Guidelines for Beneficial Use of Organic Materials on Productive Land

Centre for Integrated Biowaste Research

Ministry for the Environment
Manatū Mō Te Taiao

MINISTRY OF HEALTH
MANATŪ HAUORA

Ministry for Primary Industries
Manatū Ahu Matua

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GUIDE

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CONTENTS

1 Introduction 1
1.1 What are Organic Materials? 1
1.1.1 Inclusions 1
1.1.2 Exclusions 1
1.2 Soil Replacement Requirements 2
1.3 Purpose of this *Guide* 2
2 What has Changed? 4
2.1 Key Changes Proposed 4
3 Overview of Proposed Requirements 5
3.1 Overview of Requirements 5
3.2 How to Use this *Guide* 6
4 Risk Management Issues 10
4.1 Source Controls 10
4.2 Managing Risks to Human Health 10
4.2.1 Risks from Pathogen Content 10
4.2.2 Risks from Metal Content 11
4.2.3 Risks from Organic Contaminants 11
4.3 Environmental Risks 11
4.3.1 Groundwater Quality 11
4.3.2 Surface Waters 11
4.3.3 Habitat and Biodiversity 12
4.3.4 Soil Organisms and Soil Fertility 12
4.3.5 Plant Health and Crop Yield 12
4.3.6 Odour Generation 12
4.3.7 Dust and Bioaerosol Generation 12
4.4 Animal Health and Production 12
4.5 Trade Risks 13
4.6 Sensitivity of the Receiving Environment 13
4.7 Soil Chemical and Physical Properties 14
4.8 Proximity to Aquifers and Surface Water Bodies 14
4.9 Presence of 'Sensitive' Areas 14
4.10 Existing Land Uses 14
4.11 Social and Cultural Considerations 15
4.11.1 Community Involvement and Public consultation 15
4.11.2 Iwi Consultation 16
5 Product Standards and Processing 18

5.1 Organic Product Standards 18
5.1.1 Organic material Grading System 18
5.1.2 Stabilisation 19
5.1.3 Contaminant Content 22
5.2 Proven Production Processes 24
5.2.1 Long Term Storage 25
5.3 Manure vs other organic material Requirements 26
6 Monitoring and Sampling Standards 27
6.1 Responsibility for Monitoring 27
6.2 Process Monitoring 27
6.3 Product Monitoring 28
6.4 Pathogen Regrowth 28
6.5 Sampling Regimes 28
6.6 Stabilisation Grade Sampling 30
6.7 Contaminant Grade Sampling 30
6.8 Soil Monitoring 30
6.8.1 Soil Sampling 31
6.9 Sampling Procedures 32
6.9.1 Grab Samples 32
6.9.2 Composite Samples 32
6.9.3 Microbiological Samples 32
6.9.4 Where to Sample 32
6.9.5 Sample Equipment 33
6.9.6 Sample Containers 34
6.9.7 Sample Preservation 34
6.9.8 Sample Transportation 35
6.9.9 Laboratory Selection 35
6.9.10 Auditing 35
6.9.11 Data Reporting 35
6.9.12 Assessment of Sample Results 36
7 Quality Assurance Requirements 37
7.1 Environmental Management Systems (EMS) 37
7.2 Site Management Plan 38
7.3 Nutrient Management Plan 38
7.4 Record Keeping 39
7.4.1 Records to be Maintained by Producers 39
7.4.2 Records to be Maintained by Storers of Organic materials 39
7.4.3 Records to be Maintained During Transfer of Organic materials 40
7.4.4 Records to be Maintained by Product Dischargers 40

7.5 Labelling Standards 40
7.5.1 Statement of Hazardous Nature 41
7.6 Health and Safety Precautions 41
8 Transportation and Storage 43
8.1 Transportation 43
8.2 Storage 43
8.2.1 Siting of Stockpiles 44
8.2.2 Fencing and Signage 44
8.2.3 Drainage 44
8.2.4 Bunding 45
8.2.5 Covering 45
8.2.6 Vector Control 45
8.2.7 Monitoring 45
9 Application to Land 46
9.1 Nitrogen Content and Application Rates 46
9.2 Pathogen Content 47
9.3 Application Strategies 47
9.4 Soil Incorporation 48
9.5 Exclusion Periods 48
9.6 Background Pathogen Level Effects 50
9.7 Soil Replacement Requirements 51
Schedule 1 Example Safety Data sheet 53
Schedule 2 Recommended Test Methods 59
References 60
Glossary 61

Table 3-1 Organic product types 5
Table 3-2 Summary requirements for production grades 7
Table 3-3 Summary of recommended management controls 8
Table 5-1 Organic material types 18
Table 5-2 Pathogen reduction processes 20
Table 5-3 Vector attraction reduction methods 21
Table 5-4 Product pathogen standards 21
Table 5-5 Product contaminant concentration limits 22
Table 5-6 Capability of common production processes 25
Table 6-1 Stabilisation grade sampling frequencies 29
Table 6-2 Contaminant grade sampling frequencies 29
Table 6-3 Summary of Soil Testing Frequencies 31
Table 6-4 Sampling points for treatment processes 33
Table 9-1 Application methods and exclusion times for type B1 and B2 products 49
Table 9-2 Product and soil replacement metal limits 51

Figure 3-1 Product Types 7

1 INTRODUCTION

This section introduces the topic and its relevance

This Good Practice Guide for the Beneficial Use of Organic Materials on Productive Land (the *Guide*) covers the application of good quality organic materials and derived products to existing soils as fertiliser and/or conditioning agents to promote a more consistent approach to the management and benefit from using these materials throughout New Zealand. The quality criteria within this *Guide* are not a replacement soil specification.

1.1 WHAT ARE ORGANIC MATERIALS?

1.1.1 INCLUSIONS

This *Guide* applies to products made from organic materials or mixtures of organic materials that have been processed to make them safe for further use. The product quality and management of these materials should fully conform to the requirements of this *Guide*. Raw organic materials, often a waste product from other activities, which are suitable to make these products include:

- household organic wastes (food waste, green waste)
- paper and cardboard
- organic wastes from the secondary sector, such as meatworks wastes
- dead stock that do not pose a biosecurity risk
- manures
- sewage sludge
- pulp and paper waste
- biodegradable nappies and sanitary items

Such products will have notable fertilising and soil conditioning properties as a result of their nutrient and organic content. They also contain organic matter (carbon), which improves soil structure, water storage and microbial health.

The product inclusions for this guide are not determined by the amount of liquid contained within the products. It is acknowledged that different industries use their own definitions and names for different concentrations of their wastes e.g. typical Dairy industry terminology considers anything less than 5% suspended solids to be a liquid and 5-15% solids to be a slurry, whereas for piggeries a slurry is 10-20% solids and the wastewater industry considers anything with more than a few hundred mg/L of suspended solids to be a sludge. This Guide relates to all organic materials and derived products with applicable concentration limits and mass loading applications to productive land, regardless of whether it is called effluent, sludge, slurry or solid.

1.1.2 EXCLUSIONS

This *Guide* does not apply to home products for self-use, nor does it apply to liquid seaweed products, non-organic mulches, non-organic soils or soil conditioners and non-compostable materials e.g. plastics. However management principles within this guide may be usefully adapted to the home environment.

Farm Dairy Effluent (FDE) is not covered by this *Guide*. The responsible management of FDE is well understood, its discharge is regulated by regional councils under the Resource Management Act and, in addition, there are a number of good management practice guidelines available from the Dairy NZ website (http://www.dairynz.co.nz/).

Only healthy animal wastes can be recycled. If there is an incidence of disease outbreak then recycling of associated material must stop and the facility controlled in accordance with the Biosecurity Act.

Irrigation of dilute effluents with concentrations below those in this *Guide* are also excluded.

1.2 SOIL REPLACEMENT REQUIREMENTS

This *Guide* does not provide a specification for replacement soil:

- For the urban, commercial, industrial and rural residential areas refer the Ministry for the Environment National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, April 2012, publication reference number: ME1092. Refer http://www.mfe.govt.nz/publications/

- For rural non-residential areas (agricultural land) refer Envirolink Tools Grant: C09X1402. Refer http://www.envirolink.govt.nz/envirolink-tools/. Which developed selective soil guideline values developed to protect terrestrial biota (Eco-SGVs).

However this *Guide* recommends the following protocols for the situation where organic products are used as a complete soil replacement:

- **In the rural environment**; the product should meet the *Guide* product concentration limits and the nitrogen application limits based on the land type i.e. 'ordinary' or degraded. The soil concentrations should be measured before and after to ensure that the Eco-SGV limits are maintained, except for contaminated land where the resultant soil values could be higher.

- **In the urban environment**; the product concentration should meet the Eco-SQV concentrations except for Zn. Data shows that green waste and food waste Zn concentrations are around 300ppm. The Eco-SQV limit for Zn is only 190ppm. This would limit the application of home compost being applied to home gardens. The 300ppm comes from the soil limits in the 2003 Biosolids Guidelines which is considered more appropriate. Data suggests there will be no issue with the other metal limits in the Eco-SQVs.

Currently there are no Eco-SGV soil limits for Hg or Ni and the soil limits of 1ppm Hg and 60ppm Ni in the Guidelines for the Safe Application of Biosolids to Land in New Zealand, 2003 should be used (Table 9-2).

1.3 PURPOSE OF THIS *GUIDE*

The *Guide* contains information and recommendations to assist producers, applicators and consent authorities gain the benefits of applying good quality organic material to land to increase soil fertility and productivity.

More specifically, the *Guide* is aimed at:

- safeguarding the life-supporting capacity of soils;
- promoting the sustainable and responsible use of all organic materials;
- protecting public health and the environment;
- identifying the risks associated with use of these products and promoting best practice methods for minimising such risks;
- providing a consistent approach to regulating the application of organic waste materials to land;
- creating an awareness within the community of the benefits and risks of this practice; and

- minimising risks to the economy.

The *Guide* supersedes Guidelines for the Safe Application of Biosolids to Land in New Zealand, 2003 and its reference in NZS 4454:2005, Composts, Soil conditioners and Mulches. Useful background material from the guidelines, plus recent research reports and advice have been retained for reference within the companion Technical Manual to this *Guide*.

The change in scope of this *Guide* from the 2003 NZ Biosolids Guidelines recognises that all wastes of animal origin, whether human or otherwise, contain similar levels of pathogens, trace elements and organic contaminants and therefore pose similar risks to productive soils and society. We should manage those risks in a similar manner.

A fundamental premise of the *Guide* is that a wide range of organic materials can be beneficially recycled to land, providing that both the process of product manufacture and the process of applying the material to land are subject to adequate management control, and providing the organic material is applied at a rate that does not exceed the agronomic nitrogen requirements of crops.

This *Guide* provides both rules and practical guidance to ensure that these benefits can be realised.

These documents comprise a Guide rather than a Standard since it is not part of statute law and compliance is therefore not mandatory. Other titles were considered but Guide is consistent with its predecessors and national guidance is what it provides. Given the demonstrated central and local government and extensive industry support, it is expected that all New Zealand councils will use this guidance consistently and integrate the good practice into their district and regional plans and resource consents with industry acceptance and support. It will therefore become national good practice.

This *Guide* is intended to be a 'living document'. It is based on current knowledge about the use of organic matter in New Zealand and overseas, and will be regularly reviewed in the light of future research findings and management experiences. Reviews are intended to be undertaken by representatives of the current Steering Group organisations, led by Water New Zealand on a 5 yearly basis. Selective updates based on the latest science may be issued without prior consultation.

2 WHAT HAS CHANGED?

2.1 KEY CHANGES PROPOSED

Key changes to the 2003 Biosolids Guidelines can be summarised as:

- It is no longer limited to biosolids; it includes other organic waste materials, particularly from animals (Refer 1.1.1);
- There is a simpler grading system; no change to pathogen grading requirements but only a compliance level for contaminant grading (Table 3-1);
- Metal contaminant limits are the 2003 Biosolids Guidelines 'b' grade limits and are used as a minimum product quality criteria (Table 5-5);
- Only measure emerging organic contaminants, not historical banned substances e.g. Dioxins;
- Organic contaminant limits are related to existing EU guidance. There is limited New Zealand supporting data. It is recommended that the appropriate ministries work together to create a New Zealand database to allow derivation of New Zealand based guidance;
- No mass application limits. Given this situation it is recommended that the appropriate ministries work together to create a New Zealand database to allow derivation of New Zealand based guidance;
- Nitrogen limits are used as the primary land application control; assessments have shown this to be an effective means of limiting contaminant applications for good quality products and safeguarding our soils (Refer 9.1);
- Excludes a soil specification, this is dealt with by other guidance. However the Guide does include a recommended protocol should the products be used as a soil replacement (Refer 9.7);
- Manure management controls are similar to current good farming practices with additional measurement and documentation encouraged but not mandatory.

3 OVERVIEW OF PROPOSED REQUIREMENTS

This section gives an overview of the *Guide* requirements and where to find specific information

3.1 OVERVIEW OF REQUIREMENTS

The *Guide* covers the beneficial application of a wide range of organic materials to productive land. In summary the key issues are:

- The organic materials themselves, or the products derived from them, are classified according to their stabilisation and contaminant grades as follows:

Table 3-1 Organic product types

Type	Stabilisation Grade	Contaminant Grade
A1	A	Compliant
B1	B	Compliant
A2	A	Non-compliant
B2	B	Non-compliant

Grade A is considered essentially pathogen free and Grade B contains pathogens (refer Table 5-4).

Organic products that contain any contaminant at a concentration greater than the specified limit are non-compliant (refer Table 5-5).

Nitrogen loading is the primary limit on organic product application to land and is supported by product concentration limits and soil Eco-SGVs should soil replacement occur (refer 9.1 and 9.7):

- For the continual application of organic materials on productive land the nitrogen application rate should not exceed an average of 200 Kg total N/Ha/year over up to two years, based on evidence that the organic nitrogen present in the product is eventually mineralised. Additional applications should be based on a location specific site and crop assessment.
- Organic materials application to rebuild degraded soil or to refurbish contaminated land should be limited to a one-off nitrogen application of 150 kg mineral N/Ha. For most product applications this will be greater than that for productive land.

Given that nitrogen loading is the primary means of limiting the amount of contaminants applied to land, there need not (theoretically) be a maximum contaminant concentration. However, a maximum contaminant concentration is required for management controls and to reinforce the differentiation between a quality organic product and an unknown or non-compliant waste material.

It is envisaged that stabilisation Grade A organic product which is compliant for contaminants (Type A1) would have a Permitted Activity planning control and Grade B material which is also compliant for contaminants (Type B1) would have a Controlled Activity planning control if applied according to

the requirements of this *Guide*. Grade A or B material which is non-compliant for contaminants (Type A2, B2) should be reused under a specific discretionary resource consent or safely disposed of.

Soil incorporation is preferred but not required for:

- discharges of Type A1 organic products;
- application of manures, and
- any organic product application into forestry.
- Incorporation is required for Types B1 and B2 organic products.

Manures are not subject to the same sampling, analysis and QA requirements as other organic materials, including biosolids products Refer section 5.3 .

Specific details on how to achieve these requirements are given as follows:

- product standards, (section 5)
- monitoring and sampling standards (section 6)
- quality assurance (section 7)
- management of transportation and storage risks (section 8) and
- land application management practices including exclusion periods (section 9).

