 **
8	*125*	*112*
9	*98*	*121*
10	*125*	*84*
11	*109*	*100*
12	*125*	*195 **
13	*118*	*105*
14	*105*	*88*
15 (most recent sample)	*130*	*130*
average	***118***	***118***
standard deviation	***8***	***33***
BACC = m + 2s	***134***	***184***
Note: ** indicates occasions when lead concentrations exceeded 150 mg/kg.*		

The concentration of contaminants should not only satisfy the requirements of Sections 4.1.1 and 4.1.2, but should always be reduced to the lowest practical level.

4.2 Stabilisation Grading

A major public health concern associated with biosolids reuse is the risk of spreading disease by pathogenic organisms. Stabilisation of biosolids is undertaken to reduce pathogen levels, vector attraction, and odours. The Guidelines do not dictate the technologies required to achieve particular stabilisation grades, but do specify the requirements of stabilisation in terms of microbiological standards for Stabilisation Grade A and acceptable processes for Stabilisation Grade B. Examples of acceptable pathogen and vector reduction processes are given in Appendix D. Other processes can be used, provided the achievement of the required microbiological standards can be verified.

Two stabilisation grades are used - A and B. The stabilisation grade of biosolids may be improved by additional treatment.

4.2.1 Stabilisation Grade A Product

Grade A stabilisation is required for biosolids and derived products to be used in home gardens, nurseries and places of high public contact. Stabilisation Grade A products should not exhibit offensive odours, and require initial verification that pathogen reduction process are performing effectively, and routine monitoring to ensure a consistent quality is maintained.

Stabilisation Grade A products must meet the pathogen reduction and vector attraction reduction requirements listed in Appendix D and the microbiological standards in Tables 4.3 and 4.4. Stabilisation Grade A pathogen reduction must be accomplished before, or at the same time as, one of the vector attraction reduction requirements to prevent pathogen regrowth.

4.2.1.1 Initial process verification of Stabilisation Grade A pathogen standards

A program of initial process verification is required to ensure that the standards contained in Table 4.3 are met when producing Stabilisation Grade A biosolids.

TABLE 4.3 INITIAL PROCESS VERIFICATION STANDARDS FOR STABILISATION GRADE A.

Parameter	Standard
Enteric viruses	< 1 PFU per 4 grams total solids
Helminth ova (*Ascaris* and *Taenia* spp.)	< 1 viable ova per 4 grams total solids

A high level of process control is necessary when processing biosolids to achieve Grade A stabilisation. This requires routine calibration of control equipment to approved standards, and record keeping of all process conditions, such as time, temperature and pH.

4.2.1.2 Routine monitoring for Stabilisation Grade A pathogen standards

After initial process verification, routine monitoring is required to ensure that Stabilisation Grade A biosolids products achieve the microbiological standards set out in Table 4.4.

TABLE 4.4 ROUTINE MONITORING STANDARDS FOR STABILISATION GRADE A.

Parameter	Standard
E. coli	< 100 MPN per gram
Faecal coliforms	< 100 MPN per gram
Salmonella sp.	Not Detected / 100 grams of final product
Listeria sp.	Not Detected / 100 grams of final product

4.2.2 Stabilisation Grade B Product

Stabilisation Grade B biosolids products may be used in agriculture, forestry or similar applications. It is not necessary to sample and determine pathogen levels for Stabilisation Grade B biosolids, but a method of pathogen reduction is required as part of the wastewater treatment process (see Appendix D). Stabilisation Grade B biosolids should not exhibit offensive odours. Vector reduction processes such as direct injection or incorporation should be used as appropriate.

4.3 Classification of Biosolids

After Contaminant and Stabilisation grading, biosolids and derived products are classified into 3 classes to define the re-use options. Depending on the final classification, biosolids can be applied to land in the following situations:

a) Home lawns and gardens (highest quality)
b) Public contact sites
c) Urban landscaping
d) Agriculture
e) Forestry
f) Site rehabilitation
g) Landscaping within the boundaries of the sewage treatment plant site
h) Surface land disposal at a waste depot
i) Landfill disposal (lowest quality)

Biosolids intended for any particular end use can also be applied to lower ranking end uses. For example, referring to the above list, a product which is acceptable for use in urban landscaping (c) could also be used for purposes (d) - (i), although it is preferable to use an urban landscaping class product for urban landscaping.

The Contaminant and Stabilisation grades corresponding to each level of product classification, and the allowable uses of classified biosolids, are described in Table 4.5.

TABLE 4.5 CLASSIFICATION OF BIOSOLIDS PRODUCTS AND ALLOWABLE END USES.

Contaminant Grade	Stabilisation Grade	Biosolids Classification [1]	Allowable land application use
A	A	Class 1	Home lawns and gardens; public contact sites; urban landscaping
B	B	Class 2	Agriculture; forestry; land rehabilitation
C [2] or ungraded	C [3] or ungraded	Class 3	Disposal at a waste depot or landfill.

Notes:

[1] The classification of a biosolids product is determined by the lowest grading. eg. if a product achieves Contaminant Grade A and Stabilisation Grade B, or Contaminant Grade B and Stabilisation Grade A, it is a Class 2 product.

[2] Biosolids are given Contaminant Grade C if contaminants exceed the Contaminant Grade B thresholds or have not undergone adequate sampling, analysis or grading procedures.

[3] Biosolids are given Stabilisation Grade C if none of the processes detailed in Appendix D have been used during treatment and processing.

4.3.1 How to Classify Biosolids Products

The steps involved in the classification process are summarised in Table 4.6.

TABLE 4.6 BIOSOLIDS CLASSIFICATION PROCESS.

Contaminant Grade

1. Sample and analyse biosolids product for regulated contaminants (Section 5 and Table 4.1).
2. Calculate the Contaminant Grade for each contaminant (Section 4.1.2 and Table 4.1).
3. Assign Contaminant Grade A, B or C to the biosolids product according to the lowest grade identified in Step 2.

Stabilisation Grade

1. Conduct initial process verification sampling (Table 4.3) and routine monitoring (Table 4.4) for Grade A stabilisation.
2. Assign Stabilisation Grade A, B or C on the basis of analytical results and/or treatment processes.

Biosolids Classification

1. When Contaminant and Stabilisation grades have been assigned, compare the grades with Table 4.5 and establish biosolids Classification and permissible end uses.
2. Retain the grading and classification records in accordance with Section 8.

4.3.2 Reclassification of Biosolids

The classification procedure must be repeated if the biosolids have been diluted with other material, or received further treatment which may alter the classification.

5. SAMPLING AND ANALYSIS PROCEDURES FOR BIOSOLIDS

Biosolids products must be sampled and analysed in order to undertake grading and classification. Laboratory tests are required to determine:

- Contaminant concentrations
- Nutrient status
- Microbiological status (for Stabilisation Grade A)

5.1 When to Sample

Biosolids and related products should be sampled when they are in the condition intended for final use. Normally this will be at the end of processing and as close as possible to the time of reuse. Lagoons should be sampled before emptying if direct application is intended.

Depending on the end use, biosolids may be sampled as either liquids or solids. Liquid biosolids are defined as any biosolids with the capacity to flow and be conveyed via a pump. All other products are treated as solids.

5.2 How Often to Sample

5.2.1 Sampling for initial screening of contaminants

There are a total of 18 contaminants (9 heavy metals and 9 organic pollutants) which need to be monitored to ensure biosolids quality is suitable for reuse. However, very few WWTP's ever show unacceptable levels for more than a few of the contaminants.

An initial screening analysis prior to the implementation of reuse operations can reduce the ongoing costs of chemical analyses. For WWTP's which produce biosolids regularly (i.e. all except lagoon systems), samples should be taken monthly for 3 months and analysed for the full list of contaminants (Table 4.1) as part of a screening analysis. Any contaminant which is present at less than 50% of the Contaminant Acceptance Concentration Threshold (Table 4.1) for the target end use of the biosolids can be dropped from future sampling procedures, with the proviso the a full screening is repeated:

- at yearly intervals, and,
- when there is reason to expect a change in the composition of the influent to the WWTP, such as might occur with the connection of a new industry to the sewer.

5.2.2 Sampling for Contaminant Grading

Having established if there is opportunity to reduce the analysis requirements for contaminants, the frequency of sampling for contaminant grading depends on the production rate (Table 5.1).

TABLE 5.1 MINIMUM SAMPLING REQUIREMENTS FOR CONTAMINANT GRADING.

Sampling Frequency	High frequency	Low frequency
Number of samples / dst[1] of biosolids	1 sample per 50 dst	1 sample per 100 dst
Lagoons [2]		2 sub-samples combined to give 1 composite sample per 100 dst at the time of emptying.

Note:
[1] dry solids tonne
[2] Lagoons need only be sampled prior to emptying, the number of samples being determined by the estimated dry tonnes of biosolids present. Periodic sampling during operation of the lagoon can be undertaken to monitor contaminant concentrations, which would give prior warning of any contamination problems.

High frequency sampling is used in the following situations:

- at the start of a sampling program, when a minimum of 12 analyses is required to improve the confidence of the initial contaminant grading and to provide baseline data for future comparisons. The first 3 screening samples can be used as the start of this database. All analytical data should be added to the database, as this improves the reliability of the contaminant grading and also helps to identify changes in contaminant concentrations over time.

- if the actual concentration of any of the monitored contaminants in a sample is greater than 0.8 of the Contaminant Acceptance Concentration Thresholds (Table 4.1). In this case, high frequency sampling continues to be used until there are at least three consecutive samples in which the actual concentrations of all monitored contaminants are less than 0.8 of the Contaminant Acceptance Concentration Thresholds (Table 4.1).

Plant operators may also wish to use high frequency sampling if they notice that biosolids quality is variable, even if all of the actual contaminant concentrations are less than 0.8 of the Contaminant Acceptance Concentration Thresholds (Table 4.1). This may allow operators to identify problems in the influent or treatment process and enable corrective action. In such cases, an actual contaminant concentration that is more than 10% greater than the long term average would be a suitable trigger to move to high frequency sampling.

Low frequency sampling is used when all monitored contaminant concentrations are stable and are less than 0.8 of the Contaminant Acceptance Concentration Thresholds (Table 4.1).

The initial sampling period of 12 samples is used to calculate the mean and standard deviation of each monitored contaminant level for use in the determination of the Biosolids Adjusted Contaminant Concentration, BACC (see Section 4.1.2).

5.2.3 Sampling for Stabilisation Grading

Biosolids products which are required to meet Class 1 standard for reuse need to be sampled to verify that Stabilisation Grade A has been achieved. This is a two stage process. Firstly, samples must be analysed to initially verify that the stabilisation process is performing to the specified standards (Table 4.3), and secondly, routine monitoring is required to ensure the standards are maintained (Table 4.4).

Monthly sampling for 3 months should be used for initial verification of process conditions, and low frequency sampling should be used for routine monitoring. These sampling requirements and performance standards apply only to Stabilisation Grade A products.

5.3 How to Sample

Samples are best obtained by combining a number of individual grab samples. Individual grab samples may be collected in either a batch or continuous mode. Alternative sampling strategies are illustrated in Figure 5.1. The use of batch or continuous sampling is best demonstrated by the following example:

A WWTP has a daily process which produces de-watered cake at the rate of 600 dst per year. A composite sample taken at low frequency must represent a maximum of 100 dst of biosolids, which is the total output for 2 months.