Many of these details are the same as contained in the 2003 Biosolids Guidelines.

3.2 HOW TO USE THIS *GUIDE*

The *Guide* comprises two volumes:

- Volume 1 *Guide* (this document), which provides guidance on how to safely use organic materials and derived organic products and discusses management issues and the recommended grading and management framework; and

- Volume 2 Technical Manual, which provides detailed information about how the limit values were decided, the current regulatory framework, how to implement some of the recommendations in the *Guide* and selected technical information from Volume 2 of the 2003 New Zealand Biosolids Guidelines for historical reference.

Some information in Volume 1 *Guide* has been taken directly from the 2003 Biosolids Guidelines and therefore is not repeated within Volume 2 Technical Manual.

Figure 1 indicates whether the product is a manure, biosolid or non-biosolid organic product according to the raw materials used for its production.

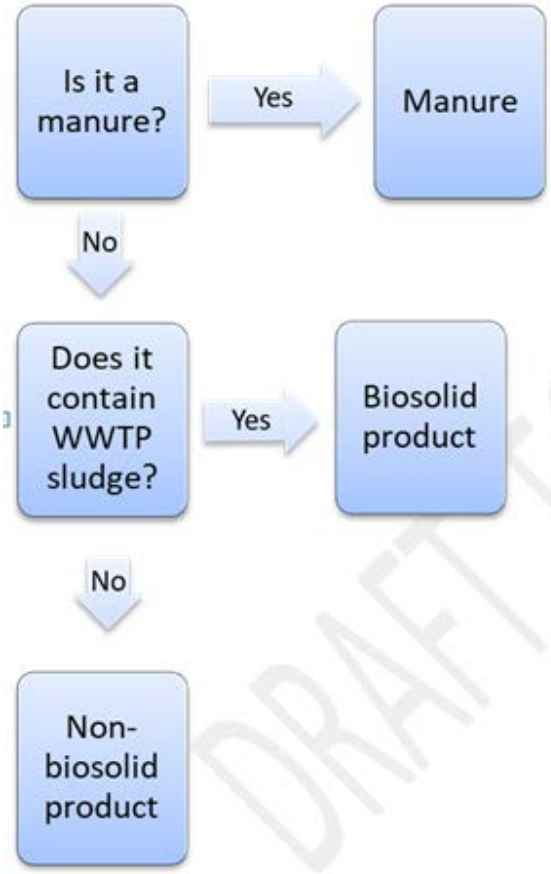


Figure 3-1 Product Types

The following questions indicate which sections of the *Guide* contain the key answers.

Q1. What grade will my product be? Refer 5.1.

Q2. Who is responsible for product sampling and testing? Refer 6.1.

Q3. Who is responsible for application site sampling and testing? Refer 6.1.

Q4. What quality controls and documentation are recommended and who is responsible for them? Refer 7.2, 7.4.

Q5. How do I determine a suitable product application rate for my productive land and method of application? Refer 7.3, 9.1, 9.3.

The following tables indicate key sections that provide requirement details for each specific grade of product and application.

Table 3-2 Summary requirements for production grades

Requirement	Material Grade			Text reference
	A	B	Non-compliant	
Pathogen reduction	✓	✓	**X**	Table 5-3 & Table 5-4, section 5.1.2.1

Requirement	Material Grade			Text reference
	A	B	Non-compliant	
Vector Attraction Reduction (VAR)	✓	✓	✓	Table 5-3 & Table 5-6
Contaminant limits:				
▪ pathogens	✓	X	X	Table 5-4
▪ metals	✓	✓	X	Table 5-5
▪ organics	✓	✓	X	Table 5-5
Process monitoring	✓	✓	X	Table 5-3 & Table 6-2
Product monitoring	✓	✓	✓	Table 6-1 &Table 6-2, section 6.3
Quality assurance	✓	✓	✓	Section 7
Labelling	✓	✓	✓	Section 7.5
Record keeping	✓	✓	✓	Section 7.4

Table 3-3 Summary of recommended management controls

Requirement	Material Grade			Text reference
	A	B	Non-compliant	
Process monitoring	✓	✓	X	Table 5-3 & 6.2
Product monitoring	✓	✓	✓	Table 6-1, Table 6-2, Table 6-4
Transportation	X	✓	✓	Section 8.1, Schedule 1 Example Safety Data sheet
Vector Attraction Reduction (VAR)	✓	✓	✓	Table 5-3
Storage	X	✓	✓	Section 8.2
N application rate	✓	✓	✓	Sections 3.1, 9.1
Soil incorporation	✓	✓	✓	Section 9.4
Exclusion periods	X	✓	✓	Section 0, Table 9-1
Soil monitoring	✓	✓	✓	Section 6.8

Requirement	Material Grade			Text reference
	A	B	Non-compliant	
Labelling	✓	✓	✓	Section 7.5
Record keeping	✓	✓	✓	Section 7.4
Environmental management system	✓	✓	✓	Section 7.1
Site management plan	✓	✓	✓	Section 7.2
Nutrient Management Plan	✓	✓	✓	Section 7.3

4 RISK MANAGEMENT ISSUES

This section summarises how to manage and mitigate risks

Any proposal to apply organic materials or derived products to land must address a number of issues in order to ensure that the potential public health and environmental risks are well managed. Adherence to this *Guide* ensures that risks are appropriately recognised, assessed and managed, as summarised below.

Further information in support of this section may be found in the following Volume 2 Technical Manual sections:

- **2.1 Sources of Contaminants**
- **2.2 Risk Assessment**
- **2.3 Soil Characteristics**
- **3.2 Resource Management Act**
- **7 Consultation Resources**

Risks affecting organisations can have consequences in terms of economic performance and professional reputation, as well as environmental, safety and societal outcomes. Therefore, managing risk effectively helps organisations to perform well in an environment full of uncertainty. Suitable methodologies for assessing and managing risks include:

- AS/NZS ISO 31000:2009 Risk management - Principles and guidelines (the Standard)
- SA/SNZ HB 436:2013 Risk management guidelines - Companion to AS/NZS ISO 31000:2009

4.1 SOURCE CONTROLS

Contaminant levels in organic materials and derived products are determined by the inherent contaminant levels in the raw materials processed. Source controls are important in managing and limiting the amounts of these contaminants.

For livestock and poultry manure, practices include feed and bedding management as well as control over veterinary medicines. Each industry has issued good advice on these issues.

For biosolids they include enforcement of trade waste bylaws based on NZS 9201.23:2004 Model general bylaws - Trade waste, or similar,

Refer Volume 2 Technical Manual section 2.1.

4.2 MANAGING RISKS TO HUMAN HEALTH

4.2.1 RISKS FROM PATHOGEN CONTENT

Grade A organic products have been treated to the point where they are deemed safe for use by the general public and they are essentially free of pathogens and there is a very low risk to people handling them. However, organic products that do not attain the required stabilisation Grade A standards, potentially contain pathogens at infectious levels, so they cannot be sold or given away direct to the public and the associated risks need to be managed by:

- employing appropriate pathogen-killing techniques during a production process
- taking precautions with handling the material
- the careful choice of end use
- temporary exclusion of people from areas where Type B1 and B2 organic materials have been applied.

4.2.2 RISKS FROM METAL CONTENT

The main metals potentially contained in organic materials and of concern to human health are cadmium, lead and mercury. The direct ingestion of material by children is the most critical pathway of exposure to cadmium, lead and mercury, with the greatest risk being for domestic gardens. Neither lead nor mercury are taken up to any extent by crops and consequently do not pose a risk through the dietary intake of plant foods.

Cadmium can accumulate in crops, however, in practice, humans are largely protected from organic material-related cadmium toxicity because the high ratio of zinc to cadmium in most organic materials inhibits the uptake of cadmium in plants.

4.2.3 RISKS FROM ORGANIC CONTAMINANTS

Human exposure to organic pollutants is primarily via the food chain, especially from the accumulation of contaminants in the body fat of grazing animals. The main risk arises from surface-applied organic material adhering to grass and being directly ingested by grazing animals.

Exposure to organic contaminants can be managed by minimising the soil-grazing animal exposure pathway, for example by ensuring that applied materials are thoroughly incorporated into the soil in situations where animals are to be grazed or by using an appropriate withholding period (Table 9-1).

4.3 ENVIRONMENTAL RISKS

4.3.1 GROUNDWATER QUALITY

The leaching of nutrients, metals or organic substances from organic material into groundwater is the main risk posed to groundwater by the application of organic material to land.

The key to both minimising the risk of nitrate leaching and the efficient use of organic material is to match application rates as closely as possible to the agronomic nutrient needs of crops. Nitrogen leaching can also be reduced by applying organic products at or as close to the time when maximum crop growth and nitrogen uptake occur.

Metals are unlikely to move through the soil and into groundwater because of the binding mechanisms in soil. However, some movement may occur through acidic, sandy soils under conditions of high organic product application, coupled with either irrigation or high rainfall.

The contaminants covered by this *Guide* are less likely to move from organic product to groundwater because of the low water solubility and binding properties of the soil for many contaminants.

4.3.2 SURFACE WATERS

Risks to surface water are similar to those for groundwater, with the additional risk of applied organic material being eroded from sloping land into watercourses if placed too close to them. Risks to surface waters can be managed by ensuring that applied organic material is not spread too close to watercourses, on waterlogged or steeply sloping land, or during periods of heavy rainfall.

4.3.3 HABITAT AND BIODIVERSITY

It is inappropriate to apply organic material to areas where there is a risk of altering important natural habitat values; for example, in native bush reserves, wetlands, or in habitats of rare or endangered species. The increased level of nutrients resulting from the applications of organic material may affect native plant communities that have adapted to soils of low fertility.

4.3.4 SOIL ORGANISMS AND SOIL FERTILITY

It is unlikely that contaminants in organic material will impair the fertility of agricultural soils if applications to land follow this *Guide*. Evidence to-date has shown that limiting the nitrogen loadings is a practical control (refer Volume 2 - Technical Manual section 5).

4.3.5 PLANT HEALTH AND CROP YIELD

Organic materials and derived products are generally applied to soils to enhance plant health and/or crop yield. Some constituents of these organic products can, however, have the opposite effect if applied in excessive quantities. Metals are generally more mobile in acid soils (pH<5.5) and in sandy soils due to the relative lack of clays and organic matter, which act to bind metals, which can affect soil health and yield.

Cadmium, while not apparently phytotoxic, can accumulate in plant tissues and present a potential health concern to humans and/or grazing animals. The levels given for cadmium in this *Guide* are designed to prevent this from occurring.

4.3.6 ODOUR GENERATION

The risk of odour generation from organic material after application can be minimised by selecting an appropriate product manufacturing process, quality control, appropriate choice of vector attraction reduction (VAR) method and land application method, and by soil incorporation. Grade A organic products should generate limited odour having met the Grade A stabilisation requirements.

There may also be specific rules around odour, odour management plans and incident reporting logs within the local regional plan.

4.3.7 DUST AND BIOAEROSOL GENERATION

Operations should be managed to avoid dust emission beyond the production premises or boundary of land application. Dust can occur during storage, grinding, mixing, screening, transport and spreading of all materials and products. Dust suppression such as covering dusty materials or applying a light water spray, and enclosing fixed mechanical equipment used to process raw and finished materials should be considered.

Bio-aerosols are air-borne particulates or liquid droplets that may contain bacteria, fungi spores, pathogens or other microorganisms. Bioaerosols may be generated during the movement or agitation of materials at any stage of the operations. The generation and dispersion of bio-aerosols should be minimised by appropriate handling and dust control procedures, including use of buffer zones and a cease of practices on particularly windy days.

Dust and bioaerosols controls should be considered within odour management plans.

4.4 ANIMAL HEALTH AND PRODUCTION

The direct ingestion of organic material-treated soil is widely considered to be the principal risk to grazing livestock from application of such material. Animals may ingest contaminants by consuming

plants that contain elevated concentrations of contaminants, or by ingestion of the soil and organic material itself. To reduce the ingestion of contaminants by grazing livestock, human waste derived products (biosolids) should be incorporated into the soil when pastures are re-sown, and withholding periods are required before allowing grazing animals on biosolids-treated land (Table 9-1).

This is not as necessary for animal manures but is still good practice and agricultural guides commonly recommend that animals are not grazed on land or vegetation visibly contaminated with manure. There are also other reasons for stock withholding periods. For example a withholding period for stock consuming crops grown on meat processing waste is used in order to meet both the Biosecurity (Ruminant Protein) Regulations 1999 and NZ Code of Practice for the Design and Operation of Farm Dairies (NZCP1).

4.5 TRADE RISKS

There are potential risks to domestic and international trade as a result of applying any organic materials, and particularly biosolids, to food-producing land. Mitigating the potential for residues to transfer to export produce is key to managing these risks. Methods may include soil incorporation, soil pH control, stock exclusion periods, and avoiding application to leaf or salad crops. Following the requirements of this *Guide* incorporates many accepted international practices and therefore should give international markets the assurance they require that there is an effective process in place for the management of soil health and subsequent crops.

Market tolerances for biosolid use may vary widely on both scientific and societal/cultural grounds and should be identified before applying to any land producing food for export.

4.6 SENSITIVITY OF THE RECEIVING ENVIRONMENT

Regard must be given to the sensitivity of the proposed receiving environment to adverse effects. Organic material and derived products (regardless of grade) should not be applied to land that is:

- frozen solid (or <4°C);
- waterlogged;
- under snow;
- sloping steeply (e.g. slopes greater than 15%);
- in close proximity (typically minimum 20 metres) to any waterbody; and
- measured as having a pH of less than 5.5.

Matters relating to the sensitivity of the receiving environment, and hence to the nature and magnitude of environmental effects, should also include:

- soil chemical and physical properties;
- soil pH;
- depth and proximity of local aquifers;
- slope of land and proximity of surface water bodies;
- presence/absence of sensitive areas such as sensitive plant habitats;
- existing land use(s); and
- social and cultural considerations e.g. the proximity of neighbours/dwellings, schools, hospitals and the presence of wahi tapu

Many of these issues may be prescribed in detail within the local regional plan.

4.7 SOIL CHEMICAL AND PHYSICAL PROPERTIES

Soil chemical and physical properties determine the suitability of a soil to receive organic materials and soils vary greatly in their ability to sustain and benefit from the application of such products.

It is good practice to test soils prior to determining the suitability of a site for bulk (>50 m^3) application of all organic material and derived products.

Soils that are high in oxide (iron, aluminium, manganese), clay and organic matter, and have a high pH, generally have a greater contaminant retention capacity. The cation exchange capacity of the soil provides a useful estimate of metal retention capacity. Maintaining the pH value of organic product treated agricultural soils above pH 5.5 minimises the risk of phyto-toxicity or excessive metal uptake by crops. Soils tend to become more acid with time so regular pH monitoring of organic product amended soils should be carried out.

Some forestry soils are naturally acidic, with pH values of less than 5. Applying organic products to forestry soils under low pH conditions may be acceptable in some circumstances, as food crops are not involved and therefore plant uptake of metals is not a health concern. The drainage regime of forest soils and the depth and proximity of local aquifers are important considerations.

4.8 PROXIMITY TO AQUIFERS AND SURFACE WATER BODIES

If specified organic product application rates are followed and soil pH is maintained, groundwater contamination is unlikely. In some situations however, the potential for leaching of contaminants, including nitrogen, may become an issue. Information on the depth and proximity of local aquifers, location of bores, along with information on the soil drainage characteristics and pH should be used to provide an overall assessment of the likelihood of groundwater contamination.