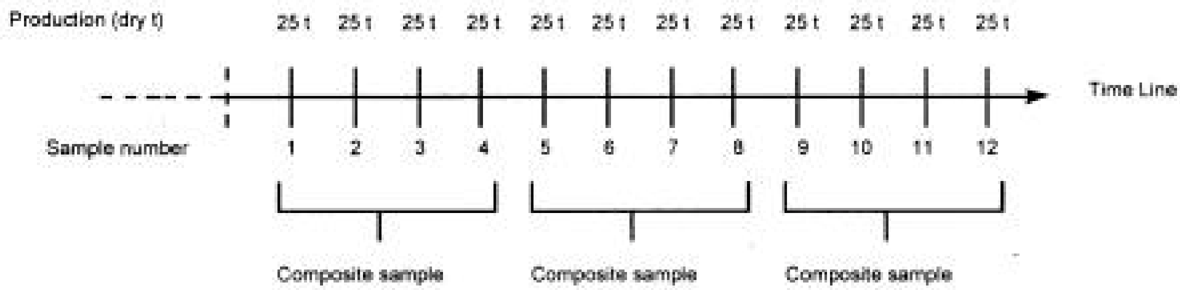
*For **continuous sampling**, an individual grab sample should be taken regularly (daily, every two days, weekly etc.), provided at least one individual grab sample is taken every 25 dst, which would be every two weeks in this case. All grab samples should be thoroughly mixed so that one sample per 100 dst is presented for analysis. Samples should be suitably stored after collection.*

*Alternatively, for **batch sampling**, the de-watered cake could be stockpiled, resulting in a 100 dst stockpile after two months. The stockpile would then be sampled as a batch by taking at least four individual grab samples from evenly distributed locations throughout the stockpile. Therefore, each individual grab sample should represent a maximum of 25 dst. The individual grab samples would then be thoroughly mixed to form one composite sample.*

If the biosolids in this example were to be analysed for microbiological standards or nutrients, it would be necessary to batch sample the stockpile at the end of the 2 month period, as microbiological populations and some nutrient concentrations can change substantially with time.

Sampling techniques should be constant for all samples and should not vary over time or between batches for each of the individual grab samples. While a minimum of four individual grab samples is required to form a composite sample, more can be taken, provided the number of individual grab samples combined to form a composite sample is consistent for all sampling occasions and all batches.

Continuous sampling - one sub-sample taken each 25 dry t and 4 sub-samples combined to form one composite sample representing 100 dry t



Batch sampling - one sub-sample taken for each 25 dry t and 4 sub-samples combined to form one composite sample representing 100 dry t

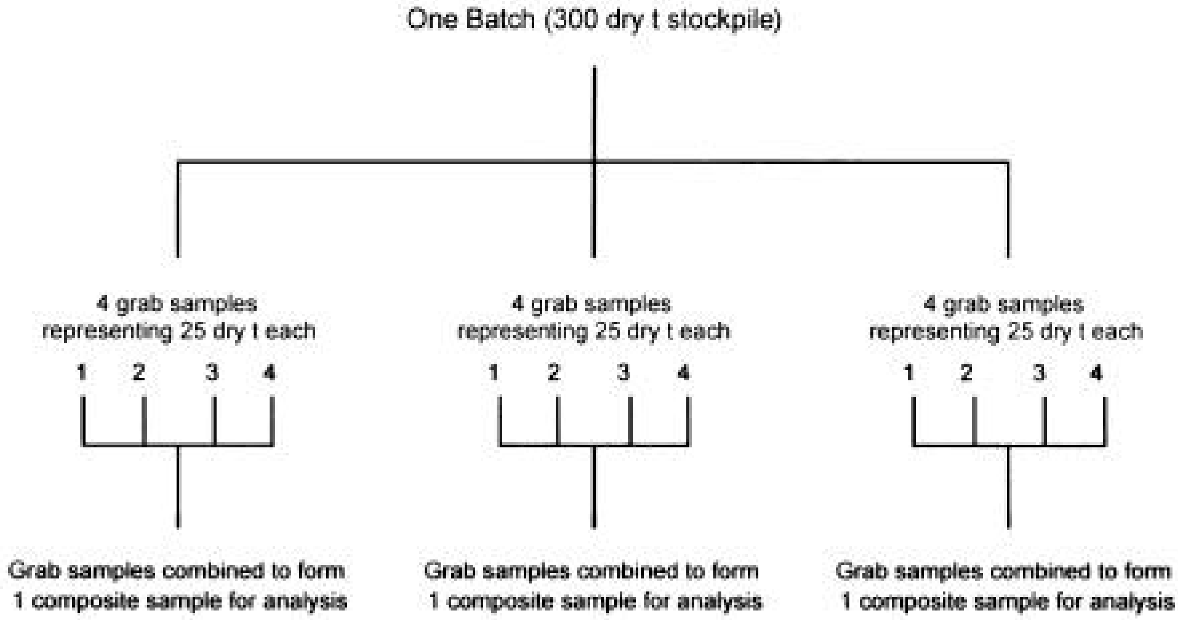


Figure 5.1 Alternative strategies for obtaining biosolids samples for analysis

Advice should be sought from the testing laboratory regarding sample sizes and storage times and conditions for samples, particularly those taken for nutrient and microbiological analysis. Depending on sample storage requirements, it may be necessary to despatch composite samples for analysis more frequently than the minimum requirements.

There will be occasions when the quantity of biosolids in a batch will be less than 100 dst. Irrespective of how small the batch is, the minimum sampling requirement is one composite sample comprised of at least four individual grab samples taken at evenly distributed times during the production process (for continuous sampling) or evenly distributed locations throughout the stockpile (for batch sampling).

Lagoons can be sampled using a boat and a clear plastic pipe (~ 40 mm dia.) to remove cores from the sludge layer.

5.4 Where to Sample

5.4.1 Liquid Biosolids Collection Points

Digesters and Tanks - Representative samples are essential. Sampling points should be located where the biosolids are well mixed. Within 3 m of the discharge side of sludge pumps will normally satisfy this requirement. When sampling, ensure that the:

- biosolids in the tank are well mixed.
- pump line is clear of stagnant biosolids.
- first flush of biosolids is discarded to avoid the risk of collecting stagnant material that may have accumulated within the sampling port.

Lagoon Sampling - The number of samples which need to be collected should be determined by making an estimate of the total dry tonnes of biosolids. Sampling locations should be located in an evenly spaced grid pattern. Samples should represent a cross-section of the sludge layer at each sampling location. A composite of individual grab samples should produce a single sample for each 100 dst.

Because the solids content of biosolids from lagoons is often low, the requirement of 1 sample/100 dst may result in a very low number of samples. As a minimum requirement, lagoon sampling should provide at least two composite samples each made up of individual samples taken from at least two separate sites. (i.e. 4 sites gives 4 samples which are combined in pairs to give 2 composite samples).

5.4.2 Solids Collection

Production of solid material can be either continuous or batch. With due regard to the requirement to sample at the completion of all processing stages, sampling of solids should follow the procedures outlined below:-

For continuous processes, individual grab samples should be taken periodically from the end of the process line, while for batch processes, individual grab samples should be taken from evenly distributed locations throughout the stockpile (refer Figure 5.1). In both cases, a minimum of four individual grab samples should be combined to form one composite sample per 100 dst, with each individual grab sample representing a maximum of 25 dst.

6. LAND APPLICATION OF BIOSOLIDS

To meet the requirements for beneficial reuse, the application rate of biosolids must be such that:

- the supply of nutrients does not exceed the requirements of the vegetation growing on the land,
- the beneficial characteristics of the organic matter are used for soil conditioning purposes, and,
- there is no degradation of groundwater, surface water or soil resources.

If the application rate exceeds the nutrient or organic matter requirements, the process is considered to be land disposal, not beneficial re-use, and can only be done at a waste depot.

6.1 Definitions of land use

It is useful to define some particular land uses for the purposes of detailing appropriate activity and management procedures when applying biosolids to land.

6.1.1 Sensitive Areas

Sensitive areas are areas with ecological, natural, cultural or heritage values worthy of preservation. Examples of sensitive areas are nature reserves, natural wetlands, karst areas, and groundwater recharge areas. The application of biosolids to sensitive areas is generally not permitted.

6.1.2 Places of High Public Contact

Places of high public contact include residential areas, schools, parks, gardens, sports ovals, recreation grounds etc. As it may not always be possible to restrict public access to places of high public contact, biosolids to be used in such places should meet high quality standards (i.e. Class 1).

6.1.3 Agricultural Land

Agricultural land is land which is currently, or could be in the future, used for agricultural (including pastoral) purposes.

6.1.4 Non-agricultural Land

Non-agricultural land is land which will not be used for agricultural (including pastoral) purposes within the foreseeable future. Non-agricultural land could include areas such as plantation forest and mine rehabilitation sites. Land where biosolids have been applied in accordance with non-agricultural land requirements is not necessarily unavailable for future agricultural use. However, before agricultural activities can begin, the site must be assessed, and soil contaminant concentrations must not exceed the levels listed in Table 7.1.

6.2 Groundwater Considerations

Groundwater is recharged by infiltration of water from the land surface, and while some concentrated recharge areas can be delineated, the process is generally diffuse. There are very few areas where it can be assumed that recharge will not occur. The vulnerability of an aquifer to pollution, as well as the current and future uses of the aquifer, need to be determined in order to assess potential risks arising from biosolids application.

The geologic formations which are most vulnerable to pollution risk are coastal dune sands, alluvial deposits, and basalt formations. The degree of vulnerability is variable and depends on the distribution of low permeability clay layers within the deposits. Clay layers at or near the surface diminish the likelihood of pollution, while fractured rock layers may enable rapid movement of pollutants into the ground water table.

Consideration should be given to the capacity of the recharge zone to accept nutrients from biosolids. Groundwater systems which are under stress due to high nutrient loadings should have appropriate limits placed on biosolids application rates. Biosolids products applied at nutrient rates below cropping requirements (see Section 7.4) are considered to have very low risk of polluting aquifers. Advice should be sought from DPIWE or Mineral Resources Tasmania for all issues related to the interaction of ground water and biosolids application.

The *State Policy on Water Quality Management 1997* requires that biosolids application sites pursue management strategies which maintain or enhance ground water quality, and that pollutants from these diffuse sources are reduced as far as reasonable and practicable through the use of best practice environmental management.

6.3 Biosolids Products for use in Agriculture, Forestry and Land Rehabilitation

Only Class 1and 2 biosolids are suitable for beneficial land application within the scope of these guidelines. The suitability of land for the application of biosolids products is determined by the site characteristics, in particular, the land use.

The only restriction applying to Class 1 biosolids when used in agriculture is that application rates do not exceed predicted nitrogen demand, as detailed in Section 7 and Appendix B. A number of restrictions related to site characteristics and management practices are applicable when using Class 2 biosolids products.

6.3.1 Site Constraints

Class 2 biosolids products should not be applied to land used for agriculture, forestry and land rehabilitation that has the constraints detailed in Table 6.1.

TABLE 6.1 SITE RESTRICTIONS FOR APPLICATION OF CLASS 2 BIOSOLIDS PRODUCTS.

Site Characteristics	Restriction
Slope [1]	- >15 %
Areas with undesirable drainage characteristics	- waterlogged soils - very slowly permeable or extremely permeable soils (see Appendix A, Table A3)
Depth to bedrock	- land where depth to bedrock is less than 45 cm
Surface rock outcrop [2]	- land with >10% surface rock outcrop
Vegetation	- native forests and significant native vegetation
pH	- <4.5 (see Appendix A)

Notes:

[1] It may be possible to use slopes up to 25% in forestry and land rehabilitation applications (see additional notes in Appendix A, Table A2).

[2] Not applicable to forestry and land rehabilitation applications.

6.3.2 Buffer Zones

Buffer zones are required between sites of biosolids application and the surrounding landscape, as detailed in Table 6.2.

TABLE 6.2: MINIMUM WIDTH OF BUFFER ZONES FOR APPLICATION OF CLASS 2 BIOSOLIDS TO LAND USED FOR AGRICULTURE, FORESTRY AND LAND REHABILITATION.

Feature	Minimum width of buffer zones (m)		
	Flat (<3 %)	**Downslope** (>3 %)	**Upslope**
Surface water (rivers, lagoons etc.)	50	100	5
Farm dams, sedimentation basins	20	30	5
Drinking water bores	250	250	250
Other bores	50	50	50
Farm driveways, access roads and fencelines	5	10	5
Native forests and other significant vegetation types	10	10	5
Animal enclosures	25	50	25
Occupied Dwelling	50	100	50
Residential Zone, urban areas	250	500	250

Notes:

Careful consideration should be given to areas within the 1 in 100 year floodline.

The seasonal water table depth should be at least 90 cm below the soil surface.

Buffer zones should be stable and covered with suitable vegetation to limit the movement of biosolids from the application area.