The slope and the proximity of the discharge site to waterbodies or the coastal marine area are important considerations. This *Guide* contains protocols to mitigate the risk of contaminating surface waters by prohibiting the discharge of organic materials to land where there is a possibility of the material entering water, e.g. within at least 20 metres from a river, lake, wetland, artificial water course or the coastal marine area or as prescribed by the local regional plan.

4.9 PRESENCE OF 'SENSITIVE' AREAS

Organic materials and derived products, particularly those containing biosolids, should not be applied within, or in the vicinity of sensitive areas such as wahi tapu (sacred places), archaeological sites, urupā (burial sites), potable water sources, locations associated with wild-food harvest or resource collection, wildlife habitats, areas of importance from a biodiversity perspective and sites that support community recreational, social or Māori cultural activities.

4.10 EXISTING LAND USES

When selecting a site it is important that specific regard is given to the existing land uses (e.g., agriculture, forestry, public recreation or Māori cultural use) of adjacent land. Land use influences land application costs, risk management considerations (e.g., soil pH trends and/or the ability to lime, plus the ability to incorporate organic materials within soil), permissible loading rates (if leaching is a potential issue), public health risks (exposure pathways) and the likely degree of local opposition to a proposal. While the existing land use can influence these factors, the primary concern should be with the risk profile of the site (its sensitivity), and whether or not the risks can be adequately managed.

4.11 SOCIAL AND CULTURAL CONSIDERATIONS

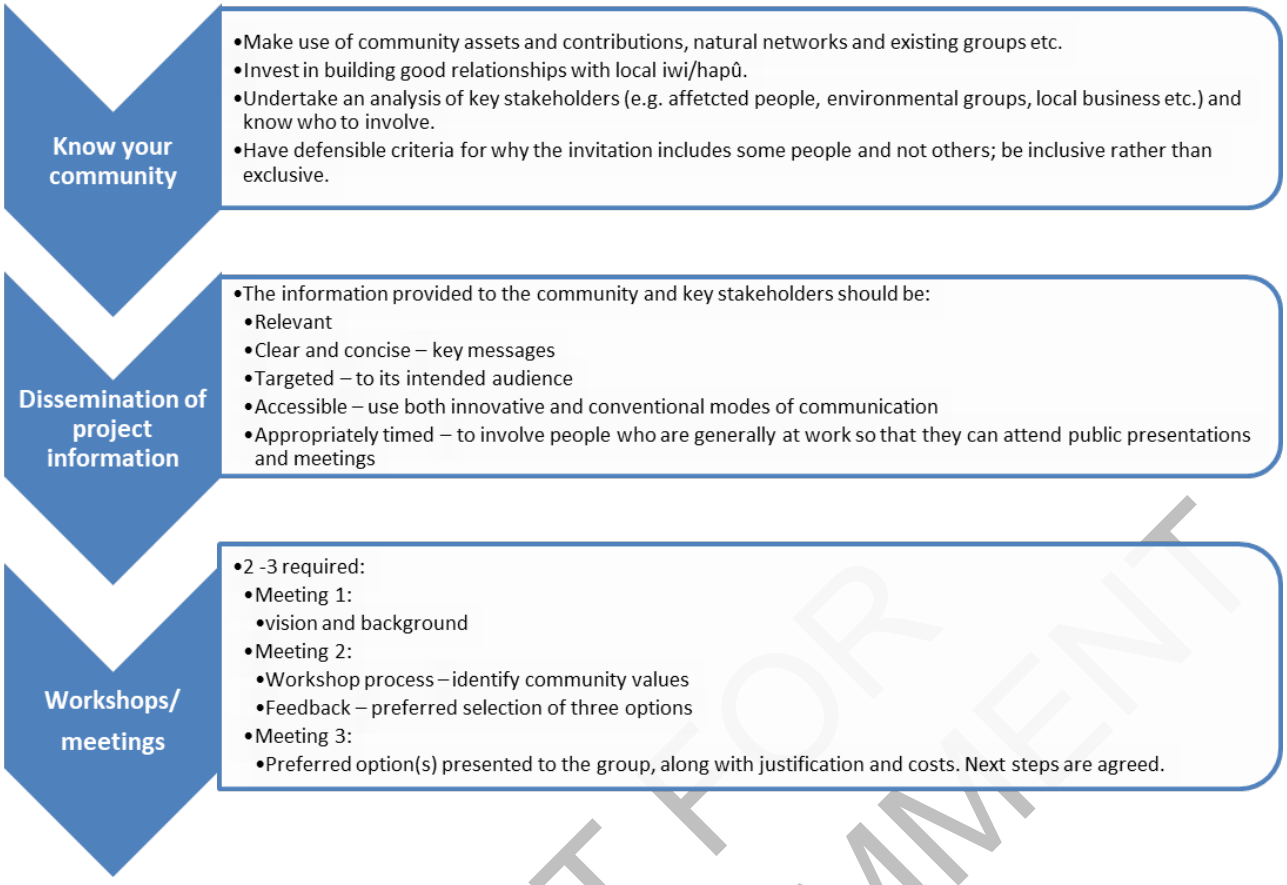
4.11.1 COMMUNITY INVOLVEMENT AND PUBLIC CONSULTATION

The sensitivity of the receiving environment extends beyond bio-physical matters to include social and cultural considerations, such as the proximity of neighbours/dwellings, the presence of 'sensitive areas', existing public use, access to the proposed land application area or adjacent areas and existing traffic movements in the area. Such considerations are all relevant to site selection, effects assessment and/or the conditions that should be applied to a resource consent.

Local communities are increasingly demanding more involvement in decision-making processes. Whilst environmental management issues can be taken for granted by communities, such issues do tend to raise concern and alarm where changes are proposed, and/or where the public perceives that the processes are not open or transparent. The Resource Management Act (RMA) 1991 consultation process provides an opportunity to proactively involve the community, identify any likely adverse impacts and address concerns. Community Involvement and Public Consultation

Stakeholder and wider community consultation is recommended, but not mandatory for RMA consenting. The Local Government Act 2002 recommends consultation when making decisions on behalf of the community. In addition, the Treaty of Waitangi 1840 guides partnerships with iwi for environmental management.

RMA resource consents may be straightforward, but the process can become contentious when neighbours or other stakeholders have conflicting views or values; or when environmental groups, recreational or customary land users contest a decision. Approaches that recognise, prioritise and balance environmental, cultural, social and economic criteria (or the quadruple bottom line (QBL)) in decision making facilitate a greater understanding of 'community' values. Considering how a possible 'technical' solution might impact upon these values, and negotiating changes or alignments may lead to new opportunities and solutions and will ensure an approach that is viable, robust and justifiable. Some of the essential steps to engage with the community from knowing your community through to holding community workshops and meetings are outlined below with further information on community consultation frameworks available within Volume 2 - Technical Manual section 6 and the CIBR/LEI Community Engagement Framework for biowastes, CIBR Report No. 16-02 (Baker et al., 2016).



4.11.2 IWI CONSULTATION

Māori are both a Treaty partner and key stakeholder for issues relating to environmental management. This duality of interest underpins a desire to be meaningfully involved in environmental decision-making that is founded on expectations as a Treaty partner and inherent obligations as kaitiaki of their local environments.

Local Government, who have delegated authority from Central Government for decision-making, are required under the Local Government Act (2002) to recognise and respect the Crown's obligations under the Treaty of Waitangi. This effectively obligates councils to consider all reasonable steps to encourage and assist Māori to participate in local affairs. However, it does not over-ride the requirements on councils specified under other statutes, like the RMA, the Historic Places Act (1993) and the Biosecurity Act (1993), that each have their own requirements for councils to consult with Māori.

Complying with the Treaty clauses requires local government to have robust relationships with relevant mana whenua organisations that are predicated on long-term partnerships, equity, transparent two-way communication and an ability to compromise when there are divergent views. This is particularly relevant for the management of organic materials, particularly those that contain human wastes and chemical contaminants. Materials of this nature create unique challenges from a Māori cultural perspective, and meaningful engagement is required in order to reach sustainable solutions.

Best practice requires that Māori tribal authorities within whose rohe (tribal district/area) the application site is situated should be consulted, at least, for biosolids management. The RMA does not explicitly require consultation for a resource consent application with anyone, including Māori, unless this is required under other legislation. In practice, there are requirements of the RMA, specifically sections 6(e) and 7(a) that cannot be met without consultation.

Achieving these conditions also provides collaborative opportunities where unique management solutions to organic products can be developed that consider and incorporate local Māori cultural knowledge and perspectives alongside scientific and technical information. These collaborative approaches create tailored solutions that are more likely to be sustainable in the long-term and ultimately more cost effective.

There are some locations or sites at which the application of wastes of human origin, including biosolids, is unacceptable to Māori, regardless of grade. Potential issues in relation to the application of organic products to land include, but are not restricted to:

- potential for contamination of food sources;
- proximity to sites of food preparation, harvesting and processing;
- potential contamination of water bodies;
- the need for potential mitigation measures (e.g., riparian planting);
- avoiding applying biosolids on, or in the vicinity of wāhi tapu;
- potential constraints on future land-uses as a consequence of biosolids applications (e.g., land subject to Treaty of Waitangi claims); and
- monitoring requirements.

5 PRODUCT STANDARDS AND PROCESSING

This section introduces a system for product standards and how they can be achieved

A simple grading system has been developed to differentiate between organic products that are of sufficiently high quality that they can be beneficially applied to land with a minimum of regulation (unrestricted use), from products that are of lower quality and whose application to land therefore needs to be subject to site-specific management controls (restricted use).

The system provides for material type based on a product:

- Stabilisation grade (which depends on pathogen content, and whether or not an approved pathogen reduction procedure and an approved vector attraction reduction method have been implemented)
- Contaminant grade (which depends on the levels of metals and organic contaminants).

Further information in support of this section may be found in the following Volume 2 Technical Manual sections:

- **2.4 Soil Contaminant Limits**
- **2.5 Stabilisation Issues**
- **4 Pathogens Review**
- **5 Trace Elements Review**
- **6 Organic Contaminants Review**

5.1 ORGANIC PRODUCT STANDARDS

5.1.1 ORGANIC MATERIAL GRADING SYSTEM

Organic products are classified as material types according to their stabilisation and contaminant grades as follows:

Table 5-1 Organic material types

Type	Stabilisation Grade	Contaminant Grade
A1	A	Compliant
B1	B	Compliant
A2	A	Non-compliant
B2	B	Non-compliant

It is envisaged that stabilisation Grade A organic material and derived products which are compliant for contaminants (Type A1) would have a Permitted Activity planning control and Grade B material which is also compliant for contaminants (Type B1) would have a Controlled Activity planning control

if applied according to the requirements of this *Guide*. Grade A or B organic material which is non-compliant for contaminants (Type A2, B2) should be reused under a specific discretionary resource consent or safely disposed of.

Given that nitrogen loading is the primary means of limiting the amount of contaminants applied to land, there need not (theoretically) be a maximum contaminant concentration. However, a maximum concentration is required for management controls and to reinforce the differentiation between a quality organic product and an unknown or non-compliant organic material.

5.1.2 STABILISATION

Most, if not all, organic materials contain pathogens, particularly when they derive from animals or humans. Manure from livestock and poultry contains a variety of pathogens; some are highly host-adapted and not pathogenic to humans, while others can produce infections in humans. Therefore all such material requires careful management to minimise any health risks while gaining the benefits. These materials also contain a range of metal and organic compound contaminants.

Stabilisation Grade 'A' (Type A1, A2) is one in which pathogens and vector-attracting compounds, such as volatile solids, have been substantially reduced or removed. Some pathogen reduction processes are also effective at reducing vector attraction. Section 5.1.2.1 prescribes the process and product standard (pathogen content) requirements to achieve each stabilisation grade. To achieve stabilisation Grade B, the product needs to meet a lesser degree of stabilisation *plus* one of the VAR requirements specified in Section 5.1.2.2; no pathogen reduction processes or product standards are applicable.

5.1.2.1 STABILISATION REQUIREMENTS

1. Stabilisation Grade A

A product is classified as stabilisation Grade A standard if:

1) The product has a documented quality assurance system; and

2) The product has undergone at least one of the pathogen reduction processes listed in Table 5-2; and

3) The product has undergone at least one of the listed vector attraction reduction methods listed in Table 5-3; and

4) The product meets all listed product pathogen standards (refer 0) after processing but prior to application.

2. Stabilisation Grade B

A product is classified as stabilisation Grade B standard if:

1) The product has a documented quality assurance system; and

2) The product has undergone at least one of the accepted vector attraction reduction methods listed in Table 5-3.

3. Other Stabilisation Methods

If a product does not attain Grade B stabilisation, it is not classified.

Table 5-2 Pathogen reduction processes

Starting material	Pathogen reduction process
Organic material containing 7% or greater dry solids by weight; or	Time temperature process within the relationship $t = \frac{131\,700\,000}{10^{0.14T}}$; t = days, T = °C where "T" is a minimum of 50 degrees Celsius and "t" is a minimum of 20 minutes.
Organic material containing less than 7% dry solids by weight	$t = \frac{50\,070\,000}{10^{0.14T}}$; t = days, T = °C where T is a minimum of 50 degrees Celsius and t is a minimum of 30 minutes.
Organic materials	Composting[1] Either: (i) In-vessel: T ≥ 55°C for ≥ 3 days, or (ii) Windrow: T ≥ 55°C for ≥ 15 days with a minimum of 5 turnings during this period (5 x 3 days at T ≥ 55°C plus time periods to reach 55°C after each turning). All compost must have at least 30 days maturation pre-use.
Organic materials	High pH – high temperature process Maintain a pH of greater than 12 (measured at 25°C) for a minimum of 72 hours and maintain a temperature of greater than 52°C for 12 consecutive hours within the 72 hours, all from the same chemical application; then dry to greater than 50% dry solids by weight.
Organic materials	Alternative Process Any process which can demonstrate Grade A quality compliance using a rigorous documented process that can be replicated using the documented proven process parameters and quality controls.

1 Also refer NZS4454:2005 Composts, Soil Conditioners and Mulches for useful operational guidance.

5.1.2.2 VECTOR ATTRACTION REDUCTION (VAR) METHODS

Vectors such as flies, mosquitoes, birds and rodents are potential carriers of disease. They can transmit pathogens to humans and other living hosts physically through contact, or biologically by playing a specific role in the lifecycle of the pathogen. Reduction of the attractiveness of organic products to vectors reduces their potential for transmitting diseases. This process is known as vector attraction reduction (VAR).

Table 5-3 summarises the accepted VAR methods for organic materials and derived products.