Stormwater runoff from biosolids application sites should be controlled by either diversion or collection to prevent contamination of surface waters.

6.3.3 Management Practices for Biosolids Products Used in Agriculture, Forestry and Land Rehabilitation

The management practices applying to the use of Class 2 biosolids products on agricultural and forestry land and land rehabilitation sites are set out in Table 6.3.

TABLE 6.3: MANAGEMENT PRACTICES FOR USE OF CLASS 2 BIOSOLIDS PRODUCTS ON LAND USED FOR AGRICULTURE, FORESTRY AND LAND REHABILITATION.

Item	Management Practices
Stockpiling on application sites	If possible, biosolids should be stored at the biosolids production or processing site rather than the application site. If it is necessary to store biosolids at the application site: • biosolids should be retained within a bunded storage area constructed and maintained to contain the first hour of a 1 in 20 year rainfall event. • biosolids should not be stored for more than 90 days. • surface water diversion is required to prevent entry of overland flow to the bunded area. • a drainage collection point should be located within the stockpile area, but separated from the stored biosolids, and collected drainage should be applied to the application site. • stockpile areas should be located on the minimum slope possible within the application area. • dewatered biosolids which have received no additional treatment should be stockpiled on slopes less than 5%. • stockpiling is limited to the day of application for biosolids requiring incorporation.
Incorporation of biosolids	Biosolids should be incorporated whenever possible (e.g. applied to land about to be cultivated, or direct injected as a liquid). However, many forms of biosolids (e.g. dried, lime amended etc.) are suited to surface application without incorporation, and management practices (e.g. biosolids treatment, withholding periods, buffer zones etc.) can be used to minimise the risk of off-site impacts and vector attraction. In all cases, reasonable judgement should be exercised with respect to the appropriate application and incorporation requirements for the biosolids and site in question.
Frequency of application and soil pH adjustment	If biosolids are applied at the NLAR, there should be a delay of at least 3 years between applications on the same portion of land and the pH should be maintained above 5.5 for at least 2 years following application.
Weather patterns and seasonality	Liquid biosolids applications in winter should not exceed the equivalent of 5 mm of water per application (i.e 50 liquid t/ha). Liquid biosolids applications should not take place on saturated soils. All biosolids applications should be scheduled to take into account preceding, present and forecast weather conditions, with particular emphasis on avoiding likely rainfall events. Pooling and runoff of liquid biosolids is to be avoided at all times.
Water sampling	Surface and ground water monitoring may be required if one-off high rate applications (total N >1200 kg/ha or available N >350 kg/ha) are made on non-agricultural land.

6.3.4 *Activity Constraints for Biosolids Products Used in Agriculture*

The constraints outlined in Table 6.4 are designed to minimise the risk of pathogen exposure when using Class 2 biosolids products in agriculture.

TABLE 6.4: ACTIVITY CONSTRAINTS FOR USE OF CLASS 2 BIOSOLIDS ON AGRICULTURAL LAND.

Item	Activity Constraints
Human food crops	• For crops which may be eaten raw, and where harvested parts are close to the soil surface (e.g. lettuce), planting should be delayed for 12 months after biosolids application. • For crops which may be eaten raw, and where harvested parts are below the soil surface (e.g. carrots), planting should be delayed for 18 months after biosolids application. • In all other cases, (i.e. food crops where the harvested product is not in contact with the ground such as apples and wheat) the crop should not be harvested for 30 days after biosolids application. • Windfalls (eg orchards) should not be collected for 12 months after biosolids application, unless further processing involving pastuerisation processes (canned fruit etc) is planned.
Animal feed and fibre crops	• Should not be harvested for 30 days after biosolids application.
Animal Withholding	• Animals should not be grazed on the site for 30 days after biosolids application. • Poultry and pigs should not be grazed on biosolids application areas [1].
Turf	• Turf grown on land to which biosolids has been applied should not be harvested for 1 year after biosolids application.
Public access	• Signs warning the public of the use of biosolids products should be placed on gates and other point of access.

Note:

_ This constraint is due to the feeding habits of these animals which result in high levels of ingested soil.

6.3.5 *Activity Constraints for Applications to Non-agricultural Land*

The constraints detailed in Table 6.5 are designed to minimise the risk of exposure to pathogens where biosolids are applied to land not used for food production. These constraints are particularly relevant when biosolids are applied on the surface and incorporation may not be appropriate, such as when applied to forestry areas and land rehabilitation sites.

TABLE 6.5: ACTIVITY CONSTRAINTS FOR USE OF CLASS 2 BIOSOLIDS PRODUCTS ON NON-AGRICULTURAL LAND.

Item	Activity Constraints
Public access	• Where there is high potential for public exposure, access should be restricted by fencing (where feasible) and signing for 1 year after biosolids application. • Where there is a low potential for public exposure, access should be restricted for 30 days after biosolids application.

7. DETERMINING APPLICATION RATES

Three processes are involved in determining the application rate of biosolids to land under beneficial reuse operations. Firstly, it is necessary to obtain information regarding the concentrations of contaminants and nutrients. This is then used to classify the suitability of the biosolids for agricultural use. Secondly, it is necessary to analyse soil samples from the proposed application site for contaminant and nutrient concentrations. Thirdly, with the information from these analyses, an application rate can be calculated which will not exceed the permissible soil contaminant concentrations (Table 7.1) or the predicted nitrogen requirements of the crop to be grown on the site. This process is shown schematically in

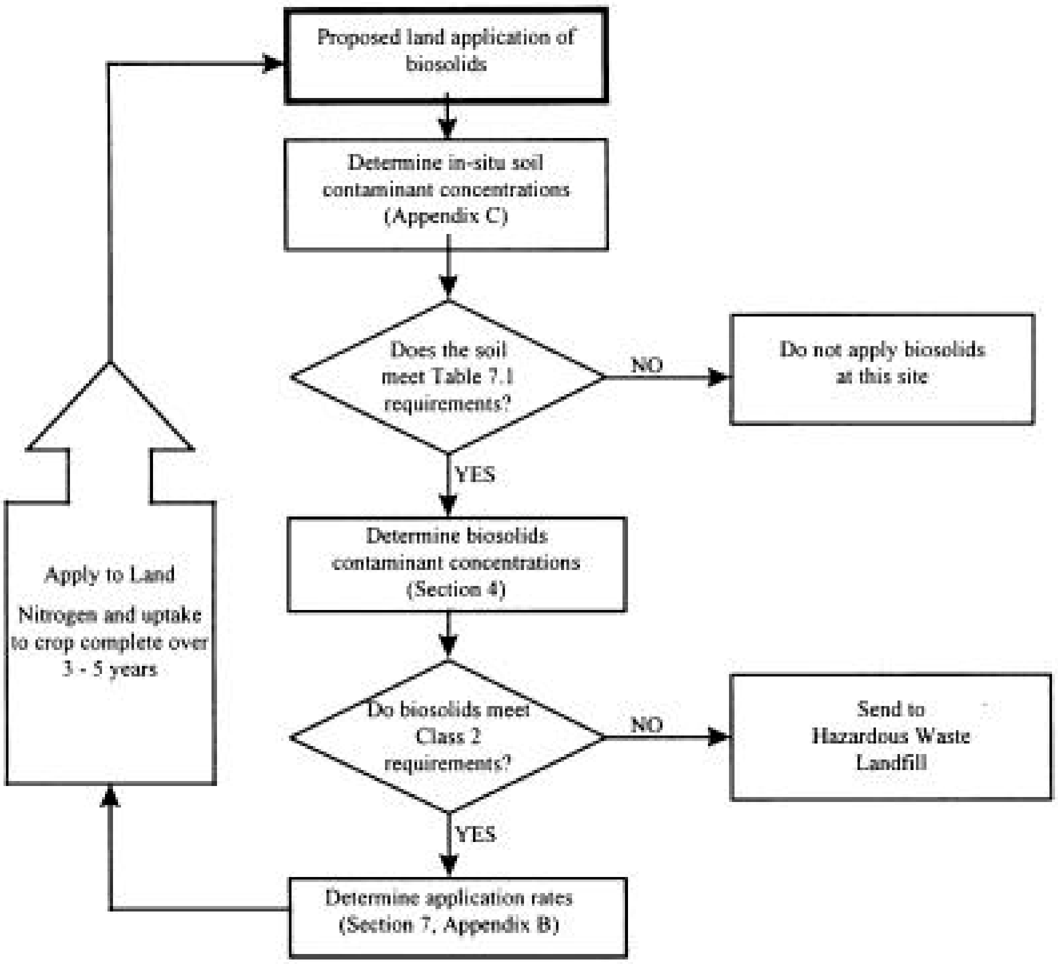


Figure 7.1 Process for proceeding with biosolids application

7.1 Determining Biosolids Contaminant and Nutrient Concentrations

Determination of biosolids contaminant concentrations, classifications and permissible end uses is covered in Section 4.

Biosolids products which are to be beneficially used in agriculture, land rehabilitation or forestry require analysis for nitrogen (total Kjeldahl, ammonium and nitrate/nitrate) and total phosphorus in order to determine nutrient loading rates. Sampling for nitrogen analysis should be done as close as possible to the time of application as nitrogen content can change during storage. Details regarding estimation of nitrogen content are given in Appendix B.

7.2 Determining Soil Contaminant and Nutrient Concentrations

Soil samples from the application site need to be analysed to determine contaminant and nutrient concentrations before biosolids application (see Appendix C for details of soil sampling procedures). The results of the soil and biosolids analyses are used to calculate the maximum permitted application rate based on contaminant and nutrient loadings. Application of biosolids should be managed so that the "Maximum Allowable Soil Contaminant Concentrations" listed in Table 7.1 are not exceeded.

TABLE 7.1: MAXIMUM ALLOWABLE SOIL CONTAMINANT CONCENTRATIONS FOR AGRICULTURAL AND NON-AGRICULTURAL LAND AFTER BIOSOLIDS APPLICATION.

Contaminant	Maximum allowable soil contaminant concentrations for agricultural land _ (mg/kg dry weight of soil)
Arsenic	14
Cadmium	0.7
Chromium	35
Copper	42
Lead	105
Mercury	0.7
Nickel [3]	42
Selenium	3.5
Zinc	140
DDT/DDD/DDE	0.50
Aldrin	0.02
Dieldrin	0.02
Chlordane	0.02
Heptachlor	0.02
HCB	0.02
Lindane	0.02
BHC	0.02
PCB's	0.30

Note:

_ Maximum Allowable Soil Contaminant Concentrations are based on mean concentrations obtained from analysis of a number of soil samples.

[2] Biosolids products should not be applied to sites where the existing contaminant concentrations are in excess of the maximum allowable concentrations listed in this table, unless it can be demonstrated that the reason for the elevated contaminant concentration is a natural feature of the soil type.

[3] Red ferrosol soils (previously known as krasnozems) are a specific case of the situation described in Note 2. Red ferrosols have naturally high concentrations of total chromium and total nickel. When applying biosolids to these soils, the Maximum Allowable Soil Contaminant Concentrations listed above should be ignored for Chromium and Nickel, but the Contaminant Acceptance Concentrations listed in Table 4.1 for biosolids are still applicable.

7.3 Determination of Biosolids Application Rate

The contaminant and nitrogen analysis data of the biosolids and the soil are used to calculate the maximum allowable biosolids application rate for a given site. Normally, the application rate will be limited by either contaminants (the Contaminant Limiting Application Rate or CLAR) or nitrogen (the Nitrogen Limiting Application Rate or NLAR). The maximum allowable application rate is the lower rate of the CLAR and NLAR.

- the CLAR is the rate at which biosolids can be applied without exceeding the maximum allowable concentration of contaminants in the soil (Table 7.1).

- the NLAR is the rate at which biosolids can be applied without exceeding the annual nitrogen requirements of the crop or vegetation grown on the land (Appendix B).

The total phosphorus and the phosphorus adsorption capacity of regularly used sites should be determined at five yearly intervals and, if required, action taken to avoid phosphorous overloading.

Lime amended biosolids should be applied at a rate which will raise the soil pH enough to ensure satisfactory crop growth rather than an application rate based on nitrogen content.

The Maximum Allowable Biosolids Application Rate should be determined by following the steps in Table 7.2. Appendix B provides an example of the determination of application rate.

TABLE 7.2: CALCULATION OF MAXIMUM ALLOWABLE BIOSOLIDS APPLICATION RATE.

1. Determine the soil contaminant and nutrient concentrations from composite soil samples collected according to the procedures in Appendix C.
2. Determine the Biosolids Adjusted Contaminant Concentration, BACC, for each contaminant in the biosolids (Section 4.1.2).
3. Calculate the CLAR and the NLAR (Appendix B) and select the lower of the two.

7.4 Low Rate Applications

The complete assessment of soil quality and site suitability encompassing all of the site constraints listed in Sections 4 and 6 and Appendices A and B can be quite expensive. However, it is possible to reduce the expense and maintain environmental safety by undertaking lower rate applications. It must be recognised that while this approach may reduce site assessment costs, it will probably increase transport and application costs. Lower rate applications may be undertaken by adhering to the following procedures:

1. soil nutrient status is assessed by normal soil sampling techniques, although other contaminant levels can be ignored. This will allow calculation of the NLAR.
2. the biosolids contaminant grade must be at least grade B
3. surface buffer zones should be observed (Table 6.2), as should a minimum depth to the seasonal water table of 90 cm.
4. in line with good practice techniques, application should only take place when there is minimal risk of run-off or leaching.
5. application rate should be less than 50% of NLAR or less than 50 wet t/ha, whichever is the lesser.
6. return periods to the same piece of land should be more than 3 years.

8. RECORD KEEPING AND INFORMATION TRANSFER

8.1 Record Keeping

Records form the basis of a quality management system for biosolids reuse. This section sets out the types of records to be kept by producers, reprocessors, appliers and final receivers/users of biosolids and biosolids products. Records relating to application are not required for Class 1 products. However, the producer and/or reprocessor records must be maintained to demonstrate compliance with the requirements for Class 1 classification.

8.1.1 Producers

Records to be maintained by the producer of biosolids are listed in Table 8.1.

TABLE 8.1: RECORDS TO BE MAINTAINED BY PRODUCERS OF BIOSOLIDS.

Class 1

1. Batch identification.
2. Production period.
3. Contaminant Concentrations and Contaminant grade for the batch.
4. Stabilisation grade, method of achieving stabilisation grade and microbiological testing results for the batch.
5. Concentration of nitrogen and total phosphorus.
6. Quantity (in dry tonnes) and solids content of the batch.
7. Type of product produced (e.g. compost).

Class 2

1. Batch identification.
2. Production period.
3. Contaminant Concentrations and Contaminant grade for the batch.
4. Stabilisation grade and method of achieving stabilisation grade for the batch.
5. Concentration of nitrogen and total phosphorus.
6. Quantity (in dry tonnes) and solids content of the batch.
7. Address of destination of biosolids.

Unclassified biosolids transferred to a reprocessor

1. Batch identification.
2. Production period.
3. Contaminant Concentrations and Contaminant grade for batch.
4. Stabilisation grade (if applicable).
5. Quantity (in dry tonnes) and solids content of the batch.
6. Biosolids classification testing completed (Yes/No).
7. Address of destination of biosolids.

Note: When monitoring shows that a classification change has occurred, all the requirements relating to the new classification should be observed immediately.

8.1.2 Reprocessors

Reprocessors may undertake to mix biosolids with other materials, or treat biosolids through composting or some other process. Records to be maintained by reprocessors of biosolids are listed in Table 8.2.

TABLE 8.2: RECORDS TO BE MAINTAINED BY REPROCESSORS OF BIOSOLIDS.

Class 1

1. Copies of classification information prepared by the biosolids producer.
2. Contaminant concentrations in reprocessed products.
3. Stabilisation grade, method of achieving stabilisation grade and microbiological testing results in reprocessed products.
4. Quantity (in dry tonnes) and solids content of the batch.
5. Type of product produced and batch identification.

Class 2

1. Copies of classification information prepared by the producer.
2. Contaminant concentrations in reprocessed products.
3. Stabilisation grade in reprocessed products.
4. Concentration of nitrogen and total phosphorus.
5. Quantity (in dry tonnes) and solids content of the batch.
6. Address of destination of biosolids and batch identification.

Unclassified at point of leaving reprocessor

1. Copies of classification information prepared by the producer.
2. Quantity (in dry tonnes) and solids content of the batch.
3. Address of destination of biosolids and batch identification.

Note:

When monitoring shows that a classification change has occurred, all the requirements relating to the new classification should be observed immediately.

8.1.3 Appliers

Records to be maintained for each application site by appliers of biosolids are listed in Table 8.3.

TABLE 8.3: RECORDS TO BE MAINTAINED FOR EACH APPLICATION SITE BY APPLIERS.

Class 1

No records required.

Class 2

1. Source of biosolids received, batch identification and classification.
2. Location of the application site.
3. Name of occupier or owner of site.
4. Area of the application site.
5. Date of application.
6. Concentrations of contaminants in soil and soil pH prior to biosolids application.
7. Contaminant grade of biosolids applied.
8. Concentration of nitrogen and total phosphorus.
9. Nitrogen Limited Biosolids application rate.
10. Contaminant-Limited application rate and the limiting contaminant (include a copy of the calculation table in Appendix B).
11. Actual application rate of biosolids.
12. Method of application of biosolids..

8.2 Information Transfer

Proper management of biosolids recycling operations requires the transfer of records between relevant groups. Depending on the circumstances, records may need to flow from the producer to the reprocessor, from the producer or reprocessor to the applier, and from the applier to the final receiver/user of the material and relevant authorities. Records must be available for inspection by relevant authorities on request.

9. COMPOSTING SEWAGE SLUDGE/BIOSOLIDS

Stabilisation is required to reduce the health risks of biosolids reuse. Two possible levels of stabilisation are given in these guidelines, along with end uses for biosolids products that have met these stabilisation requirements. Processes that are able to achieve Grade A or B stabilisation are given in Appendix D.

Composting is one biosolids stabilisation process which is attracting increased attention with more interest in beneficial reuse of organic wastes. A range of composting strategies can be used to produce a stabilised and pest free compost that incorporates biosolids. The following information deals with windrow and forced aeration composting, as these methods are the most likely to be used in Tasmania. There are numerous publications on composting for those interested.

9.1 The Composting Process

A number of factors impact on the success of the composting process (Table 9.1). The most important are moisture content, temperature, pH, C:N ratio and aeration. A bulking agent (such as woodchips, sawdust, mulched green waste etc.) can be added to provide carbon, absorb moisture or assist aeration. The bulking agent and the biosolids should be well mixed to aid rapid and complete composting. As a general rule, composting with green waste and biosolids is undertaken at a ratio of between 3:1 and 5:1 green waste to biosolids.

TABLE 9.1: IMPORTANT CONSIDERATIONS FOR AEROBIC COMPOSTING

Factor	Comment
Blending and seeding	Composting time can be reduced by seeding with other compost to about 1 to 5 percent by weight.
Carbon - Nitrogen ratio (C:N ratio)	Initial C:N ratios (by mass) between 25:1 and 50:1 are optimum. At lower ratios, ammonia is produced and biological activity is impeded. At higher ratios, nitrogen may be a limiting nutrient. The effective C:N ratio varies with the availability of carbon to the composting bacteria e.g. sawdust has more available carbon than the same volume of woodchips.
Control of pathogens	Composting will kill all pathogens, weeds and seeds, provided that all the material in the windrow is subjected to temperatures between 60 and 70 ^{o}C for 24 h at some stage of the process.
Initial mixing	Good mixing is essential for effective composting, particularly for forced aeration systems.
Moisture content	Moisture content should be between 50 and 60 percent.
Oxygen	Oxygen content should be between 5 and 15%. Less than 5% is acceptable for the first week of composting and above 15% is suitable in forced aeration systems when combined with temperatures that increase moisture removal.
Particle size	Particle size of solid wastes should be 25 - 75 mm. A bulking agent can be added to provide carbon, absorb moisture or improve aeration and needs to be well mixed in the windrow.

pH	pH should be between 6 and 7.5. Keeping pH < 8.5 will minimise the loss of nitrogen in the form of ammonia.
Temperature	Temperature should be maintained between 50 and 55°C for the first few days and between 55 and 60 °C for the remainder of the active composting period. Sustained temperatures above 66 °C limit biological activity.
Turning	Windrows should be turned on a regular schedule, or as required, to provide aeration, break up preferential air flow channels, and maintain high temperatures and the desired moisture content. Turning should be scheduled according to monitoring and weather conditions. Forced aeration windrows are not usually mixed after formation, so extra care must be taken to ensure a good initial mix.
Time composting	30 days minimum & five turns
Time curing or stockpiling	60 days minimum

9.2 Windrow Management

Periodic turning is required to provide aeration and to maintain correct temperatures and moisture content. Turning exposes all of the compost heap to the high temperatures required for effective stabilisation. Turned windrows should be less than 2m high. Forced aeration piles may be 1.5 – 3m in height.

9.2.1 Approximate Turning Schedule

If the initial moisture content is below 70%, the first turn should be made after about the 3 days. Table 9.2 is a guide to turning requirements for the first 2 weeks.

TABLE 9.2: SUGGESTED TURNING REQUIREMENTS FOR COMPOST WINDROWS.

Moisture content	Turning schedule
60 - 70%	Turn at 2-day intervals, 4 to 5 turns in total
40 - 60%	Turn at 3-day intervals, 3 to 4 turns in total
<40%	Add water

Turning the windrow frequently (approximately 5 times) in the first 10 - 15 days of the composting operation achieves the same amount of stabilisation as turning over a longer period. Greater aeration in these initial stages of decomposition intensifies the activity of the microorganisms, shortens the period of active decomposition, and consequently, reduces the time and the land area required for composting.

9.2.2 Odour Problems

Most odours generated in composting are related to aeration and moisture content problems and are likely to be due to either aerobic processes (eg. ammonia) or anaerobic processes (eg. sulphur compounds). As a rule of thumb, if anaerobic odours are present when the pile is disturbed for inspection purposes, turn the pile daily until the odours disappear. The minimum recommended buffer zone to minimise the impact of odour problems arising from compost turning activities is 500m.

Wastewater sludge is high in nitrogen and is usually not odorous to compost, whereas composting materials that are high in sulphur may cause significant odour problems. Sulphur odours are also produced when anaerobic processes become dominant due to lack of aeration or too much moisture in the windrow. Maintaining a C:N ratio of about 35:1 during composting, and producing a finished compost with a ratio of about 20:1 will prevent most odour problems and also prevent compost toxicity due to ammonia production.

Some odours are generated by collection of moisture at the base of the pile, especially in high rainfall areas. This can be prevented by building a filter layer for the base or designing a subsurface leachate collection system to remove leachate to a storage pond.

9.2.3 Fly Control

Flies are the main disease vector and public health risk associated with composting operations and must be controlled at all times. If fly breeding is a problem, the windrows must be turned daily until the breeding cycle of the flies is broken. Forced aeration composting will require blanketing with fly free stabilised compost.

9.2.4 Monitoring

Samples should be taken throughout the windrow to ensure that the processes at the base, middle sections and top of the windrow are monitored (Table 9.3).

TABLE 9.3: SUGGESTED MONITORING SCHEDULES

Parameter	**Size of Operation** (dry solid tonnes)		
	25 dst	25 - 250 dst	>250 dst
Moisture content	monthly	weekly	daily
Temperature	daily	daily	daily
Oxygen	optional	monthly	weekly
Process odours	daily	daily	daily
Blower operations (for forced aeration systems)	daily	daily	daily
pH of compost	monthly	monthly	monthly
Pathogen survival	See section 4.2		
Heavy metals & organic pollutants	See section 4.1		

9.3 Windrow Paving Base Materials and Runoff Collection

Climatic conditions and composting processes determine the best material to use for the windrow base (Table 9.4). When compost windrows are formed on soil, an initial layer of tree clippings or wood chips can be a good way to provide a filter layer to ensure adequate drainage and improve aeration.