Table 5-3 Vector attraction reduction methods

Vector Attraction Reduction Methods	Organic Materials suited to these methods
Reduction of the mass of volatile solids by a minimum of 38 percent	Anaerobically or aerobically digested slurry or sludge
Drying to ≥ 75% dry solids by weight	Stabilised, anaerobically or aerobically digested slurry or sludge
Heating at temperatures greater than 80 °C to achieve a minimum dry solid content of 90 percent by weight	Heat dried unstabilised slurry or sludge
Maintaining a minimum temperature of 40° C for a minimum of 14 days, with an average minimum temperature of 45° C or greater	Compost products
Not exceeding a maximum SOUR at 20° C of 1.5 g/hr/m^3	Liquid sludge from aerobic processes operating at 10-30°C and ≤2% dry solids
Maintaining a pH of no less than 12 at 25° C for at least 2 hours and without further alkali addition a pH of no less than 11.5 for an additional 22 hours	Alkali amended product
Drying to ≥75% solids	Stabilised, anaerobically or aerobically digested sludge
Drying to ≥90% solids	Heat dried unstabilised sludge
soil incorporation is undertaken as soon as practicable and within at least 24 hours of the product discharge. Where liquids are injected below the soil surface there shall be no significant amount of material visible after 1 hour.	Partially stabilised or unstabilised slurries or sludges

5.1.2.3 PRODUCT PATHOGEN STANDARDS

Product pathogen standards for Grade A are summarised in Table 5-4 below. Sampling methods and compliance levels are to comply with those specified in this Guide (Refer Schedule 2 Recommended Test Methods).

Table 5-4 Product pathogen standards

Pathogen	Standard
Verification Sampling:	
E. coli	less than 100 MPN/g
Campylobacter	less than 1/25g
Salmonella	less than <2 MPN/g
Human adenovirus	less than 1 PFU/0.25g

Pathogen	Standard
Helminth ova	less than 1/4g
Routine Sampling:	
E. coli	less than 100 MPN/g

Verification sampling demonstrates whether a treatment process is producing a final product of consistent quality and is typified by a high-frequency sampling regime. Verification monitoring should occur whenever there could be a possible change to the quality of the final product, including:

- when a new process is commissioned;
- when changes are made to an existing process; and
- when any of the routine samples exceed the limits set for pathogens or chemical contaminants.

Routine sampling is required to demonstrate continued compliance with the product standards. Table 6-1 and Table 6-2 detail the frequency and number of samples required in relation to the product Type (Grade), and whether the samples are being taken for verification or routine sampling.

5.1.3 CONTAMINANT CONTENT

Table 5-5 gives the maximum contaminant concentrations that are required for grade compliance. Any products with greater contaminant concentrations are non- compliant, even if it meets stabilisation Grade A standard. The primary means of limiting the potential for elevated contaminant levels in soils is through nitrogen loading limits.

5.1.3.1 PROCESS STANDARDS FOR CONTAMINANT LEVELS

Contaminants present in the raw materials or mixtures will dictate contaminant levels within the resultant product. The main methods for controlling contaminant levels in the products and hence discharged to land include:

- controlling the input (raw organic material quality); and
- blending with other materials.

5.1.3.2 CONTAMINANT LIMITS

1. Grade Compliant

A product is classified as compliant for the chemical contaminant limits if the concentrations for all listed parameters do not exceed the limits specified in Table 5-5. These are threshold values not to be exceeded.

2. Other Products

If any listed parameter concentration exceeds the limit specified in Table 5-5, the product is non-compliant.

Table 5-5 Product contaminant concentration limits

Parameter	Concentration limit (mg/kg dry weight)
Metals:	
Arsenic	30
Cadmium	10
Chromium	1500
Copper	1250
Lead	300
Mercury	7.5
Nickel	135
Zinc	1500
EOCs:	
Nonyl phenol and ethoxylates (NP/NPE)[4]	50
Phthalate (DEHP)	100
Linear alkydbenzene sulphonates (LAS)[5]	2600
Musks – Tonalide	15
Musks – Galaxolid	50

Notes

1. Sampling methods are to comply with those specified in this guide (refer 6.9).
2. All values are to be 95th percentiles from the data set.
3. No individual value from the data set shall exceed the limits by more than 20%
4. Comprising the sum of technical nonylphenol, NPE10 and NPE20 equivalents
5. Comprising the sum of technical C11-C13 homologues and corresponding mixtures of isomers.

Increased use of glyphosate in the agricultural and horticultural sectors is of growing concern as has been that of Triclosan in personal care products, although its use is reducing. Further investigation of their concentrations and environmental effects is recommended with consideration for a product concentration limit within the next 5 yearly review of this *Guide*.

3. Blending to Achieve Contaminant Grades

The blending of product or raw materials with other substances (e.g., pumice, sand, sub-soils, bark, sawdust, green waste) before, during or after treatment is an acceptable way of diluting contaminant levels in order to attain contaminant grade compliance.

The potential for adverse environmental effects is governed by the quality of the organic product. Animal feed and bedding management, cleaner production and improved trade waste management (i.e. source control, waste minimisation) will be needed if producers are to consistently meet

contaminant grade compliance and/or avoid the need to obtain large quantities of blending materials.

5.2 PROVEN PRODUCTION PROCESSES

Table 5-2 and Table 5-3 specify the pathogen reduction processes and VAR methods required to achieve different grades of product. Grade A products require a much greater degree of stabilisation than Grade B products. Producers have access to a wide range of treatment processes to enable them to meet the required stabilisation levels. Some of these processes are effective at reducing both pathogens and vector attraction, whereas others may be better at one or the other. Depending on the process used, it may be necessary to combine different treatment processes to ensure that the final product achieves the required stabilisation grade. For some organic materials (e.g. food waste) levels of pathogens may be very low thus the stabilisation process required may be minimal.

VAR methods can apply to both manufacturing processes and land application processes. For Grade A products the VAR treatment of the product occurs during the manufacturing process rather than during the application process.

VAR should take place either at the same time as pathogen control or just after it. VAR control measures should also be taken during product storage.

There are six broad approaches to controlling pathogens in organic materials:

- high temperatures;
- radiation;
- chemical disinfectants;
- pH adjustment;
- reducing volatile organic content; and
- removing moisture.

Within these six approaches there are a number of different types of processes and technologies that are proven and common in the market place, some of which can be categorised under more than one approach. These common processes are tabulated below. It should be recognised that for each generic process type there will be a number of different physical configurations using a range of standard equipment. There is 'flexibility' of treatment process to allow for new technologies but it must be demonstrated through process verification and routine monitoring that any proposed treatment method meets an equivalent pathogen standard. The key issue is not the specific process type, physical arrangement or equipment types used but whether the total facility can record and demonstrate consistent compliance with the process criteria.

For some treatment processes, e.g. vermicomposting, demonstration of process control may not be possible. Under these circumstances, each batch must be verified as meeting Grade A pathogen reduction requirements for:

- *E. coli* less than 100 MPN/g
- *Campylobacter* less than 1/25g
- *Salmonella* less than <2 MPN/g
- *Human adenovirus* less than 1 PFU/0.25g
- *Helminth ova* less than 1/4g

A brief summary of common production processes that, with appropriate design and operation, are capable of meeting the pathogen reduction, stabilisation and/or VAR requirements for Grade A are summarised in Table 5-6. It is up to the producer to decide which process or equipment should be used to ensure the product standards are met. Specific odour control measures may be required following processes that do not provide adequate stabilisation. There may also be opportunity to

improve environmental sustainability practices and the reduction of greenhouse gases e.g. biogas collection from anaerobic processes with subsequent productive use as an energy source.

Table 5-6 Capability of common production processes

Process	Grade A Pathogen Reduction	VAR	Stabilisation
Pasteurisation	Yes	No	No
Irradiation	Yes	No	No
Lime Stabilisation	Yes	Yes	Yes
Composting[1]	Yes	Yes	Yes
Vermicomposting	Yes	Yes	Yes
Aerobic digestion:			
Ambient	No	Yes	Yes
Thermophilic	Yes	Yes	Yes
Anaerobic Digestion:			
Mesophilic	No	Yes	Yes
Thermophilic	Yes	Yes	Yes
plus Thermal Hydrolysis	Yes	Yes	Yes
Thermal Drying	Yes	Yes	Yes
Air Drying	Yes	Yes	Yes
Sludge Pond Storage	No	Yes	Yes

1. Also refer NZS4454:2005 Composts, Soil Conditioners and Mulches.

The primary issue, regardless of production process, is to demonstrate meeting the required product quality at point of use,

5.2.1 LONG TERM STORAGE

The storage of organic materials for extended periods can be used as a risk management technique to reduce the level of pathogens in the material prior to land application. Storage can be viewed either as an adjunct to other pathogen reduction or VAR methods, or as a treatment process in its own right, particularly when further drying takes place.

Long-term storage of organic materials will result in the reduction of bacteria and viruses present. The effectiveness of storage depends on the type of prior treatment, and the length of storage time. The ambient temperature also affects the efficiency of this process. Storage of organic materials also reduces nitrogen levels and nitrate leaching risks, which potentially reduces the product's agricultural value.

If the requirements for stabilisation Grade A products are met in full, storage is not necessary. However, where there is doubt about the ability of a new production facility to consistently achieve

Grade A stabilisation requirements, it is prudent for producers to begin with an initial storage period, then, when confident, gradually reduce or phase it out entirely when it is established that pathogen standards are being met.

In the case of stabilisation Grade B products, such as those produced by mesophilic digestion, storage can be used to further reduce pathogen levels. This includes sludge pond storage and sludge from waste stabilisation ponds; it should be remembered that storage age is based on time since the most recent sludge was deposited.

5.3 MANURE VS OTHER ORGANIC MATERIAL REQUIREMENTS

Manures need not comply with the same sampling, analysis and documentation protocols as other organic materials, including biosolids. Traditional manures will be Type B1 or B2 products managed under existing regional plan rules or existing consents. It is not intended that those existing regimes change for manures. However the management practices in this *Guide*, including knowledge of contaminant levels in the manure and the receiving soil, is similar to current good farming practice and could usefully be applied.

6 MONITORING AND SAMPLING STANDARDS

This section summarises what to monitor and how, when and where to sample. It applies to all specific bulk organic product manufacturing. It good practice for all organic waste products but not required for manures.

Further information in support of this section may be found in the following Volume 2 Technical Manual sections:

- **2.6 Monitoring and Quality Assurance**
- **2.7 Sampling Procedures**
- **4 Pathogens Review**

6.1 RESPONSIBILITY FOR MONITORING

The producer is responsible for conducting any monitoring that relates to production and storage and labelling for product they control on their site. The producer should develop a detailed process and product monitoring programme in accordance with this *Guide*.

Where product is transferred, stored or distributed from a third party site the organisation controlling that site and activity should be responsible for those functions.

The holder of the discharge consent, or owner of the land covered by a regional consent or when a consent is not required, is responsible for monitoring in relation to land application activities. Consent holders or owners may contract others to undertake activities for them, including the monitoring, but they themselves will remain ultimately responsible.

6.2 PROCESS MONITORING

Process monitoring provides assurance that stabilisation objectives are being achieved. Process monitoring should be managed within an auditable environmental management system (refer 7.1).

The production of organic products should include the management practices detailed below regardless of whether producers are monitoring VAR, pathogen reduction, or both.

- all process conditions, design diagrams and calculations should be recorded;
- any changes to the process and/or equipment should be noted and retained for future reference and they may initiate repeated verification sampling (see 6.5);
- equipment should be operated and calibrated in accordance with the manufacturer's instructions, with independent test records/certificates kept up to date;
- records should be maintained for all key process conditions, such as time, temperature and pH; and
- production records should be maintained for at least two years.

6.3 PRODUCT MONITORING

Monitoring of the final product is required to determine the extent of vector attraction reduction, pathogen numbers and chemical contaminant concentrations. When determining the stabilisation grade, pathogen monitoring should be undertaken on both the unprocessed material and the final product to positively confirm pathogen removal. Verification sampling should occur directly after processing.

Routine sampling of the final product should occur for pathogen content just prior to use (or sale) as pathogenic organisms may regrow after treatment has taken place. Producers should inform the analytical laboratory of the need to complete the analysis as quickly as possible.

It is less important to undertake monitoring just before sale when determining product contaminant compliance, as the concentrations of these parameters are unlikely to change after treatment. When products are to be mixed with another material before sale, monitoring should be undertaken on the final product, after the mixing is complete.

For batch production e.g. composts and vermi-composts all product batches should be tested.

Records should be kept of the results, and of results of any other testing conducted on the final product (e.g. percentage solids, reduction in volatile solids, pH). Records are used to demonstrate compliance with the VAR requirements, pathogen requirements and chemical contaminant concentrations.

6.4 PATHOGEN REGROWTH

Bacteria present in the organic materials or derived products have the potential to regrow after treatment. Regrowth testing for *E. coli* is required in order to demonstrate that the treatment process is working effectively and that, in combination with normal end-use management controls, regrowth has not occurred. Regrowth testing should be conducted annually, using three samples.

6.5 SAMPLING REGIMES

The sampling frequency in a product monitoring programme depends on the sampling objectives. There are two types of sampling:

- verification sampling; and
- routine sampling.

Note that for any organic material or product sample returning <LOD (lower than the limit of detection), the value of 0.5 x LOD is to be used for statistical analysis.

Verification sampling demonstrates whether a treatment process is producing a final product of consistent quality and is typified by a high-frequency sampling regime. Verification monitoring should occur whenever there could be a possible change to the quality of the final product, including:

- when a new process is commissioned;
- when changes are made to an existing process; and
- when any of the routine samples exceed the limits set for pathogens or chemical contaminants.

Routine sampling is required to demonstrate continued compliance with the product standards. Table 6-1 and Table 6-2 detail the frequency and number of samples required in relation to the product Type (Grade), and whether the samples are being taken for verification or routine sampling.

Table 6-1 Stabilisation grade sampling frequencies

Grade	Monitoring type	Sampling regime	Parameters to be monitored
A	Product verification[1,2]	≥ 7 evenly dispersed grab samples per month for a 3-month period with ≤ 3 failures. If > 3 failures then the 7 following consecutive grab samples must comply.	*E. coli* *Salmonella* *Campylobacter* *Human adenovirus* *Helminth ova* VAR
	Routine sampling	≥ 1 grab sample per week	*E. coli* VAR
B	Product verification[2]	Not applicable for pathogen testing	VAR[3]
	Routine sampling	Not applicable for pathogen testing	VAR[3]

[1] No more than 3 samples should be taken per day during this period. The number of verification samples has been reduced from 15 in the Guidelines for the Safe Application of Biosolids to Land in New Zealand, 2003, to 7 samples which is in line with the Western Australian guidelines for biosolids management (2012),

[2] In the case of manufacturing facilities in existence prior to the publication of this document, it is acceptable to use data up to 12 months old for the purposes of *product verification*.

[3] If a barrier is to be used for VAR e.g. soil incorporation, no monitoring is required at the production stage.

Table 6-2 Contaminant grade sampling frequencies

Grade	Sample type	Number of samples
Compliant	Product verification[1]	Metals: 1 composite[2]/week over a 3-month period Organics: 1 composite sample[2]/month over a 3-month period
	Routine sampling[1, 2]	Metals: a) For metals ≥ half the guideline limits 1 composite/ 2 month. b) For metals ≤ half the guideline limits 1 composite/4 months. Organics: a) For organics ≥ half the guideline limits 1 composite/6 months. b) For organics ≤ half the guideline limits 1 composite/12 months.

[1] In the case of manufacturing facilities in existence prior to the publication of this document, it is acceptable to use data up to 12 months old for the purposes of *product verification*. For the purposes of determining compliance at the 95 percentile for *routine sampling*, the age of the data set shall be no more than 2 years for

metals and organics. This avoids the scenario of old data masking upward trends in contaminant concentration.

[2] Samples tested should be made up from daily composites for metals and weekly composites for organics. For organics verification sampling there shall be no exceedance over 3 consecutive samples.