Full bunding with ramped vehicle access should be maintained around the composting area to adequately collect stormwater runoff. Runoff and leachate must be stored in a collection pond, and a plan developed for the treatment or use of any liquid collected. The collected liquid may be applied to agricultural land, or treated appropriately before disposal. In summer, the liquid could be returned to the composting windrows.

TABLE 9.4: PAVING BASE MATERIALS FOR COMPOST WINDROWS.

Crushed rock	Marginally suitable. Requires considerable maintenance, is hard to clean. Often has soft spots until consolidated. Serpentine rock has been shown to increase nickel in compost.
Fly ash	Marginally suitable. Dusty, hard to clean. Only suitable for low rainfall areas as it becomes very muddy when wet.
Asphalt	Suitable for some sites. Can be kept clean. May soften and degrade at composting temperatures.
Concrete	Very suitable, low maintenance, easy cleaning, but expensive.
Cement stabilised fine crushed rock	Very suitable when properly laid, much cheaper than concrete.
Dirt	May be suitable for dry climates. Cannot be cleaned, becomes muddy when wet.

9.4 Occupational Health and Safety Requirements

There is little evidence of health risk for workers associated with biosolids composting activities, provided adequate dust control measures and suitable dust masks are used.

9.5 Trouble Shooting Guide for Biosolids Composting

TABLE 9.5: TROUBLE SHOOTING GUIDE FOR BIOSOLIDS COMPOSTING

Problem	Possible solution
Odours	• Windrow becoming anaerobic – turn daily until odours stop. • Don't turn or handle compost during conditions of low wind speed, excessive rainfall, and temperature inversions. • Excessive moisture – monitor temperature, moisture and oxygen levels. • Adjust bulking agent ratio in response to wet weather or changes in sludge quality. • Blanket with cured compost to absorb odour (particularly for forced aeration composting). • Clean composting area and equipment. • Ensure adequate drainage. • "Bad batch" planning – quick remixing or disposal to landfill if necessary.
Fly breeding	• Turn daily or blanket with cured compost to control numbers.
Poor aeration	• Too much moisture. • Too long between turns of the windrow. • Poor initial mix for forced aeration composting.
Low temperature	• Pile becoming anaerobic – turn pile or increase aeration. • Too much surface area for the volume of the windrow - increase depth of windrow. • Material not sufficiently shredded or mulched. • High C/N ratio – too much ash or other minerals. • Poor initial mix of compost.
Excessive temperatures	• reduce height and width of windrow in steps of 0.5m (should lower temperature within hours).
Poor pathogen kill	• Poor mixing. • Insufficent temperature or time of exposure to adequate temperatures - increase moisture content without losing aeration.

10. DISPOSAL OF BIOSOLIDS PRODUCTS

DPIWE's waste management strategy is based on the widely accepted waste management hierarchy, which favours the prevention or reduction of waste generation, followed by reuse or recycling where possible. In accordance with this approach, DPIWE encourages reuse of biosolids over other options. However, it is possible that economic or other factors may prevent the beneficial reuse of materials which are of a suitable quality for reuse. These materials may be suitable for surface land disposal at rates which exceed the agronomic loading rate. In addition, some biosolids may be classified as hazardous waste because certain quality characteristics prevent their reuse. Disposal to landfill is at present the only option for these materials. This section covers issues associated with surface land disposal at application rates which exceed the agronomic loading rate and landfill disposal of those materials classified as hazardous waste.

10.1 Surface Land Disposal

While beneficial reuse at the agronomic loading rate is the preferred option for Class 1and 2 biosolids, it is recognised that surface land disposal may be the only feasible alternative in some cases, such as where there is no economically viable beneficial reuse option. DPIWE proposes to amend tip/landfill permits to prohibit landfill disposal of biosolids that are of sufficient quality for reuse unless it can be adequately shown that there are no beneficial reuse or surface land disposal options available.

Examples of surface land disposal include the use of excess volumes of biosolids as fill for golf courses, parklands, sporting grounds, site remediation etc., and landfill capping material.

10.1.1 Assessment of Surface Land Disposal Sites

Before surface land disposal of biosolids at a new site, or continuing with current surface disposal methods, the biosolids producer must ensure that the disposal operation will not have a significant environmental impact. Any potential impacts must be able to be effectively managed.

As part of this process the biosolids producer should:

1. Proceed with Council planning scheme approval, if required.
2. Establish systems to protect the amenity of neighbouring properties.
3. Determine the volume and frequency of disposal of the biosolids.
4. Provide detail on the characteristics of the site such as topography, soils, drainage lines, geology and ground and surface water, and specify the management practices to be used to protect ground and surface waters. DPIWE may be consulted to determine the level of detail required at this point.

10.1.2 Remediation

Surface disposal of biosolids should not lead to elevated levels of contaminants within the disposal site. Contamination of land, such that the soil, groundwater or surface water quality fails to meet current guideline levels for contaminated sites, may require remediation of the area. In particular, if there is considered to be a likelihood that the area may change to a more sensitive land use in the future, more stringent remediation levels may be required.

Planning authorities must consider potential contamination issues when considering application for change of land use of a site which has formerly been used for surface land disposal activities. If environmental harm is considered to be occurring either at a disposal site, or as the result of the operation of a disposal site, DPIWE would require assessment and remediation by serving an Environment Protection Notice.

10.1.3 Management Practices for Surface Disposal of Biosolids

The following management practices should be followed for surface disposal of biosolids.

- The biosolids should be covered by incorporation or direct injection if nuisance odours are likely to occur, if the waste is attractive to disease vectors, or if surface movement off the disposal site is possible.
- Stormwater runoff should be controlled with diversion and collection systems.
- Sites with slopes >15%, very low permeability or extremely permeable soils, and underlying groundwater should be avoided.

Recommended buffer zones for surface land disposal of biosolids are shown in Table 10.1

TABLE 10.1: BUFFER DISTANCES FOR LAND DISPOSAL OF BIOSOLIDS

Feature	Buffer distance (m)
Surface waters	100
Ground water bores	250
Roads and fences	10
Animal enclosures	50
Sensitive areas	1000

10.1.4 Record Keeping Requirements

The biosolids producer shall keep a record of all surface land disposal activities. The information to be recorded must include:

1. Biosolids quality information (Section 4)
2. The location of the site
3. A plan of the site
4. Volume of biosolids applied
5. The dates of disposal.

10.2 Landfill Disposal

Biosolids not meeting Class 1 or Class 2 standards are to be classified as hazardous waste, and will have to be disposed of in a landfill permitted to receive hazardous waste. Disposal of contaminated biosolids to landfill may only take place with DPIWE approval.

If the contaminated biosolids do not meet the requirements of the toxicity characteristic leaching procedures (TCLP) test then they must be further treated to an appropriate standard before final landfill disposal. It is necessary to contact DPIWE for advice when planning to dispose of contaminated biosolids to landfill.

APPENDIX A

LANDFORM AND SOIL CHARACTERISTICS AND THEIR INFLUENCE ON THE SUITABILITY OF SITES FOR BIOSOLIDS APPLICATION

A1 Landform and soil quality

Landform and soil quality are important in determining the suitability of a site for biosolids application. The prevailing weather and soil moisture conditions interact with the landform to determine the limitations to biosolids application. For example, a site with few landform limitations may be suitable for biosolids application at all but the wettest times of the year. Conversely, a site with severe landform limitations may be able to safely receive biosolids only in the driest part of the year. The following tables give some guidelines as to the limitations of particular landforms and soil quality parameters when applying Class 2 biosolids.

Sites with nil or slight limitations are likely to be able to receive regular applications of any biosolids product at maximum allowable rates without serious on or off site effects, bearing in mind the influence of weather and soil moisture conditions.

Sites with moderate limitations may be more limited in the number of biosolids applications that can be made, the range of products that can be used, or the acceptable weather and soil moisture conditions.

Sites with severe limitations will be restricted to fewer applications of biosolids, or a limited range of biosolids products, with greater constraints imposed by weather and soil moisture conditions.

Sites with very severe limitations are generally not suitable for biosolids application, although there may be exceptions. For example, forestry sites may have a severe slope limitation, but if other factors are not limiting, application may still be possible. Similarly, land rehabilitation sites may have slope limitations, but if they are in a confined area, it may be possible to provide measures to prevent surface run-off which would allow application to proceed, particularly since most land rehabilitation sites would require a only “one-off” application process.

A1.1 Landform Guidelines

Table A 1: Landform guidelines for biosolids application.

	Limitation			
Property	**Nil or slight**	**Moderate**	**Severe**	**Very Severe**
Slope (%) [1]	0 - 6	6 - 12	12 - 15	15 - 30
Flooding	none	rare	common	common
Landform	hill crests and concave side slopes	convex side slopes	footslopes	drainage plains and incised channels
Surface rock outcrop (%)	nil	0 - 2	2 - 10	>10

Note:
[1] Additional comments on slope limitations are detailed in Table A2.

Explanation of the most restrictive feature:

- *Increased slope* - increases risk of movement of soil or biosolids downslope.
- *Flooding* - increases risk of movement of surface applied biosolids.
- *Landform* - footslopes and drainage plains may be prone to erosion and seasonal waterlogging.
- *Surface rock outcrop* - surface rock increases the difficulty of biosolids incorporation, if required.

Table A 2: Slope guidelines for biosolids application.

Slope (%)	**Comment**
0 - 3	Ideal; no concern of run-off or erosion of biosolids.
3 - 6	Acceptable; slight risk of erosion of surface applied biosolids if heavy rain occurs soon after application.
6 - 12	Direct injection or incorporation of liquid biosolids preferred; surface application of dewatered biosolids and liquids acceptable in closed drainage basins, if there is effective run-off control, or if weather and soil conditions are not likely to cause surface run-off.
12 - 15	Surface application of liquid biosolids acceptable only with effective run-off control; incorporation of dewatered biosolids or direct injection of liquids preferred.
15 - 30	Application to forested sites with good vegetation cover and slopes less than 30% is acceptable, provided that buffers around surface waters are observed. Application to slopes exceeding 15% not recommended during wet seasons.

A1.2 Soil Quality Guidelines

Table A 3: Soil quality guidelines for biosolids application.

Property	Limitations			
	Nil or slight	**Moderate**	**Severe**	**Very Severe**
Saturated hydraulic conductivity (K_s, mm/h) of most restrictive layer in top 90 cm	moderately permeable soils (K_s 2 - 20)	slowly and highly permeable soils (K_s 0.5 - 2 or 20 - 50)	very highly permeable soils (K_s 50 - 100)	very slowly and extremely permeable soils (K_s <0.5 or >100)
Depth of seasonal high water table (cm)	>90	60 - 90	45 - 60	<45
Depth to most restrictive layer (cm)	>90	60 - 90	45 - 60	<45
Salinity (dS/m) (0 - 45 cm)	EC <2	EC 2 - 4	EC 4 - 8	EC >8
pH (0 - 10 cm) (10 - 45 cm)	 >6.5 >6.0	 5.5 - 6.5 5.0 - 6.0	 4.5 - 5.5 4.0 - 5.0	 <4.5 <4.0
Note: A test for K_s may not always be necessary, as K_s can be estimated by an experienced person. pH can be measured using a field pH kit. If pH is less than 5.0 by this method, a laboratory test should be used to obtain a more accurate result.				

Explanation of the most restrictive feature

- *Saturated hydraulic conductivity* - low or very low saturated hydraulic conductivity can lead to anaerobic conditions in the soil and increase the risk of runoff. Soils with high or extremely high saturated hydraulic conductivity may allow rapid movement of nutrients into groundwater after biosolids application.

- *Depth of seasonal high water table* - A shallow seasonal watertable may favour movement of nutrients and contaminants into groundwater.

- *Depth to bedrock or hardpan* - Risk of runoff after rainfall increases with a shallow restrictive layer. If underlying bedrock is fractured there is a risk of movement of nutrients and contaminants into the groundwater.

- *Salinity* - Biosolids application may increase salinity. At EC levels >4 many plant species will not grow. At EC >8 most plant species will not grow.

- *pH* - In general, a site is too acid if pH <4.5 (0 - 10 cm depth) or pH <4.0 (10 - 45 cm depth).

The limitations outlined above are based on the assumption that liquid or dewatered biosolids are used. Where lime amended biosolids are used, the limitations in regard to hydraulic conductivity, depth to water table and soil pH would not apply. Lime amended biosolids have low total nitrogen and are not likely to cause significant nitrate leaching. In addition, soil pH will be significantly increased by using limed materials and low pH would not be a limitation.

APPENDIX B

DETERMINATION OF MAXIMUM ALLOWABLE BIOSOLIDS APPLICATION RATE

B1 Limitations to application rate

The contaminant and nitrogen analysis data of the biosolids and the soil are used to calculate the maximum allowable biosolids application rate for a given site. The maximum allowable application rate is the lower rate of the Contaminant Limiting Application Rate, or CLAR, and the Nitrogen Limiting Application Rate, or NLAR.

- The CLAR is the rate at which biosolids can be applied without exceeding the maximum allowable concentration of contaminants in the soil (Table 7.1).

- The NLAR is the rate at which biosolids can be applied without exceeding the annual nitrogen requirements of the crop or vegetation grown on the land.

Methods for determination of available nitrogen, NLAR and CLAR are presented below.

B2 Nitrogen Limited Application Rate (NLAR)

B2.1 Calculation of Available Nitrogen in Biosolids

Because part of the nitrogen in biosolids is in organic form, it is not readily available for plant use immediately after application. The available nitrogen content of the biosolids includes the soluble nitrogen (nitrate/nitrite), ammonium nitrogen and a fraction of the organic content of the biosolids. The fraction of the organic content available will depend on the mineralisation rate in the year following application. There are a number of ways of calculating the amount of nitrogen available from biosolids, of which the following is one:

Available Nitrogen (Year 1) = ammonia N + 0.15(Total Kjeldahl N - ammonia N)

Agricultural use

The Nitrogen Limiting Application Rate, in dry solids tonnes per hectare, is based on the crop requirements and the available nitrogen content of the biosolids and the soil. The higher the available nitrogen in the soil, the lower the NLAR.

NLAR (t/ha) = Crop Requirement (kg/ha) / Available Nitrogen (kg/t)

For agricultural applications the NLAR for biosolids application rate will vary depending on the crop and the site history. Table B2 contains the indicative nitrogen and phosphorus requirements for various crops.

Table B 1: Crop and pasture nutrient requirements.

Crop or Pasture	Nitrogen (kg/ha)	Phosphorus (kg/ha)	
		Red ferrosol soils	Other soils
Barley, oats, wheat	50	25	9
Beans, poppies	60	60	21
Broccoli, cabbage, cauliflower	150	150	52
Carrots	80	100	35
Dairy pasture	0	50	18
Extensive grazing pasture	0	10	5
Onions	80	80	28
Peas	20	30	10
Potatoes	200	250	87

The values in Table B1 are only a guide. For example, grazing pastures have little need for nitrogen, but applications of up to 100 kg/ha of N can be useful in certain circumstances. The nutrient requirements of a crop or pasture are dependent upon management practices, soil and climate, and advice should be sought from an agronomist to determine the specific requirements for a given site.

Land Rehabilitation

Biosolids used for land rehabilitation are typically applied as a single application. To provide adequate nutrients and organic matter for vegetation establishment on land rehabilitation sites, the annual nutrient requirements of the particular pasture or tree species may be exceeded. The maximum total nitrogen application rate allowed on land rehabilitation sites is 1200kg N/ha, based on total Kjeldahl nitrogen as a once only application. If repeated applications are intended, the NLAR should be determined on the basis of annual nitrogen requirements.

Forestry

Nitrogen requirements vary over the life of a forest, with many factors affecting the rate of nitrogen uptake. Research indicates that biosolids application rates which apply about 350 kg/ha available nitrogen in the first year can give acceptable growth responses with negligible environmental impacts. Applying biosolids when the demand for nitrogen it as at a maximum (2-4 years after planting) is considered to maximise results. Research is continuing in other parts of Australia to determine the optimum application rate for maximising growth response while minimising environmental effects.

B3 Contaminant Limited Application Rate (CLAR)

The CLAR is the rate, in dry solids tonnes per hectare, which will cause the concentration of the limiting contaminant to reach the Maximum Allowable Soil Contaminant Concentration after application is completed.

The CLAR for a particular biosolids product at a particular site is determined by calculating the CLAR for each contaminant using the following equation:

$$CLAR = \frac{(MASCC - ASCC)}{BACC} \times SM$$

where:

CLAR	= Contaminant Limited Application Rate (dry tonnes/ha)
MASCC	= Maximum Allowable Soil Contaminant Concentration (mg/kg) (Table 7.1)
ASCC	= Actual Soil Contaminant Concentration (mg/kg) obtained from soil samples (Section 7.2, Appendix C)
BACC	= Biosolids Adjusted Contaminant Concentration (Section 4.1.2)
SM	= Incorporated Soil Mass per hectare (dry tonnes/ha)

Regardless of the method of application, it is assumed that the biosolids are incorporated into the top 7.5 cm of the soil to calculate the final soil contaminant concentration.

The CLAR for each individual contaminant can be compared by undertaking calculations in a tabulated format. The contaminant with the lowest CLAR is the limiting contaminant, and its CLAR is the maximum application rate permitted.

Table B2 gives an example of the calculation of CLAR for agricultural land using data obtained from biosolids and soil samples. The information required from sampling includes the Biosolids Adjusted Contaminant Concentration, BACC (see Section 4.1.2), and the Actual Soil Contaminant Concentrations (see Section 7.2 and Appendix C). In the example given in Table B2, copper is the limiting contaminant, giving a CLAR of 24 dry tonnes per hectare.

The NLAR for the site can be determined in a similar manner by using the average available nitrogen content of the soil and the biosolids obtained from sample analysis. Only the current analysis data are used in the case of nitrogen, with no need to include historical data. In the example in Table B2, the NLAR is 17 dry tonnes per hectare, based on the following data and assumptions:

- the nitrogen requirement of the crop (potatoes) is 200 kg/ha, which is equal to 200 mg/kg on the basis of an incorporated soil mass of 1000 t (75 cm deep by 10,000 m^2/ha).
- analyses indicate that the available nitrogen is 70 mg/kg in the soil, and 7500 mg/kg in the biosolids.

This example is consistent with frequent practice in that the application rate is usually limited by the nitrogen content of the biosolids. Although the nitrogen limiting application rate is 17 dst/ha, there is evidence which suggests that the first time biosolids is applied to a given area of land, a rate of 20 - 30 dst/ha can provide the best result in terms of improving the soil quality, which then allows better utilisation of the nutrients by growing crops.

Table B 1 Contaminant and nitrogen limited application rates - an example for agricultural land.

	Column 1	Column 2	Column 3	Column 4	Column 5
Contaminant	Maximum allowable soil contaminant concentration (mg/kg)	Existing soil contaminant concentration (mg/kg)	Capacity of soil to assimilate contaminants (mg/kg) [1]	Biosolids adjusted contaminant concentration (mg/kg) [2]	Contaminant-limited application rate (dry tonnes/ha) [3]
	from Table 7.1	from soil test	= Col (1) - Col (2)	from Sect 4.1.2	= (SM) x Col (3) / Col (4)
Arsenic	14	1	13	6.2	2097
Cadmium	0.7	0.05	0.65	4.6	141
Chromium	35	9	26	203	128
Copper	42	10	32	1349	24
Lead	105	25	80	307	261
Mercury	0.7	0.02	0.68	10	68
Nickel	42	35	7	97	72
Selenium	3.5	3	0.5	14	36
Zinc	140	40	100	1466	68
DDT/DDD/DDE	0.5	0.2	0.3	0.2	1500
Aldrin	0.02	0.01	0.01	0.1	100
Dieldrin	0.02	0.01	0.01	0.1	100
Chlordane	0.02	0.01	0.01	0.1	100
Heptachlor	0.02	0.01	0.01	0.1	100
HCB	0.02	0.01	0.01	0.1	100
Lindane	0.02	0.01	0.01	0.1	100
BHC	0.02	0.01	0.01	0.1	100
PCBs	0.3	0.1	0.2	0.2	1000
Maximum Contaminant-Limited Application Rate (dry t/ha)					**24**
Nutrient	Predicted nitrogen requirement (kg/ha)	Available nitrogen in soil (kg/ha)	Nitrogen shortfall (kg/ha) [1]	Available nitrogen in biosolids (mg/kg)	Nitrogen-limited application rate (dry tonnes/ha) [4]
	from Table A2.2	from soil test	= Col (1) - Col (2)	from biosolids analysis	= (SM) x Col (3) / Col (4)
Nitrogen	200	70	130	7500	17
Maximum Nitrogen-Limited Application Rate (dry t/ha)				**17**	

Assumptions:

Soil bulk density (dry tonnes/m^3)	1.333
Incorporation depth (m)	0.075
Incorporated soil mass, SM (dry tonnes/ha)	1000

Incorporated soil mass (dry tonnes per hectare) = soil bulk density x incorporation depth x 10,000m^2/ha.

Notes:

1. Capacity of soil to assimilate contaminants and nutrients without exceeding Column (1).
2. Biosolids Adjusted Contaminant Concentration based on mean (m) + 2 x standard deviation of historical data and current samples.
3. Contaminant limited biosolids application rate for specific site, calculated for each contaminant in dry tonnes per hectare.
4. Nitrogen limited biosolids application rate for specific site, in dry tonnes per hectare.

APPENDIX C

TAKING SOIL SAMPLES FOR ANALYSIS

Tests are required to determine the acidity or alkalinity of soil and to check whether certain contaminants are present or nutrients are required. Soils often vary considerably in chemical and physical composition over short distances, even in paddocks of apparently uniform soil. Representative soil samples are obtained by mixing soil from a sufficiently large number of locations in the paddock. The more locations that are sampled, the more reliable the analysis.

Use the following guidelines to obtain representative soil samples and prepare them for analysis:

- Avoid sampling excessive amounts of plant material with soil.
- Separate samples must be taken for different soil types and areas cropped or fertilised differently.
- Paddocks must be sampled separately.
- Each mixed sample should represent not more than 20 hectares. Larger areas should be subdivided and two or more samples submitted.
- Each sample should be a mixture of soil from at least 30 to 40 locations.
- Samples should not be taken from areas fertilised or limed within the previous three months.
- Samples should be taken from average spots or from poorer spots if they are numerous.
- Samples are best taken in a zig-zag pattern across the sample area to give an even distribution of sampling sites.
- Avoid patches of very good growth, stock camps, fence lines, dam and trough surrounds and burnt areas (such as windrows).
- Take samples using a tube sampler or spade, but not a soil auger. If a spade is used, dig a small hole with a vertical side and take a slice of soil about 20 mm thick from the surface to the appropriate depth as given in Table C1.
- Collect the samples in a clean container. Do not use old fertiliser or lime bags.
- If the sample obtained is more than 0.5 - 1.0 kg, spread it out on a clean surface, break the lumps and mix them in thoroughly. Take small portions from 20 different parts of the mixture to obtain a final sample of 0.5 - 1.0 kg.
- Place the sample in a clean container (e.g. plastic bag).
- Label all samples clearly.
- Always check with the laboratory on the requirements for sample containers and storage and shipping of samples.

Table C 1: Sampling depths for different cropping situations.

Cropping situation	Sampling Depth
Pasture	0 - 75 mm
Field crops (cereals, legumes, oilseeds)	0 - 150 mm
Orchards, vineyards and row crops	0 - 150 mm. Sub-soil samples are also required.

APPENDIX D

TREATMENT PROCESSES FOR PATHOGEN REDUCTION

Provided they are properly managed, the treatment processes listed in Table D1 will give the required degree of pathogen reduction to achieve the stabilisation grades indicated. Other processes may be acceptable, provided they can meet the relevant standards, as detailed in Tables 4.3 and 4.4 with respect to Stabilisation grade A. Liquid biosolids products have the potential for odour problems and bacterial regrowth and therefore cannot be Class 1 biosolids, even if the contaminant and stabilisation grades are both Grade A.