6.6 STABILISATION GRADE SAMPLING

When monitoring for pathogens it is important to take grab samples and to report the actual (not the average) values from each grab sample.

During the process verification period a total of three failures is allowed. If this number is exceeded, then the next 7 grab samples must comply. If any of the failures occur during the last month of verification sampling (i.e. there are fewer than 7 samples left to take), samples must continue to be taken at the verification frequency until 7 consecutive compliant samples have been obtained.

When verification monitoring is complete, the sampling regime can change to a routine monitoring regime. If any routine monitoring samples fail then, for stabilisation Grade A, a return to the verification monitoring regime for all pathogens is required to ensure product quality.

The samples taken during the verification period must be analysed for *E. coli, Salmonella, Campylobacter, enteric viruses, Helminth ova* and vector attraction reduction. When it is confirmed that the product is of a consistent quality then, for Grade A, routine samples only need be analysed for *E. coli* and vector attraction reduction. For Grade B, there is only a requirement for VAR monitoring during routine sampling, unless a barrier is to be used for VAR, in which case no monitoring is required.

6.7 CONTAMINANT GRADE SAMPLING

To determine the contaminant concentrations, the sampling regime detailed in Table 6-2 should be followed. Sampling is required to demonstrate that process controls are working and that the *average* levels of contaminants in the product are below the limits specified.

Composite samples are to be taken for contaminant grade monitoring. Each composite sample should be made up of a number of grab samples taken from different locations and/or at different times.

Irrespective of whether the samples are taken as part of verification monitoring or of routine monitoring, they should all be analysed for the contaminants specified in this *Guide*.

If the concentration of any contaminant exceeds those specified in this *Guide*, then a return to verification monitoring is required for that contaminant only. All other contaminants should continue to be monitored at the routine sampling frequency. The failed contaminant can only return to the routine sampling frequency once it is in compliance with the product limits from this additional verification sampling.

6.8 SOIL MONITORING

Monitoring the build-up of contaminants in the receiving soil is an important risk management measure. Recommended test methods for contaminants and pathogens are listed in Schedule 2 Recommended Test Methods.

Soil should be tested before any organic materials are applied to land to determine the existing soil contaminant concentration and for background *E. coli* levels when Type B1 and B2 materials are to

be applied. For bulk users, soil samples should be taken before the initial application of material and then at least every five years after this.

In line with stock exclusion requirements it would be prudent to wait 3 months after land application before taking further soil samples.

In this way any accumulation of chemical contaminants in the soil can be monitored and testing for *E.coli* before repeat applications of Type B1 and B2 products will demonstrate that the soil treatment process is working effectively and that, in combination with normal end-use management controls, regrowth has not occurred. Regrowth testing should be conducted annually, using three samples.

Regular monitoring of soil is recommended only for the application of Type A2 and B2 materials, as chemical contaminant limits in Type A1 and B1 products are low enough to prevent significant rates of accumulation. However, periodic monitoring of soil that has had Type A1 and B1 products applied to it would be useful information for long-term reviews and risk assessments of the site. This data should be collected and held available as a restricted record for review.

Table 6-3 summarises the recommended soil testing frequency.

Table 6-3 Summary of Soil Testing Frequencies

	Product Standard Applied			
	A1	**A2**	**B1**	**B2**
Pre-application:	contaminants	contaminants	contaminants, pathogens	contaminants, pathogens
Post-application:				
Pre subsequent applications		contaminants	pathogens	contaminants, pathogens
5 yearly	Contaminants[1], pathogens[1]	Contaminants, pathogens[1]	Contaminants[1], pathogens	contaminants, pathogens

Note: 1. Preferred only

6.8.1 SOIL SAMPLING

Soil from sites to which organic materials have been applied should be sampled using an unbiased pattern such as a rectangle or grid. Samples should be taken from areas representative of the site as a whole. Avoid taking samples from non-representative areas such as fence lines, dung patches, areas where burning has taken place, fertiliser storage areas, swampy areas, and near roads or buildings.

A minimum of 10 core samples, taken to a depth to which the organic materials were incorporated into the soil, up to a maximum of 200 mm, should be collected per hectare of product application. If there is no soil incorporation, the sampling depth should be 200mm. All samples should be combined to form a composite and then tested for the contaminants listed in Table 5-5. The pH of the sample should also be determined.

There are approved protocols for monitoring soils in certain circumstances e.g. the Tiered Fertiliser Management System for monitoring soil cadmium. It is important therefore to record the protocol used and depth of soil sampled.

6.9 SAMPLING PROCEDURES

6.9.1 GRAB SAMPLES

A grab sample (also called 'spot' or 'catch' sample) is one where the whole sample volume is collected at a particular time and place and represents the composition of the source at that time and place. Results from individual grab samples cannot be assumed to be representative of the sample source over time. Grab samples should be used for determinands that deteriorate or change quickly after sampling, such as pathogens.

6.9.2 COMPOSITE SAMPLES

Composite samples are prepared by mixing a number of grab samples. Composite samples give an average concentration for the parameter in question over the period of time the sample was collected.

Composite samples are not suitable for parameters that degrade/alter as a result of storage. Therefore composite sampling should only be used for components that remain unchanged under the conditions of sample collection, preservation and storage. Composite samples should only be used for chemical contaminants (i.e., metals and organics). Composite sampling should not be used for monitoring pathogens.

For organic parameters care must be taken with sample collection and preservation to ensure that the loss of volatiles is minimised. Soil samples collected for volatile contaminants must be collected quickly, with as little disturbance as possible. A detailed protocol for sampling, sample preservation, mixing, transport and analysis should be agreed with the laboratory beforehand. The limitations of the sampling method should be identified at the reporting stage. Advice on this is available in Contaminated Land Management Guidelines No. 5: Site Investigation and Analysis of Soils, MfE 2016 and Volume 2 – Technical Manual, section 6.

6.9.3 MICROBIOLOGICAL SAMPLES

Microbiological samples are very susceptible to being contaminated by poor sampling technique. When taking microbiological samples, the following must be taken into account:

- containers and tools should be sterilised;
- the lids of sterile sampling containers should have a seal over them, which has to be broken before taking the sample. If this seal is damaged in any way, do not use the container as it may no longer be sterile;
- the container may have a use-by date on it. If it has and the date has passed, do not use the container as it may no longer be sterile;
- when taking the sample do not touch the neck of the container, or the inside of the lid. The lid must not be put down on any surface as this can contaminate the sample; and
- when transporting microbiological samples, keep them separate from other non-sterile samples and cool with ice. Take care not to let melted ice come into contact with the container tops (this is best achieved by keeping the ice inside a plastic bag, separate from the sample container). Samples must not be exposed to direct sunlight and must reach the laboratory within the specified time limit.

6.9.4 WHERE TO SAMPLE

More representative sampling generally occurs when the materials being sampled are moving rather than stationary, but this is not always possible. Table 6-4 describes preferred locations for taking samples from some treatment processes.

Table 6-4 Sampling points for treatment processes

Treatment Type	Sampling point
Anaerobic digestion	Collect sample from taps on the discharge side of positive displacement pumps.
Aerobic digestion	Collect sample from taps on discharge lines from pumps. If batch digestion is used, collect sample directly from the digester. Note that when aeration is shut off, solids may settle rapidly.
Thickener	Collect sample from the taps on the discharge side of positive displacement pumps.
Heat treatment	Collect sample from the taps on the side of positive displacement pumps after decanting. Be careful when sampling heat-treated sludges/slurries because of: • A high tendency for solids separation • The high temperature of the sample can cause problems with sample containers due to cooling and subsequent contraction of entrained gases.
Dewatering, drying, composting, vermi-composting or thermal reduction	Collect sample from material collection conveyors and bulk containers. Collect sample from many locations within the material mass, and at various depths.
Mechanical dewatering by belt filter press, centrifuge, vacuum filter press	Collect sample from discharge chute or storage bin (see below).
Mechanical dewatering by plate press	Collect sample from the storage bin; select 4 points from within the bin; collect an equal amount from each point and combine to form one sample.
Dewatering by drying beds	Divide bed into quarters, grab equal amounts of sample from the centre of each quarter and combine to form a composite sample of the total bed. Each composite sample should include the entire depth of the material (down to the sand/drainage layer).
Compost or vermi-compost piles	Collect sample directly from the front-end loader while materials are being transported or stockpiled within a few days of use.
Sludge Ponds	Composite of samples from representative grid pattern including variable depths.

6.9.5 SAMPLE EQUIPMENT

The sampling equipment will depend on the type of material being sampled, however the following rules apply to all situations:

- automatic sampling equipment (such as that used at wastewater treatment plants for watery samples) is not suitable for sampling sludges, slurries or dryer material. All such samples need to be taken manually;
- equipment should be easy to clean and constructed of non-corrosive materials, such as Teflon, glass or stainless steel;
- equipment used for raw material or product sampling should not be used for any other purpose; and
- equipment should be well cleaned after use and stored in a clean location. It may be advisable to wrap any equipment between uses to ensure it stays clean.

6.9.6 SAMPLE CONTAINERS

The following factors must be considered when choosing a sample container:

- high resistance to breakage;
- good sealing efficiency;
- ease of reopening;
- good resistance to temperature extremes;
- practicable size, shape and mass;
- good potential for cleaning – this is especially important for containers used to collect samples for microbiological analysis ; and
- availability and cost.

Sample containers are generally made out of glass or plastic. The type of determinand the sample is to be analysed for often controls the type of material the container is made from, as some containers will react with the determinands and give false results when the sample is analysed. If a sample is to be analysed for more than one determinand, it may be necessary to use more than one type of sample container and sample size.

The possibility of leaching out of plastic containers should be considered with samples to be analysed for organic contaminants.

6.9.7 SAMPLE PRESERVATION

For samples to remain representative of the material from which they are taken, it is usually necessary to preserve the samples to prevent changes taking place during the period prior to analysis. The most common way of preserving samples is to cool to between 0°C and 4°C. Once collected, samples should be stored at this temperature until analysis.

Agree procedures with the laboratory beforehand as they will often provide the container and have specific requirements for sample size, handling and transport. If the sample is not provided according to their protocols they may decline to analyse it.

Minimising sample sizes ensures rapid and effective cooling. Samples less than 4 litres in size should ensure this.

Freezing should not be used to preserve samples being analysed for bacteria. Freezing is not normally a standard preservation technique for samples to be analysed for metals or organic contaminants. If samples are to be frozen, they should not be collected in borosilicate glass containers, which are liable to fracture.

If samples are being collected over an extended period of time, the preservation of the sample should form an integral part of the collection procedure. Keeping the samples in the dark can further enhance preservation.

6.9.8 SAMPLE TRANSPORTATION

Samples to be analysed for microbiological parameters should be transported to the laboratory within six hours of collection. All other samples should be transported within 24 hours, unless suitably preserved. Sample transportation should be undertaken in accordance with standard quality assurance procedures, including the use of chain of custody forms.

6.9.9 LABORATORY SELECTION

The primary accreditation agency in New Zealand for analytical laboratories is International Accreditation New Zealand (IANZ). This agency, formerly known as TELARC, is governed by an Act of Parliament. Generally laboratories with IANZ accreditation should be selected for sample analysis because these laboratories will have quality assurance programmes in place to maintain analytical performance. IANZ accreditation is test-specific and therefore not all IANZ laboratories may be accredited for the particular test that is required. Confirm the status of the test (i.e. analyte *and* method) accreditation with the laboratory *before* sending samples for analysis.

There are a number of New Zealand laboratories that have accreditation for the analysis of metals and organic contaminants governed by this *Guide*. There may, however, be microbiological tests for which no laboratory has the specific accreditation. In this case choose a competent laboratory and discuss the selection of an appropriate standard test method.

6.9.10 AUDITING

All sample programmes should be audited to ensure that samples are being collected, transported and analysed correctly. If any problems are identified they should be resolved immediately to prevent the reporting of erroneous results.

To audit *sampling procedures*, a chain of custody form should be used throughout the sampling process. This should record the following information:

- name and signature of person collecting sample;
- date and time sample collected;
- purpose of the sample;
- analysis required;
- location of sample point and unique reference number (if one has been assigned);
- sampling method (i.e. grab or composite);
- preservation method;
- name of person receiving the sample for analysis;
- date analysed; and
- results, and whether these have been confirmed.

On-site sampling operation audits should be conducted to ensure that samples are being taken correctly.

6.9.11 DATA REPORTING

Analytical laboratories should provide reports that are complete, accurate and unambiguous so that clear conclusions can be drawn from the data without the need to make any assumptions. Laboratories must also maintain full records of samples, methodology and experimental data so that auditing can be carried out at any time to verify the reported results.

As a minimum, analytical reports should contain the following:

- sample identification and description;
- date of receipt of the sample and conditions of storage;

- date extraction of the sample commenced;
- details of the sample preparation and fraction of sample analysis;
- citation and summary of analytical procedure – it may be just the title for a validated regulatory method. Any modifications to the protocol should be noted; and
- date of reporting and signature of laboratory manager or other authorised signatory.

6.9.12 ASSESSMENT OF SAMPLE RESULTS

Results from the analysis of materials for chemical contaminants, reported on a dry weight (in mg/kg) basis, must meet the criteria given in Table 5-5 of this guide. In assessing compliance, the concentration measured for a contaminant may exceed the limit given in Table 5-5, providing that:

- the 95th percentile of the previous monitoring results (up to 24 months) for that contaminant are below the criteria; and
- the concentration does not exceed 20% of the limit value for that contaminant.

7 QUALITY ASSURANCE REQUIREMENTS

This section summarises how to do Quality Assurance:

- **Environmental Management Systems**
- **Record Keeping**
- **Labelling**
- **Health and Safety**

Quality Assurance is recommended for all bulk dischargers. However specific product and labelling records, while good practice, are not required for manure applications.

Further information in support of this section may be found in the following Volume 2 Technical Manual sections:

- **2.6 Monitoring and Quality Assurance**

Additionally much of the detail is taken directly from the 2003 Biosolids Guidelines and current agricultural industry manuals.

7.1 ENVIRONMENTAL MANAGEMENT SYSTEMS (EMS)

Quality control and management practices are required to minimise risks associated with the use of organic materials and derived products. Their collective use and documentation provide quality assurance. The most effective way of ensuring a consistently high-quality product is to implement control and monitoring mechanisms at different stages in the organic product life cycle, rather than just one quality check of the final product. This means that if one check or control fails, any problems should be picked up by the other mechanisms.

The best management plans are site-specific and the specific life cycle of each batch of organic material should be considered when devising a management plan.

It is recommended that all producers and bulk dischargers of organic materials and derived products have a system of formalised (auditable) management plans in place. The ISO management systems are probably the best known e.g. AS/NZS ISO 9001:2016 Quality management systems – Requirements, but other in-house systems can be equally useful provided they can be audited and verified by an approved external agency.

The basic foundation of an EMS is a written plan, which includes a description of responsibilities for managers, production workers, those responsible for transport and land application, and the regulators. The plan usually has five sections: environmental policy, planning, implementation, monitoring and corrective action, and management review.

An EMS would cover *all* activities relevant to the producer or discharger, including detailed operational activities (Standard Operational Procedures (SOPs)) with limit process and key performance parameters e.g. minimum retention, maximum odour, measured quality. If the

producer is also the discharger, the EMS would cover all production, storage, transport and discharge activities.

AS/NZS ISO 14001:2016 *Environmental management systems - Requirements with guidance for use m*aps out a framework that a company or organisation can follow to set up an effective environmental management system. It can be used by any organisation regardless of its activity or sector and applies to the environmental aspects of its activities, products and services that the organization determines it can either control or influence considering a life cycle perspective.

Beyond ensuring full compliance with all resource conditions and other regulatory requirements, e.g. regional plan incident logs, an EMS can address such issues as odour, noise and other potential community concerns.

7.2 SITE MANAGEMENT PLAN

A land application site management plan (LASMP) is a useful way of co-ordinating an approach to managing the risks associated with any specific land application project. Such a plan provides the detail of how it is proposed to implement, or ensure compliance with, the *Guide* and any consent conditions. It also provides an opportunity to integrate consent requirements with other desirable site management practices such as public liaison and complaints procedures.

A LASMP may form part of an environmental management system and contain content of a nutrient management plan.

A LASMP would typically contain the following information:

- Site and ownership details
- Soil and drainage details
- Type of land use
- Proposed application; products, methods and timing
- Odour management
- Nutrient Management Plan
- Potential risks and management proposals
- Monitoring and record keeping
- Staffing and responsibilities

7.3 NUTRIENT MANAGEMENT PLAN

Many organic products have useful fertilising and/or soil conditioning properties as a result of the nutrients and organic materials they contain. To ensure that appropriate consideration and management of the nutrients is applied a Nutrient management Plan (NMP) is recommended.

A Nutrient Management Plan is a written plan that describes how the major nutrients and any others of importance to specialist crops will be managed to achieve the farms objectives efficiently and safely. It will typically include a nutrient budget (NB), often using Overseer, SPASMO or any other recognised nutrient planning tool. The NB should document all inputs and outputs, climatic and soil conditions and assess the potential for nitrogen and phosphorus losses.

The NMP then identifies actions to minimise any loss of nutrients from your production system. These actions may fall into one or several of the following categories:

- fertiliser management;
- effluent management;
- soil management;
- pasture, tree or crop management;
- production and stock management;

- riparian management;
- cropping management; and
- management of waterways risk from hot spots: silage pits, offal holes and farm dumps.

Some regional council's require a specific NMP to demonstrate compliance with fertiliser application rules and consent conditions.

The Fertiliser Association of New Zealand's Code of Practice for Nutrient Management (2013) provides a useful framework for NMP production including a template and detailed guidance notes.

7.4 RECORD KEEPING

Manufacturers, dischargers and any third parties involved in the bulk transport of organic materials should keep appropriate records. The following sections detail the information that is required at each stage in a product's lifecycle. These sections relate to bulk and commercial operations and are not intended for purchasers and dischargers of bagged product for domestic use.

Records should be kept and maintained for as long as possible. In the case of records relating to contaminant loads applied to a site, they should be maintained for at least as long as products are applied to that site and for a five-year period after application ceases.

All organic products should have traceability of the source material as part of identifying risks and how they are being managed.

7.4.1 RECORDS TO BE MAINTAINED BY PRODUCERS

All producers of all grades of product should maintain the following records:

- batch number (if batched);
- date of production;
- stabilisation grade, including microbiological results, frequency of sampling, method of achieving stabilisation grade and VAR method;
- contaminant grade, including contaminant concentrations and frequency of sampling;
- nature of any co-blended material (e.g. green waste in compost);
- quantity of product produced in that batch;
- treatment processes employed;
- monitoring of treatment processes and results;
- documented procedures for operations, sampling, monitoring and auditing;
- concentrations of nitrogen, phosphorus and potassium; and
- the address of destination for discharge of product if the product is intended for *bulk use* (> 50 m^3) or it is a Type B1 product or Type B2 material, regardless of whether it is intended for bulk use.

7.4.2 RECORDS TO BE MAINTAINED BY STORERS OF ORGANIC MATERIALS

The following records are to be maintained by storers of loose bulk organic material:

- complaints received and responses made;
- inputs and outputs;
- information on any monitoring carried out, including vector nuisance and odour; and
- storage times.

7.4.3 RECORDS TO BE MAINTAINED DURING TRANSFER OF ORGANIC MATERIALS

This section applies to information that should be collected and passed on during the transfer of bulk organic materials from the producer to the end user. It is best collected on a chain of custody form. If the producer is also the discharger, then this phase of record keeping is not necessary.

The records to be maintained during transfer are:

- source of the organic product, batch number and date of dispatch;
- mass of product;
- stabilisation grade;
- contaminant grade; and
- location to which the products are transferred.

7.4.4 RECORDS TO BE MAINTAINED BY PRODUCT DISCHARGERS

Dischargers of bulk products should collect the following information:

- location of application site;
- current land use;
- name of site occupier and owner (if different);
- area of application with an accompanying map showing the area;
- date of application;
- soil pH before organic product application;
- soil pathogen and contaminant concentration before organic product application;
- organic product application rate;
- method of application;
- source of organic product and batch number;
- product Type;
- product certified N loading;
- monitoring methods; and
- frequency of soil sampling.

7.5 LABELLING STANDARDS

All products must be appropriately labelled. In the case of products supplied in bulk, it is the responsibility of the producer to ensure that the discharger of the product receives documentation providing the same information that would appear on the label of a packaged product, at the time of delivery of the bulk order.

Labelling or accompanying documentation containing the following details (as applicable) should accompany all grades of material produced:

- trade name (if it has one);
- name and address of the producer/manufacturer;
- product Type/Grade and/or registration number;
- confirmation that the product has been manufactured in accordance with this *Guide*.
- recommended nitrogen application limit;
- information on the product's origins (e.g., that it includes treated human waste, or specific manure) and precautionary handling instructions should be included. An example of wording for a biosolids compost is: "made from the natural composting of garden trimmings and biosolids (treated human waste) that has been subject to temperatures of at least 55°C";

- health warning – generally a health statement is printed on the packaging of all garden mixes and should similarly be used for all bagged organic materials; suitable wording is:

"This product may contain a variety of living micro-organisms, some of which on rare occasions can cause illness in humans. Serious infection is rare but can happen for older people and those with reduced immunity. Please take the following precautions:

- avoid opening the bag in enclosed areas;
- avoid inhaling the mix;
- always wear gloves and wash hands after use;
- work with damp or wet mix/soil to reduce the dust potential;
- see your doctor if you develop a high fever, chill, breathlessness or cough."
- batch number (if applicable);
- order number (if applicable);
- delivery date (if applicable);
- requirement to incorporate into soil if applied to agricultural land.

7.5.1 STATEMENT OF HAZARDOUS NATURE

Documentation accompanying Grade B products and Type 2 material should also include a materials safety data sheet containing the following information:

- producer details (name, address, telephone number, emergency telephone number;
- product name;
- dangerous goods class;
- hazchem code;
- uses;
- physical description / properties;
- appearance;
- specific gravity;
- ingredients;
- health effects (acute swallowed, eye, skin, inhaled, chronic);
- first aid (swallowed, eye, skin, inhaled);
- advice to doctor;
- personal protection;
- storage and transport;
- spills and disposal; and
- other information as appropriate.

7.6 HEALTH AND SAFETY PRECAUTIONS

These products may contain micro-organisms; therefore care should be exercised when working with them. Individuals handling them should ensure that:

- hands are washed and nails scrubbed well with soap before eating, drinking or smoking, and at the end of the working day;
- cuts and skin abrasions are covered with waterproof dressings;
- no food or drink is consumed or smoking permitted by employees while working with biosolids, manures or their products;
- a suitable change of clothing is worn during work, and safety footwear and gloves are worn to protect against injury from sharp objects;
- showering facilities are available to production workers;
- eye protection is worn to protect against dust;
- if dust or aerosols are considered a problem, masks conforming to a recognised standard should be worn to prevent inhalation;
- wherever possible, workers should be upwind of the land application process;

- organic material and product producers, transporters and applicators should provide an occupational health and safety plan to ensure workers handling these materials and their products are adequately protected from, and informed of, risks.
- employees working with biosolids, manures and/or wastewater residuals should review their immunisation history. As a minimum, anyone working in this type of environment should be immunised against tetanus, but should also consider immunisations against Hepatitis A and B. As available inoculations vary over time, update advice should periodically be sought from the public health service of the local District Health Board.

Useful additional guidance can be found in:

- National Institute of Occupational Safety and Health publication 2005 - 149 (NIOSH, 2007).
- Various Worksafe New Zealand publications on working with biological risks e.g. working with soil, compost and potting mix, health and safety on farms,

8 TRANSPORTATION AND STORAGE

This section summarises management of transportation risks and storage requirements.

Further information in support of this section may be found in the following Volume 2 Technical Manual sections:

- **2.6 Monitoring and Quality Assurance**

Information has also been taken and updated from the 2003 Biosolids Guidelines and the Western Australian guidelines for biosolids management, December 2012.

8.1 TRANSPORTATION

The transport of Grade B organic products is regulated under the Dangerous Goods Rule (Land Transport Act) and NZS 5433 Transportation of Dangerous Goods on Land. Consent authorities may wish to impose consent conditions covering issues such as action in the event of spillage (prevention of contamination of waterways), avoidance of nuisance odours, or the timing of trucking movements.

The recommended tools for managing transportation risks are:

- consignment papers must include the relevant Safety Data Sheet (refer Schedule 1 Example Safety Data sheet as an example) within the labelling and consignment documents;
- the driver must be licensed for that class of goods; and
- the vehicle must display adequate signage for the class of goods.

8.2 STORAGE

Many of the potential environmental and health risks associated with the land application of organic materials can be related to extended local storage prior to spreading. These potential risks include:

- ground and surface water contamination;
- leaching of contaminants during heavy rainfall events and floods; and
- public and occupational health risks from uncontrolled access and/or inappropriate storage, transport or handling.

The following factors can influence the severity of these risks:

- stockpile size;
- product quality;
- length of time product will be stored;
- time of the year (that is, effects of moisture, temperature and wind gradients);
- stockpile design (capacity, run-off and leachate controls); and
- stockpile location.

Minimum in-field storage is encouraged, to reduce these issues and nuisance potential.

Storage conditions shall ensure that product is never contaminated with other chemicals or chemical products, and that it does not escape from the storage facility. Some local authorities have specific requirements for storage and its signage.

If the initial short-term storage period becomes a long-term storage period (that is, more than 30 days), a more permanent and specifically designed structure and signage may need to be constructed to hold this stockpile.

The supplier and end recipient are both responsible for ensuring that the risks associated with stockpiling organic materials within a facility or application area are well managed.

8.2.1 SITING OF STOCKPILES

It is important that an appropriate location is selected when organic materials are stockpiled. The following criteria describe the most appropriate site for the stockpile:

- flat (slope gradient ≤3 per cent); raised land set well back from waterways and flood prone land;
- protected from unauthorised access;
- stockpiles should not be situated in an area deemed unsuitable for Grade B material application, for example, due to soil type, proximity to dwellings or sensitive areas or groundwater depth; and
- stockpiles of Grade B material should not be located on any land where run-off or leachate could directly access a waterway.

8.2.2 FENCING AND SIGNAGE

Grade B material should not be stored for any period of time in areas where the public has ready access. The property owner must ensure that the location selected for the storage of organic materials is:

- fenced to prevent unauthorised access;
- sign-posted at all entrances to the property, from the time of delivery of the material to the property until the materials have been incorporated and stock exclusion periods are completed. Signs must be:
  - weatherproof (for example, metal or sturdy plastic);
  - in compliance with NZS/AS 1319–1994, Safety signs for the occupational environment; and
  - worded, at a minimum to include the following information:

BIOSOLIDS/MANURES ARE BEING STORED AND USED IN THIS AREA. CONTACT MAY AFFECT HUMAN HEALTH. THEREFORE, UNAUTHORISED ACCESS IS PROHIBITED.

8.2.3 DRAINAGE

Organic material stockpiles, regardless of the length of storage, should be located on flat (slope gradient of ≤3 per cent), raised land so that stormwater from other areas does not run through the stockpile, which may cause leaching of contaminants and nutrients into the environment.

If a flat, raised storage area is not possible, a drainage channel should be constructed to divert stormwater away from the stockpile and minimise the potential for contaminant and nutrient leaching. Any leachate collected inside the storage area should preferably be used within the product application area.

8.2.4 BUNDING

Bunds should be constructed around stockpiles if the material has to be stored for longer than 30 days or the stockpile is located on a slight slope (slope gradient of >3 per cent).

Bunds serve a number of purposes. They ensure that the organic materials are contained within a specific area; they assist in keeping stormwater away from the stockpiles; and they provide a physical barrier to help restrict access. Bunds may, in most cases, be constructed from earth from the application site. Run-off diversion drains may be required around the upslope side of the bund.

8.2.5 COVERING

Stockpiles are not required to be covered provided that the storage period and monitoring requirements are met. Any monitoring or sampling should be conducted prior to use or when the covers (if used) are removed if stockpiling for >30 days.

8.2.6 VECTOR CONTROL

A vector is an animal that could potentially play a role in transmitting pathogens from Grade B material to humans. Vectors could include flies, mosquitoes, fleas, rodents, birds or domestic animals.

Risks from vectors can be controlled by reducing the potential for physical contact (for example, minimising the storage time; covering stockpiles). Methods to manage vectors may vary between sites depending upon the vectors to control, seasonal conditions and the type of organic materials used. If climatic conditions e.g. high temperature and humidity, create high probability of vector attraction then storage on site should be reduced.

8.2.7 MONITORING

Stockpiles should be visually inspected by the recipient or their representative regularly, to ensure the integrity of the stockpile, and/or bunds, drainage channels and potential fly breeding. If the integrity of the stockpile, bunds or drainage channels is found to be compromised, action to rectify the situation needs to be implemented as soon as possible. More frequent monitoring may be required in the event of heavy rainfall.

9 APPLICATION TO LAND

This section covers how to manage applications to land:

- **Maximum Nitrogen loadings**
- **Management practices:**
  - **Soil incorporation**
  - **Exclusion Periods**
  - **Pathogen content and background levels**
  - **Application strategies**

Land management can significantly minimise adverse effects from the application of organic material and derived products to land. Management strategies must be based on the way the contaminants present in these organic materials react with the soil and should be aimed at minimising the bio-availability and mobility of contaminants thus reducing their likely movement into the food chain, or water bodies.

Further information in support of this section may be found in the following Volume 2 Technical Manual sections:

- **2.5 Stabilisation Issues**
- **5 Trace Elements Review**

Information has also been taken and updated directly from the 2003 Biosolids Guidelines.

9.1 NITROGEN CONTENT AND APPLICATION RATES

The product nitrogen content, proposed application rate and soil characteristics influence the amount of benefit as well as the potential for soil and/or ground water contamination. Therefore the maximum (total) product nitrogen application rate for the Type/Grade of product needs to be used as the primary means of control.

If the products are to be marketed as a fertiliser it will also be useful to analyse and label the phosphorus and potassium contents at the same time, in order to calculate the N:P:K ratio. Biosolids and manures are variable in quality; the nutrient content is affected by the solids content, handling process and length of time the product is stored. Therefore it is important to analyse the product just prior to it being applied to land.

Not all organic materials and derived products are balanced with respect to nutrients. Wise fertiliser use combines nutrient budgeting with soil testing to check the desired nutrient levels are being achieved.