Table D 1: Treatment processes for pathogen reduction

Stabilisation Grade	Approved Process	Other Conditions
Grade A	*Composting In-vessel method:* The temperature of all the compost material is to be maintained >55_C for 3 continuous days.	• Biosolids to be digested prior to composting. • 30 days maturation of product required before use.
	Composting windrow method: The temperature of all the compost material is to be maintained >53_C for 5 continuous days.	• A minimum of 5 turnings of the windrow. • 30 days maturation of product required before use.
	pH and heating: pH of all the biosolids product to be raised above 12 and pH to remain >12 for a minimum of 72 continuous hours. During this 72 hour period the temperature must be >53_C for a minimum of 12 continuous hours.	• At the end of the 72 hour period, biosolids product should be air dried to a final solids content >50%.
	Heating and drying: Biosolids dried by heating particles to >80_C to achieve a final solids content of at least 90% w/w.	• Final product to be kept dry until applied.
	Long Term Storage: • Sludge is digested; • Dewatered to a solids content >17%; • Stored under aerobic conditions for >3 years.	• Product to be stored in a manner which prevents contamination.

Table D 1: (cont'd): Treatment processes for pathogen reduction

Stabilisation Grade	Approved Process	Other Conditions
Grade B	*Heating and drying:* Biosolids to be heated to 70_C for 1 hour and dried to a solids content of at least 75%.	• Final product to be kept dry until applied.
	Aerobic Thermophilic Digestion	• Aerobic conditions at 55 - 60 °C maintained for 10 continuous days. • Volatile solids reduction of at least 38% from the original.
	Anaerobic Digestion - (including anaerobic and facultative lagoons)	• 15 days at 35_C or 60 days at 15_C. • Volatile solids reduction of at least 38% from the original.
	Aerobic Digestion - (including aerated lagoons)	• 40 days at 20_C or 60 days at 15_C. • Volatile solids reduction of at least 38% from the original.
	Composting: 5 days at >40_C including 4 hours at >55_C.	• Aerobic conditions to be maintained.

Stabilisation Grade C biosolids have not been subjected to adequate stabilisation processes to allow reuse within these guidelines.

APPENDIX E

BENEFICIAL REUSE OF DOMESTIC SEPTIC TANK WASTE

E1 General

Some operators involved in the land application of septic sludge may be unable to meet all of the environmental monitoring and site assessment requirements for maximum agronomic rate biosolids applications. To allow for the continued beneficial land application of septic wastes, an alternative system of site assessment, monitoring and reporting requirements and pathogen and vector attraction reduction, has been proposed.. A standard application rate has been calculated using information obtained from a limited survey of septic tank sludge.

Tanker loads of domestic septic tank waste were analysed for nutrients, chemical contaminants and pathogens. This information was used to determine an average chemical and pathological “profile” of domestic septic tank waste.

Although the survey was somewhat limited in its extent, the results were used to determine the application rate required to provide various levels of nitrogen application. The crops to be grown on sites receiving septic sludge are restricted to those which are completely above ground, and excludes crops which may be eaten raw. The crops permitted include pastures, cereals and crops with similar growth habits.

E2 “Standard” septic sludge profile

The samples collected during the survey were analysed for a range of chemical contaminants and nutrients. Due to potentially wide variation, the “average” septic sludge chemical profile does not represent an appropriate measure on which to base application rate calculations with due consideration of health and environmental safety. Therefore, 95% and 99.9% confidence interval profiles were calculated. Working to these profiles, it is reasonable to assume that in 95% (or 99.9%) of cases, the concentrations of contaminants and nutrients would be below the levels listed in Table E1, which would allow a significant safety factor in relation to the impact of land application processes.

Table E 1: Characteristics of a "standard" septic tank sludge profile.

(All concentrations are in mg/kg unless otherwise stated.)

	Average *	upper 95 % confidence limit	upper 99.9 % confidence limit
Conductivity (dS/m)	0.66	0.9	1.0
Total solids (%)	5.30	7.2	8.5
Organic Matter (%)	2.56	3.9	4.9
pH	7.19	7.4	7.5
Nutrients			
Ammonia N	7980	10326	11919
Nitrate N	5.2	13	18
Nitrite N	1.0	1.0	1.0
Total N (Kjeldahl)	29100	37565	43312
Phosphorus (total)	7468	10752	12981
Potassium	1771	2339	2724
Contaminants			
Arsenic	2.0	3.1	3.8
Cadmium	0.9	1.2	1.4
Chromium (total)	12	16	19
Copper	222	305	362
Lead	42	64	79
Mercury	0.5	0.7	0.8
Nickel	10	12	13
Selenium	2.0	2.6	3.1
Zinc	2261	3834	4902
DDT	0.01	0.01	0.01
DDE	0.02	0.03	0.04
DDD	0.01	0.01	0.01
Total DDT analogs	0.02	0.03	0.04
Aldrin	0.01	0.01	0.01
Dieldrin	0.03	0.06	0.07
Chlordane	0.01	0.01	0.01
Heptachlor	0.01	0.01	0.01
HCB	0.01	0.01	0.01
Lindane	0.01	0.01	0.01
BHC	0.01	0.01	0.01
PCB	0.10	0.10	0.10

* Average derived from analyses of 10 septic sludge samples

On the basis of average, 95% or 99.9% confidence intervals, almost all of the contaminant concentrations are below Contamination Grade A thresholds. The exceptions are copper and zinc, for which the upper 95% and 99.9% confidence limit values are influenced by very high concentrations in three samples. However, the threat of copper and zinc contamination of agricultural soils can be significantly reduced by using a low application rate.

E3 Application rates for septic sludge

An application rate of 50 wet t/ha, using the upper 95% confidence limit "standard" sludge, would apply 22 kg/ha of available N, or 30 kg/ha based on the 99.9% confidence limit data.

This application rate assumes a return period of three years.

An application rate of 50 wet t/ha with a return period of three years should provide ample safety factor for the use of septic sludge from the perspective of contaminant and nutrient loads in soils.

E4 Site Assessment Requirements for Septic Sludge Land Application

Septic tank sludge reuse sites must fulfill all of the requirements of "Nil or Slight" limitations in Appendix A, Table A1. Depth to ground water must be determined before a site can be considered for septic sludge application. If domestic septic sludge is applied at or less than the "standard rate" (see section E3) , soil testing for contaminants and nutrients will not be required. These application rates, along with the environmental management practices and activity constraints of Section 6, will form the basis for any environmental permit, or Environment Protection Notice issued to control the activity.

E5 Septic Tank Waste Screening

Where practicable, septic tank waste should be screened to remove plastics and other non-biodegradable large solids prior to land application. The solids removed by the screening process must be disposed of at an appropriate refuse disposal site. The persons responsible for the site must remove visible litter if screening cannot be undertaken.

E6 Approved Reuse/Disposal Methods for Septic Sludge

The methods approved by DPIWE for the reuse or disposal of septic tank wastes are as follows:

1. In-ground injection
2. Surface spreading followed by incorporation
3. Disposal into a municipal wastewater treatment plant

E6.1 In-ground Injection

This procedure involves the placement of waste, at the predetermined application rate, 150 - 300mm below the ground surface. This is achieved with a purpose built tractor or truck drawn tyned implement which breaks the ground surface, injects the septic waste, and then reseals the ground surface with the use of press wheels. Further details on this procedure may be obtained from DPIWE. This procedure may require fewer restrictions on environmental management practices than the surface spreading and incorporation method.

E6.2 Surface Spreading and Incorporation

This procedure involves spreading the waste on the soil surface at the predetermined application rate. Within 36 hours, the application area must be ploughed, usually with a disk or mouldboard plough, to create an effective barrier between the septic waste and the ground surface. This serves to protect public health, prevent runoff, and begins the process of biological decomposition. The application site should be sown with the chosen crop within 2 weeks of spreading and incorporation.

Livestock must be excluded from the application area for a period of 2 months after the completion of the spreading and incorporation activities.

E6.3 Disposal into Council approved Wastewater Treatment Plant

If not being recycled for land application, septic waste may be disposed of in approved level 2 wastewater treatment plants (WWTP's). Waste transporters must secure the appropriate approvals from the local Council and establish a trade waste contract with the (WWTP) before delivery can be accepted. Many WWTP's will not accept liquid wastes without appropriate laboratory testing. If the liquid wastes are not accepted by the WWTP, then Council and the Environment and Planning Division must be contacted to arrange an appropriate disposal option.

E7 Approvals Process

1. A person who transports septic waste for fee or reward requires a waste transport business Environment Protection Notice from DPIWE.
2. A person shall not reuse or dispose of any septic wastes unless approval of DPIWE and the local planning authority (Council) is obtained.
3. The application to use or dispose of septic wastes will either be assessed by DPIWE as a "Level 2" activity (>100 tonnes/year) or by Council as "Level 1". The Environmental Impact Assessment procedure requires public advertising, and the production of an Environmental Management Plan which satisfies the requirement that the applicant provide the necessary information for DPIWE to assess the proposed activity. The Environmental Management Plan must address the environmental management and activity constraints as described in Chapter 6.

APPENDIX F

APPROVALS PROCESS FOR BIOSOLIDS REUSE ACTIVITIES

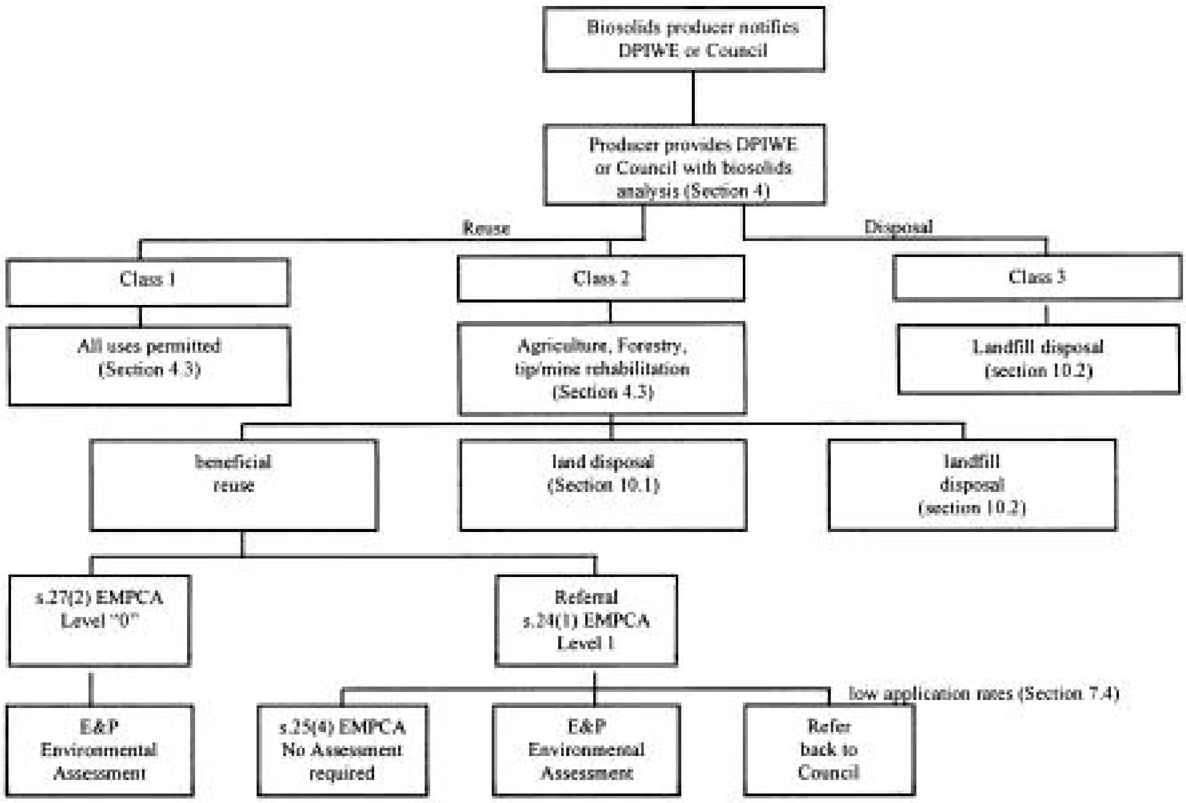


Figure F1 Approvals process for biosolids reuse activities

Local Councils are the planning authorities for all developments. They are the first point of contact when developing a proposal involving environmentally relevant activities. They will determine the level of operation of the proposal and refer development applications to the Environment and Planning Division that require environmental impact assessment. The information required to conduct the environmental assessment must be provided within the Development Proposal and Environmental Management Plan (DPEMP) for the proposal. Information required in a Biosolids DPEMP would include but not be limited to:

- Plan of land parcels and application areas
- Description of uses (Agriculture, Forestry, Rehabilitation)
- Application rates, nutrients, contaminants
- Frequency of application
- Site description –identify restrictions (Table 6.1)
- Plan of Buffer zones (Table 6.2)
- Environmental Management practices (Table 6.3)
- Monitoring/sampling regime

Costs to Proponent for Assessment of proposal:

- advertising for public comment
- EPN or Permit assessment
- Site and biosolids testing costs
- Production and publishing DPEMP

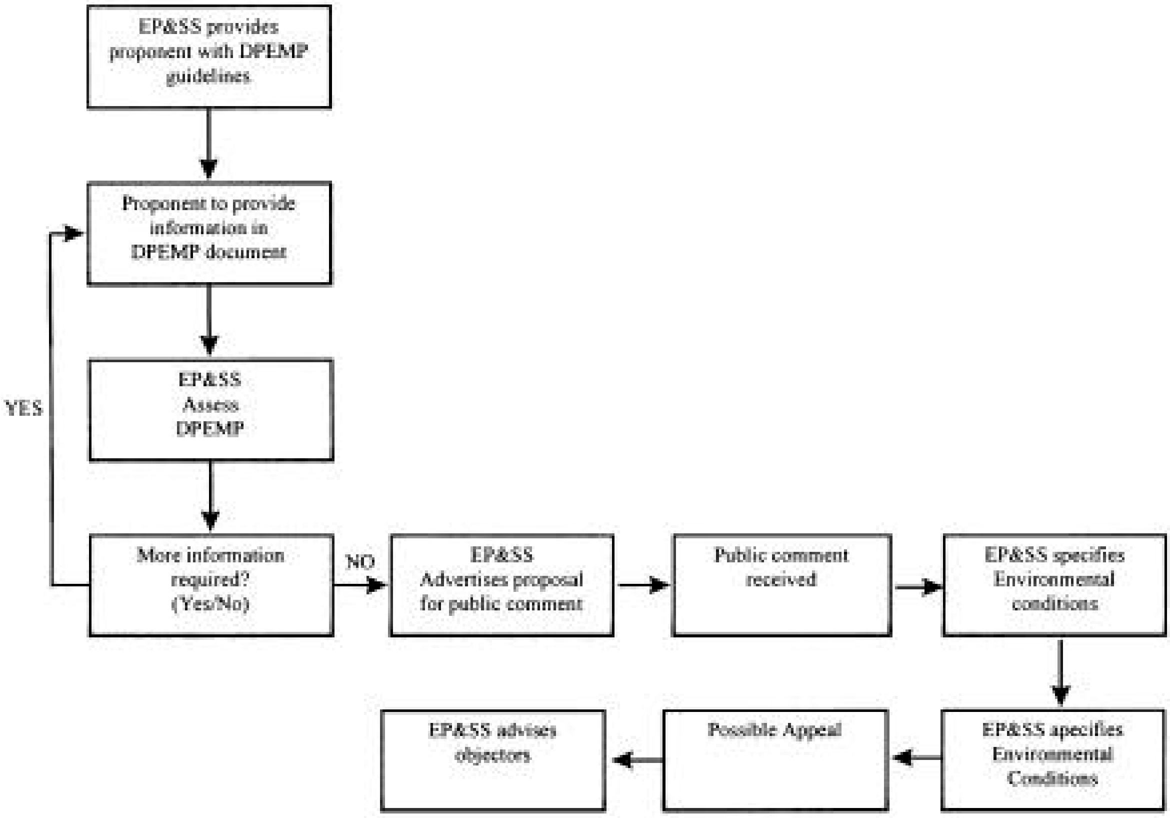


Figure F2 Environment, Planning and Scientific Services Division (EP&SS) Environmental Assessment Process

APPENDIX G

LABELLING OF BIOSOLIDS PRODUCTS

Class 1 biosolids products that are sold for domestic garden markets must meet the requirements of accepted industry standards, such as the Australian Standard for Composts, Soil Conditioners and Mulches (AS 4454-1997), and be labelled appropriately. The Department of Health and Human Services have provided the following example of the minimum requirement for labelling bags or providing information with trailer loads of biosolids products:

HEALTH WARNING
THIS PRODUCT MAY CONTAIN MICRO-ORGANISMS THAT MAY BE HARMFUL TO YOUR HEALTH.
AVOID BREATHING DUST OR MISTS FROM THIS PRODUCT.
WEAR GLOVES AND KEEP PRODUCT MOIST WHEN HANDLING
WASH HANDS IMMEDIATELY AFTER USE.
READ DETAILED LABEL ON THIS BAG.

The detailed label should convey product information and end use guidelines as detailed in AS4454 1997.

GLOSSARY OF TERMS

Actual Soil Contaminant Concentration - the concentration of each contaminant determined by analysis of soil samples.

aerobic digestion - the biochemical decomposition of organic matter in sewage sludge into carbon dioxide and water, by micro-organisms in the presence of dissolved oxygen.

agricultural land - land which is used for horticulture, growing turf, animal husbandry including the keeping or breeding of livestock, poultry or bees, and the growing of fruit, vegetables, field crops or pastures. Includes land which is currently used for agriculture or could be in the future.

anaerobic digestion - the biochemical decomposition of organic matter in sewage sludge into methane, carbon dioxide and water, by micro-organisms in the absence of dissolved oxygen.

application site - the area over which biosolids products are applied or used.

applier - person responsible for an operation which receives, transports and applies biosolids or related products on land for purposes other than domestic and public landscaping and gardening.

batch - a clearly identifiable and traceable quantity of biosolids which may be classified according to the Guidelines.

beneficial use - the use of nutrients in biosolids at or below the agronomic loading rate and/or use of the soil conditioning properties of the biosolids.

biosolids - primarily organic solid product produced by wastewater processing. Until such solids are suitable for beneficial use they are defined as *wastewater solids or sewage sludge*. The solids content of biosolids should be equal to or greater than 0.5% (w/v). Solid biosolids are defined as >17% solids.

Biosolids Adjusted Contaminant Concentration (BACC) - a statistically modified measure of contaminant concentration, based on current and historical data. The BACC must not exceed the Contaminant Acceptance Concentration Threshold for biosolids to be accepted for beneficial use.

biosolids products - material containing any component of biosolids including undiluted biosolids in the form of liquid or cake, or derived materials such as compost, lime amended biosolids or pellets.

buffer zone - an area of vegetated land between an area of biosolids application and a drainage line, creek, river or sensitive area.

bund - a wall structure, usually formed with soil, designed to retain or exclude run-off.

classification - the process of assigning biosolids products into classes based on their quality.

composting - the aerobic, biological decomposition of the organic constituents of biosolids and other organic products, under controlled conditions. The rate of composting depends upon a number of factors, including moisture content, carbon to nitrogen ratio, aeration, temperature and microbial population. Mesophilic composting takes place at temperatures below 40^{o}C, while thermophilic composting takes place at temperatures above 40^{o}C.

contaminant - metals and organochlorine pesticides occurring in biosolids and soils. Regulated contaminants are listed the Guidelines.

Contaminant Acceptance Concentration Threshold (CACT) - the contaminant concentration below which biosolids may be accepted for beneficial use.

contaminant grade - grading category used to describe the quality of a biosolids product based on the concentration of its constituent contaminants.

Contaminant Limited Application Rate (CLAR) - the maximum rate at which biosolids can be applied without exceeding the maximum allowable soil concentration of any one contaminant.

grading - process of describing biosolids products on the basis of their constituent contaminants (contaminant grade), and degree of stabilisation (stabilisation grade).

groundwater - water saturating the voids in rocks and soil.

heating and drying - treatment processes involving the application of heat to remove moisture from the biosolids to a practical limit.

incorporation - the use of one pass of a plough under favourable moisture conditions to combine biosolids into the soil.

land application - spreading of biosolids products onto the land surface or their injection below the land surface.

land disposal - application of biosolids where beneficial use is not an objective. Disposal will normally result in application at rates which exceed the nutrient requirements of crops or pastures, or the requirement for organic matter.

lime amended or lime stabilised biosolids - biosolids that have had sufficient lime added to destroy or inhibit pathogens and micro-organisms involved in the decomposition of the biosolids.

liquid biosolids - biosolids containing sufficient water (usually more than 90 per cent) to permit flow by gravity or pumping. Liquid biosolid is defined as <17% solids for the purposes of transport, and environmental management requirements, although for the purposes of pumping, solids content needs to be <~8%.

maximum allowable biosolids application rate - the maximum rate at which biosolids can be applied to a land area without exceeding the recommended maximum contaminant and nitrogen loadings of the soil.

maximum allowable soil contaminant concentration (MASCC) - the recommended maximum concentration of a contaminant in a soil.

Nitrogen Limited Application Rate (NLAR) - the maximum rate at which biosolids can be applied without exceeding the agronomic nitrogen requirements.

pathogens - disease-causing organisms. These include certain bacteria, protozoa, viruses and viable helminth ova.

permeability - the general term used to describe the ease of water movement through a soil profile.

producer - person or authority responsible for the operation of the sewage treatment plant which produces the biosolids and provides associated on-site storage facilities.

reprocessor - person or authority operating a facility which receives biosolids from a sewage treatment plant operator (producer) or other source and modifies the physical, chemical or microbiological condition of the biosolids to produce a product suitable for beneficial use.

salinity - a measure of the electrical conductivity (dS/m) of a mixture of soil and water, and is an indication of the amount of readily soluble salts in the soil. These salts, when dissolved in water, form electrical ions. While ions are a normal and essential part of a healthy soil, too many can make it difficult for plants to extract water from the soil.

saturated hydraulic conductivity (K_s - mm/h) - the rate of movement of water through saturated soil.

sensitive area - land areas which are considered to be of ecological, natural, cultural or heritage value and worthy of preservation.

sewage treatment plant (STP) or wastewater treatment plant (WWTP) - the processing facility that treats sewage and, in the process, produces biosolids, effluent and minor residuals.

sludge (sewage sludge) - solid, semi-solid or liquid residue generated during the treatment of sewage in a treatment works. When it is in a form suitable for beneficial reuse, it is now more commonly known as biosolids.

soil conditioner - a substance used to improve the physical (e.g. soil structure) or chemical (e.g. pH) properties of soil.

stabilisation - the processing of biosolids to reduce or eliminate the potential for putrefaction and thus reduce pathogens, vector attraction and offensive odours.

stabilisation grade - grading category used to describe the quality of a biosolids product based on its microbiological characteristics, vector attraction and potential to generate offensive odours.

surface land disposal - licensed and approved waste disposal area where “Class 1” or “Class 2” biosolids are applied at rates that exceed the requirements of beneficial land application or where the application has no intended beneficial use.

surface water - any river, stream, lake, lagoon, swamp, wetland, unconfined surface water, dam or tidal water. A river or stream may be perennial or intermittent, flowing in a natural channel with an established bed or in an artificially modified channel which has changed the course of the stream.

TCLP (Toxicity Characteristics Leaching Procedure) test - an analytical test used to determine the leaching characteristics of a material under standardised conditions.

vector - any insect or animal, such as flies, mosquitoes and rodents, which are attracted to the putrescible organic material in biosolids and which may spread pathogens.

volatile solids - the amount of total solids in sewage sludge lost when the sewage sludge is subject to combustion at 550^{o}C in the presence of excess air.

wastewater solids - the primarily solid organic product produced by wastewater treatment processing. These solids cease to be defined as 'wastewater solids' when they are in a suitable form for beneficial use, at which time they become known as biosolids. Also known as 'sludge'.

water table - the surface of an underground water body at which the pressure is atmospheric.