A total nitrogen load of 200 kg/ha/y for productive land was included in the 2003 Guidelines for the Safe Use of Biosolids to Land in New Zealand. This was considered a conservative estimate and reasoning and discussion was given in Table 5.1 and Section 6.3. The same value has been adopted

for this *Guide* as a level at which the effects due to nitrogen (in particular the risk of mineralised N reaching surface or groundwater) are minimal.

At this rate of application, the risk of soil acidification (via nitrification and the uptake of soil alkalinity), leading to metal toxicity is negligible, and the rate of application does not exceed the ability of the soil and plant system to beneficially use the applied nitrogen. In all organic materials the predominant form of nitrogen is organically bound nitrogen. The rate of release of mineral nitrogen from organic materials depends on the origin and processing of the material.

When the application is managed in accordance with this *Guide*, at a rate of 200 kg Total N/ha/y there is sufficient certainty that the application will not cause an adverse effect, such that a detailed evaluation of the product breakdown and interaction with the discharge environment is not needed. It is possible to apply a higher rate of nitrogen from organic materials without causing an adverse effect, however a greater level of evaluation is needed to demonstrate that the effects due to nitrogen are acceptable. In addition, an application rate in excess of 200 kg Total N/ha/y would trigger the need to consider the contaminant loading to the soil (trace elements and organic compounds).

Thus the nitrogen application rate limit together with the product concentration limits provides confidence that adverse effects are unlikely. A third tier of control (Refer section 9.7) is proposed should organic products be used as soil replacement rather than a fertiliser.

Nitrogen application rates are therefore limited as follows:

- For the continual application of organic materials and derived products on productive land the nitrogen application rate should not exceed an average of 200 Kg total N/Ha/year over up to two years, based on evidence that the organic nitrogen present in the product is eventually mineralised. Additional applications should be based on a location specific site and crop assessment (e.g. nutrient management plan, refer section 7.3) demonstrating acceptability of the proposed application rate.

Organic material/product application to rebuild degraded soil or to refurbish contaminated land should be limited to a one-off nitrogen application of 150 kg mineral N/Ha. For most product applications this will be greater than that for productive land.

9.2 PATHOGEN CONTENT

Type A1 and A2 materials can be considered safe (i.e. essentially pathogen free) and no other risk management measures (other than precautionary handling instructions on the label) are necessary from a human health perspective.

Type B1 and B2 materials potentially contain pathogens at levels constituting a risk to human health. Section 4.2 of this *Guide* lists risk management techniques to minimise the risk of human infection, having regard to land use. These must be carried out by the discharger.

9.3 APPLICATION STRATEGIES

The method of applying organic materials and derived products to land (e.g., spraying, ploughing, surface application, soil injection etc) can determine the range of potentially adverse environmental effects and can therefore be an important risk management consideration.

Organic materials and derived products should only be applied to soils in ways, and under conditions, that will ensure they remain in place and do not move off-site. Sufficient buffer zones should be left to ensure that sensitive areas, such as waterways, are not directly affected (refer 4.8). The climatic conditions during application also need to be taken into account to ensure that the material cannot be blown or washed onto non-target areas. This will depend on the actual method

used for application, and the physical nature of the material, particularly its moisture content. Incorporation of organic material and derived products into the soil will minimise losses during application and ensure good contact with the soil, thus placing contaminants in close proximity to sites where immobilisation reactions can occur. Organic material remaining on the land surface may be subject to run-off, so steeply sloping sites should be avoided.

9.4 SOIL INCORPORATION

Soil incorporation (e.g., via ploughing, rotary hoeing, injection etc) is an effective risk management technique. It has the effect of:

- reducing exposure to pathogens (public or animal health risk);
- reducing the uptake of contaminants by grazing animals and transfer to the human food chain (animal health, public health and trade risks);
- removing vector access to pathogens (public health risk);
- maximising dilution and dispersal of contaminants, enhancing immobilisation reactions in soil; and
- minimising losses after application from wind blow or surface run-off, and effects on non-target areas.

Injection can be a good management practice on sites where established vegetation is present or for slopes greater than 6%.

For Type B1 and B2 material of human origin soil incorporation should take place within 24 hours of application, preferably as soon as practicable and the material should be incorporated to a depth of at least 100 mm, and preferably 200 mm.

Soil incorporation is preferred but not required by this *Guide* for discharges of Type A1 and A2 materials, for any application of manures onto farmland and for any product application into forestry. Soil incorporation before planting annual crops is a way of using organic material and derived product as a fertiliser and soil conditioner, and may therefore occur as a matter of course. Soil incorporation for Type B1 and B2 products avoids applying organic materials to leaf, salad, or root crops where there is a risk of direct transfer to animals or humans and prevents contamination of meat and dairy produce via direct ingestion of pasture and/or surface soil.

Care should be taken to ensure that soil mixing is sufficiently even in profile across the whole application area. Where surface plowing or similar is used a visual assessment will give an indication of the effectiveness of the mixing; checking for example that the soil has a consistent texture and colour vertically and laterally, and has been broken down without large clods or clumps of turf or soil attached to roots.

9.5 EXCLUSION PERIODS

Imposing public exclusion or stock withdrawal periods following the application of organic material of human origin to land is an important risk management technique for Type B1 and B2 products. It allows time for the natural die-off of pathogens in the soil and the re-establishment of vegetation cover on the land following soil incorporation.

Exclusion periods are particularly relevant where the organic material is surface-applied and is known to have a high pathogen content. Adequate publicity of exclusion periods is required, particularly where there has been a history of unconstrained public access and/or recreational use of the affected area. The establishment of buffer zones around the application area and/or erecting fences and warning signs should also be considered.

Soil testing should occur for *E. coli* before biosolids application and again afterwards to demonstrate that die-off to original background levels has occurred, prior to removing exclusion controls (refer 6.8.1 and 9.6).

Table 9-1 summarises the application methods and exclusion times for Type B1 products.

Table 9-1 Application methods and exclusion times for type B1 and B2 products

Land use	VAR requirement (refer Table 5-3)	Recommended controls
Salad crops, fruit, other crops for human consumption that may be eaten unpeeled or uncooked	▪ Mass of volatile solids in material shall be reduced by a minimum of 38%; or ▪ SOUR @ 20°C ≤ 1.5 g/m^3 for liquid sludges from aerobic processes; or ▪ pH ≥ 12 @ 25°C for at least 2 hours and pH ≥ 11.5 for 22 more hours.	May be applied immediately ***plus*** soil incorporation ***plus*** a further waiting period of at least 1 year before crops are sown (the land may be used for other purposes in the meantime).
	▪ Storage/restricted access	Store or lagoon for at least 1 year prior to application ***plus*** soil incorporation ***plus*** a further waiting period of at least 1 year before crops are sown (the land may be used for other purposes in the meantime).
Public amenities, sport fields, public parks, golf courses, play grounds, land reclamation	▪ Mass of volatile solids in material shall be reduced by a minimum of 38%; or ▪ SOUR @ 20°C ≤ 1.5 g/m^3 for liquid sludges from aerobic processes; or ▪ pH ≥ 12 @ 25°C for at least 2 hours and pH ≥ 11.5 for 22 more hours.	Store or lagoon for at least 6 months prior to application ***plus*** soil incorporation (***plus*** restriction on public access for period of time necessary to establish a full vegetation cover on the land.
	▪ Storage/restricted access	Store or lagoon for at least 1 year prior to application ***plus*** soil incorporation ***plus*** restriction on public access for a period of time necessary to establish a full vegetation cover on the land.
Fodder crops and pasture[1], orchards where dropped fruit is not harvested, turf farming, industrial or non-edible crops, crops that will be peeled or cooked before eating.	▪ Mass of volatile solids in material shall be reduced by a minimum of 38%; or ▪ SOUR @ 20°C ≤ 1.5 g/m^3 for liquid sludges from aerobic processes; or ▪ pH ≥ 12 @ 25°C for at least 2 hours and pH ≥ 11.5 for 22 more	May be applied immediately ***plus*** soil incorporation ***plus*** fruit and turf should not be harvested or pastures grazed for at least 6 months after applications ***plus*** crops that will be peeled or cooked should not be harvested for at least 6

Land use	VAR requirement (refer Table 5-3)	Recommended controls
	hours.	months after application.
	▪ Storage/restricted access	Store or lagoon for at least 1 year prior to application ***plus*** soil incorporation ***plus*** fruit and turf should not be harvested or pastures grazed for at least 6 months after applications ***plus*** crops that will be peeled or cooked should not be harvested for at least 6 months after application.
Forest, trees or bush scrubland	▪ Mass of volatile solids in material shall be reduced by a minimum of 38%; or ▪ SOUR @ 20°C ≤ 1.5 g/m^3 for liquid sludges from aerobic processes; or ▪ pH ≥ 12 @ 25°C for at least 2 hours and pH ≥ 11.5 for 22 more hours.	May be applied immediately ***plus*** public access restricted for 6 months ***plus*** buffer zones should be fenced and signposted.
	▪ Storage/restricted access	Store or lagoon for at least 1 year prior to application ***plus*** public access restricted for 6 months ***plus*** buffer zones should be fenced and signposted.

9.6 BACKGROUND PATHOGEN LEVEL EFFECTS

Soil samples should be taken before product application to land and tested for background *E. coli* concentrations. Soil sampling should be repeated prior to relaxing the isolation restrictions and isolation restrictions should not be removed unless it can be demonstrated that *E. coli* levels had

reduced to the original background levels. Control samples (i.e. from an adjacent site that has not had any organic material or derived products applied to it) should be taken before application and at the end of the restraint period to determine 'background' *E. coli* numbers as these may fluctuate naturally (with season), high background levels could also indicate input from feral animals, or from birds.

If numbers of *E. coli* are found to be 100 fold higher than background counts, the local authorities (including the consent authority) and the Medical Officer of Health (via the local public health unit) should be notified. Decisions about further restricted access or land-use should be made on a case-by-case basis after consultation with the local Medical Officer of Health (Health Act, 1956).

9.7 SOIL REPLACEMENT REQUIREMENTS

This *Guide* does not provide a specification for replacement soil:

- For the urban, commercial, industrial and rural residential areas refer the Ministry for the Environment National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health, April 2012, publication reference number: ME1092. Refer **http://www.mfe.govt.nz/publications/**
- For rural non-residential areas (agricultural land) refer Envirolink Tools Grant: C09X1402. Refer **http://www.envirolink.govt.nz/envirolink-tools/**. Which developed selective soil guideline values developed to protect terrestrial biota (Eco-SGVs).

However this Guide recommends the following for the situation where organic products are used as a complete soil replacement:

- In the rural environment; the product must meet the *Guide* product concentration limits and the nitrogen application limits based on the land type i.e. 'ordinary' or degraded. The soil should be measure before and after to ensure that the Eco-SGV limits are maintained, except for contaminated land where the resultant soil values could be higher.
- In the urban environment; the product concentration must meet the Eco-SQV concentrations except for Zn. Data shows that green waste and food waste Zn concentrations are around 300ppm. The Eco-SQV limit for Zn is only 190ppm. This would limit the application of home compost being applied to home gardens. The 300ppm comes from the soil limits in the 2003 Biosolids Guidelines which is considered more appropriate. Data suggests there will be no issue with the other metal limits in the Eco-SQVs.

Currently there are no Eco-SGV soil limits for Hg or Ni and the 2003 Biosolids Guideline soil limits of 1ppm Hg and 60ppm Ni should be used**.**

Table 9.2 summarises the proposed soil replacement metal limits in comparison to the Guide product metal limits (Table 5-5).

Table 9-2 Product and soil replacement metal limits

Parameter	Product concentration limit (mg/kg dry weight)	Soil replacement limit (mg/kg dry weight)
Arsenic	**30**	**20**
Cadmium	**10**	**3.1**
Chromium	**1500**	**300**

Parameter	Product concentration limit (mg/kg dry weight)	Soil replacement limit (mg/kg dry weight)
Copper	1250	150
Lead	300	530
Mercury	7.5	1
Nickel	135	600
Zinc	1500	300

SCHEDULE 1 EXAMPLE SAFETY DATA SHEET

Example Safety Data Sheet (Pg 1 of 5)

PRODUCT AND COMPANY IDENTIFICATION	
Product name:	ABC Compost
Company:	ABC Biowaste Ltd
Address:	
Telephone number:	
Emergency telephone numbers:	0800 CHEMCALL (0800 243 622) 24 hours 0800 POISON (0800 764 766) National Poisons Centre 111 – New Zealand Fire Service
HAZARD(S) IDENTIFICATION	
HSNO Hazard Classifications: Based on available information, not classified as hazardous according to criteria in the HS (Minimum Degrees of Hazard) Regulations 2001.	
COMPOSITION / INFORMATION ON INGREDIENTS:	
Ingredients	**Proportion**
Compost mixes are made by blending naturally occurring materials with composted plant material including bark and manure. The material contains a variety of living micro-organisms including bacteria, fungi and protozoa. Minerals & fertilisers	**>90%** **>10%**
FIRST-AID MEASURES	
For advice, contact the National Poisons Centre 0800 POISON (0800 764 766) or a doctor/physician. This product is made from organic materials which may contain living micro-organisms, including bacteria, fungi and protozoa. This product also contains mineral and fertiliser additives. Read the safety data sheet and packaging information before opening and using this product. ▪ Avoid breathing product dust or mists ▪ Always wear gloves and wash hands immediately after use. Seek medical attention if you develop high fever or respiratory symptoms including chills, shortness of breath or cough within two weeks of using this product.	

Inhalation: Remove to area free from risk of further exposure.

This product may contain micro-organisms which can be harmful to health and, although it occurs infrequently, some can result in serious illness (including *Legionnaires'* disease) in people especially the elderly, smokers and those with impaired respiratory health or immunity. Serious infection is rare, however in severe cases; it can be life-threatening.

Seek medical attention if you develop high fever or respiratory symptoms including chills, shortness of breath or cough within two weeks of using this product.

Avoid breathing dust, vapour, aerosols and/or liquid mist (bioaerosols), inhalation may irritate, inflame or sensitise the nose, throat and lungs.

Ingestion: If swallowed, rinse mouth with water, do not induce vomiting. Give a glass of water to drink, seek medical advice. Seek medical attention if you develop high fever or respiratory symptoms including chills, shortness of breath or cough within two weeks of using this product.

Eye Contact: If in eyes, wash out immediately with water, continue to wash eye thoroughly for at least 15 minutes with clean fresh water. In all cases of eye contamination it is a sensible precaution to seek medical advice.

Direct contact with this material or its dust and/or liquid mists (bioaerosols) may cause eye infection or irritation. Seek medical attention if eye irritation or infection occurs, you develop high fever or respiratory symptoms including chills, shortness of breath or cough within two weeks of using this product

Skin Contact: If skin contact occurs, remove contaminated clothing and wash skin with soap and water. Direct contact with this material or its dust and/or liquid mists (bioaerosols) may cause skin irritation (dermatitis), and/or skin infection. Seek medical attention if skin irritation or infection occurs, you develop high fever or respiratory symptoms including chills, shortness of breath or cough within two weeks of using this product.

Notes to Physician: Treat symptomatically taking into account product risks and potential for serious illness (including *Legionnaires'* disease) listed above.

FIRE-FIGHTING MEASURES

Suitable Extinguishing Media: Not combustible, however, if material is involved in a fire use: Media applicable to surrounding fire.

Precautions for fire fighters and special protective clothing: Not combustible, however, if material is involved in a fire fighters to wear breathing apparatus and suitable protective clothing applicable to surrounding fire.

Hazards from combustion products: Non-combustible

SPILLAGE, ACCIDENTAL RELEASE MEASURES

Emergency Procedures: Keep unnecessary and unprotected personnel from entering the area. If contamination of sewers or waterways has occurred advise local emergency services.

Personal Precautions and Protective Equipment: Refer to SDS section 7 for handling and precautionary measures. Refer to SDS section 8 for additional information and personal

protection equipment.

Environmental Precautions: Contain - prevent from entering sewers, waterways and/or groundwater.

Methods and Materials for Containment and Clean up: Sweep up spilled material, avoid creating and breathing in dust when cleaning up, e.g. by wet sweeping, collect and store in properly labelled, sealed containers for safe disposal. If contamination of sewers or waterways has occurred advise local emergency services.

HANDLING AND STORAGE

Precautions for safe handling and storage: Read the safety data sheet and packaging information before opening and using this product. Seek medical attention if you develop high fever or respiratory symptoms including chills, shortness of breath or cough within two weeks of using this product.

Handling: Keep out of reach of children and animals. This product is made from organic materials which may contain living micro-organisms, including bacteria, fungi and protozoa which can be harmful to health and, although it occurs infrequently, some can result in serious illness (including *Legionnaires'* disease) in people especially the elderly, smokers and those with impaired respiratory health or immunity. Serious infection is rare, however in severe cases; it can be life-threatening.

This product also contains mineral and fertiliser additives.

To reduce risks when using this product, please take the following safety precautions:

- Always wear gloves (AS/NZS 2161 standard) when handling and wash hands immediately after use.
- Work in a well-ventilated area
- Avoid inhaling product dust or mist by wearing a disposable face mask or respirator securely covering the nose and mouth (AS/NZS 1715 and AS/NZS 1716 standard), especially if:
  - Handling the product in an enclosed space or in windy conditions.
  - You are elderly or have impaired respiratory health or immunity.
  - You are working with bulk quantities.
- Open the bag carefully and direct the opening away from your face.
- Keep the product damp to reduce airborne particles such as dust and avoid creating dust when cleaning up.
- Water gardens, soil mix and potted plants gently, using a low pressure hose.
- Avoid skin, mouth and eye contact (eye protection AS/NZS 1336 standard).
- Avoid transferring product from hand to mouth.
- After work, remove any protective clothing. Wash hands, arms and face after handling.
- Do not eat, drink or smoke when using this product or in the areas where they may become contaminated with this material.
- Avoid raising soil near evaporative coolers.

Seek medical attention if you develop high fever or respiratory symptoms including chills, shortness of breath or cough within two weeks of using this product.

Storage: Store out of reach of children and animals. Store in the closed, original container in a dry, cool, well-ventilated area out of direct sunlight.

EXPOSURE CONTROLS AND PERSONAL PROTECTION

Personal Protective Equipment: No WES values are set by EPA or NZ Dept. of Labour Health & Safety for this substance at this time. However, Workplace Exposure Standard(s) for particulates not otherwise classified:

- Inhalable dust: WES-TWA 10 mg/m3
- Respirable dust: WES-TWA 3 mg/m3

This product is made from organic materials which may contain living microorganisms, including bacteria, fungi and protozoa which can be harmful to health and, although it occurs infrequently, some can result in serious illness (including *Legionnaires'* disease) in people especially the elderly, smokers and those with impaired respiratory health or immunity. Serious infection is rare, however in severe cases; it can be life-threatening.

This product also contains mineral and fertiliser additives.

Ensure ventilation is adequate to maintain low air concentrations of dust, vapour, bioaerosols and mists. Keep packaging closed when not in use.

Respiratory Protection: Use with adequate ventilation, avoid breathing dust, vapour, aerosols or mist.

If there is a risk of inhalation of dust, vapour, aerosols and/or liquid mist (bioaerosols), wear a suitable particulate respirator meeting the requirements of AS/NZS 1715 and AS/NZS 1716.

Skin protection: Avoid contact with skin. Wear standard light gloves, as specified in AS/NZS 2161 and keep product moist when handling. Wear protective clothing.

After use and before eating, drinking or smoking, wash hands, arms and face thoroughly with soap and water. Wash contaminated clothing and other protective equipment before storage or re-use.

Eye protection: Avoid contact with eyes.

If there is a risk of exposure to dust and/or liquid mists, also wear dust resistant eye protection, as specified in AS/NZS 1336.

PHYSICAL AND CHEMICAL PROPERTIES	
Appearance:	Coarse Brown Solid.
Odour:	Organic.
Solubility in water:	Insoluble in water.
Specific Gravity (kg/l @ 20°C):	0.4 – 0.8 kg/litre (bulk density)
Flash point (°C):	Not applicable.
STABILITY AND REACTIVITY	
Chemical Stability:	Stable under normal conditions of use.
Conditions to avoid:	Avoid contact with foodstuffs. Avoid contact with other chemicals.

Incompatible materials:	Incompatible with oxidising agents.
Hazardous decomposition products:	Oxides of carbon, oxides of phosphorus, oxides of sulphur and ammonia.
Hazardous Reactions:	None known.

TOXICOLOGICAL INFORMATION

Potential Health Effects: This section includes possible adverse effects, which could occur if the product is not handled in the recommended manner.

This product is made from organic materials which may contain living micro-organisms, including bacteria, fungi and protozoa which can be harmful to health and, although it occurs infrequently, some can result in serious illness (including *Legionnaires'* disease) in people especially the elderly, smokers and those with impaired respiratory health or immunity. Serious infection is rare, however in severe cases; it can be life-threatening.

Seek medical attention if you develop high fever or respiratory symptoms including chills, shortness of breath or cough within two weeks of using this product.

All people working regularly with these and other landscaping products should ensure that they are adequately protected against tetanus**.**

Eye Contact: Dust and/or liquid mist (bioaerosols) may irritate the eye resulting in redness and watering, or eye infection.

Skin Contact: Contact with skin may cause irritation and in some people may lead to skin sensitisation, dermatitis or skin infection.

Ingestion: Swallowing can result in abdominal discomfort. There is an increased risk of gastrointestinal infections.

Inhalation: Avoid breathing dust, vapour, aerosols and/or liquid mist (bioaerosols), inhalation may irritate, inflame or sensitise the nose, throat and lungs resulting in illnesses ranging from hay fever and asthma to pneumonia (eg. legionnaire's disease) and pneumonia like illnesses and aggravate pre-existing conditions such as asthma and bronchitis.

Toxicological Data: No LD50 information available for the product.

ECOLOGICAL INFORMATION

Ecotoxicity: Contain - prevent from entering sewers, waterways and/or groundwater.

DISPOSAL INFORMATION

Disposal methods: Dispose of this product by using in accordance with the product label directions.

Packaging disposal – Dispose of packaging in accordance with the product label directions or empty packaging, wrap in paper, place in a plastic bag and dispose safely with domestic rubbish.

If wastes and/or packaging cannot be disposed of according to the product label directions or instructions above, disposal must be in accordance with your local area regulatory authorities following all applicable regional, national and local laws and regulations.

TRANSPORT INFORMATION

Not classified as a Dangerous Good for Transport.	
REGULATORY INFORMATION	
EPA New Zealand Approval Code: Based on available information, not classified as hazardous according to criteria in the HS (Minimum Degrees of Hazard) Regulations 2001.	
OTHER INFORMATION	
Date of preparation of SDS: **Abbreviations in SDS:**	November 2017. **EPA**: The Environmental Protection Authority of New Zealand. **LD50**: Lethal Dose-50%. The doses of a chemical that will kill 50% of the test animals receiving it. **WES**: Work place exposure standard set by EPA or NZ Dept. of Labour Health & Safety.

SCHEDULE 2 RECOMMENDED TEST METHODS

There are a number of analytical methods for contaminants and pathogens. The following methods (or updates where available) are recommended:

Campylobacter: *Either*

a) AgResearch Meat Industry Microbiological Methods (2011). Chapter 7 Testing Meats and Meat Products for Pathogens Section 7.3 – Thermotolerant Campylobacter. Edition 5 (Abbreviated as MIMM 2011).
b) ISO 10272-1:2006 Microbiology of food and animal feeding stuffs -- Horizontal method for detection and enumeration of Campylobacter spp. -- Part 1: Detection method

Emergent Organic Compounds (EOCs): All of the chemicals can be analysed by GCMS after different extraction techniques. Refer CIBR report dated 7 August 2017 by Dr Grant Northcott (Vol2 – Technical Manual) for comments on extraction techniques and reporting protocols.

Enteric Viruses: *specific test method*

Adenoviruses are a group of enteric viruses transmitted by the faecal–oral route and are recognised as one of the more persistent enteric viruses when subjected to environmental stresses such as temperature, visible light and UV irradiation. Adenoviruses occur in high numbers in sewage and sludges. Adenoviruses were proposed as the sentinel virus for UV irradiation of wastewater effluent (USEPA, 2003) and virus contamination of shellfish (Pina et al., 1998). Adenoviruses are proposed here as an indicator of virus persistence in biosolids.

The recommended methodology requires detection of infectious adenovirus by culture in a susceptible cell line followed by PCR detection (culture-PCR). The combined use of culture and molecular methods allow detection of those adenoviruses that do not produce clearly observable cytopathic effect (CPE), avoids misinterpretation of CPE caused by other viruses or non-infectious material, and only detects infectious viruses.

The method for their detection as described in the 2003 version of the *Guidelines for the Safe Application of Biosolids to Land in New Zealand* has been modified (by Joanne Hewitt, ESR). The amended method should include the addition of a PEG precipitation step for virus concentration, use of culture-PCR using HEK-293 cells with a generic adenovirus PCR or qPCR assay that will detect all adenovirus types (Lewis and Metcalf 1988; Hernroth 2002, Chapron 2000; Hewitt Pers Comm.).

REFERENCES

Chapron CD, Ballester NA, Fontaine JH, Frades CN, Margolin AB. 2000. Detection of astroviruses, enteroviruses, and adenovirus types 40 and 41 in surface waters collected and evaluated by the information collection rule and an integrated cell culture-nested PCR procedure. Appl Environ Microbiol 66, 2520-2525.

Hernroth BE, Conden-Hansson AC, Rehnstam-Holm AS, Girones R, Allard AK. 2002. Environmental factors influencing human viral pathogens and their potential indicator organisms in the blue mussel, *Mytilus edulis*: the first Scandinavian report. Appl Environ Microbiol 68, 4523-4533.

Lewis GD Metcalf TG. 1988. Polyethylene glycol precipitation for recovery of pathogenic viruses, including hepatitis A virus and human rotavirus, from oyster, water, and sediment samples. Appl Environ Microbiol 54, 1983-1988.

Pina S, Puig M, Lucena F, Jofre J. Girones, R. 1998. Viral pollution in the environment and in shellfish: Human adenovirus detection by PCR as an index of human viruses. Appl Environ Microbiol 64, 3376-3382.

USEPA. 2003. Under 40 CFR Part 503, Appendix H. Method for the recovery and assay of total culturable viruses from sludge, Control of pathogens and vector attraction in sludge, vol. EPA/625/R-92/013, Washington, DC, US.

***E. coliform*:** *Part 9221 F or Part 9223 B, Standard Methods for the Examination of Water and Wastewater (APHA, 1998).*

***Helminth ova*:** *W.A. Yanko, Occurrence of Pathogens in Distribution and Marketing Municipal Sludges, EPA/600/1-87/014, 1987. PB 88-154273/AS, National Technical Information Service, Springfield, VA.*

Percent volatile solids reduction calculation: *Environmental Regulations and Technology: Control of Pathogens and Vectors in Sewage Sludge (USEPA, 1992).*

***Salmonella sp bacteria*:** *Part 9260 D, Standard Methods for Examination of Water and Wastewater, (APHA, 1988), or Detection and enumeration of salmonella and Pseudomonas aeruginosa (Kenner and Clark, 1974).*

Specific oxygen uptake rate*: Part 2710 B, Standard Methods for the Examination of Water and Wastewater (APHA, 1998).*

Total, fixed, and volatile solids: *Part 2540 G, Standard Methods for the Examination of Water and Wastewater (APHA, 1998).*

No test methods are specified for metals, since there are a number of methods that can be used for measuring these contaminants in organic material. However, New Zealand laboratories generally adopt USEPA methods, (see https://www.epa.gov/measurements/collection-methods where their analytical methods can be accessed).

GLOSSARY

Agricultural land: Horticultural, cropping and pastoral land.

Agronomic rate: The agronomic rate for biosolids application is designed to provide the amount of nutrients needed by a crop or vegetation to attain a defined yield, while minimising the amount of nitrogen that will pass below the root zone of the crop or vegetation to the groundwater.

AOX: the abbreviation of the sum parameter for water soluble "adsorbable organic halogens" in which 'A' stands for adsorbable, 'O' for organic and 'X' for the halogens chlorine, bromine and iodine. Most AOXs do not have a specific use and are not intentionally manufactured but are by-products.

Beneficial: In the context of organic material applied to productive land, the product must improve soil physical, chemical or biological health.

Beneficial reuse: when a material destined for landfill is captured and made into a high-value material or product that will feed into, or benefit, another system or product. For example, transforming food waste into compost, or soil conditioner that will be used to improve the health of the soil to grow food or plant life that will be beneficial to the community or environment.

Bio-availability: The availability of substances for uptake by plant and animal species.

Biosolid: A sewage or sewage sludge derived from a sewage treatment plant that has been treated and/or stabilised to the extent that it is able to be safely and beneficially applied to land. Biosolid is a Biowaste Product that contains waste material of human origin.

Bulk use: Application of organic waste material to land equalling or exceeding 50 m^3 by volume per application.

Composting: A product manufacturing process that biologically stabilises organic materials. It is ordinarily an aerobic process taking place at thermophilic temperatures (about 55°C) because of heat released by biochemical transformations.

Contaminant: Any substance (including heavy metals, organic compounds and micro-organisms) that, either by itself or in combination with other substances, when discharged onto or into land or water, changes or is likely to change the physical, chemical or biological condition of that land or water.

Contaminant concentration limits: The maximum permissible amount of a given contaminant in organic materials or derived products (see Table 5-5 of this Guide).

Degraded Land: Land where there is a decrease in the optimum functioning of soil in ecosystems.

DEHP: the most common member of the class of phthalates which are used as plasticizers.

Discharger of organic waste products: The party responsible for applying biosolids, manures or derived products to land; the discharge consent holder.

DS: Dry solids.

EMS: Environmental management system.

Grazed land: Land that is being grazed or will be grazed in the next 12 months. Grazed land may have a cover of pasture or fodder crops.

Groundwater: Sub-surface water from which wells or springs are fed; strictly, the term applies only to water below the water table.

Heat drying: A manufacturing process whereby sludges or slurries are dried by direct or indirect contact with hot gases to reduce the moisture content, typically to 10% or lower.

***Helminth*:** Parasitic worm-like invertebrate.

Horticultural land: Land used for process food crops, leaf crops, root crops.

LAS: linear alkylbenzene sulfonates and commonly used in cleaning agents.

Lime stabilisation: A manufacturing process involving the addition of sufficient lime or lime mixtures to raise the pH of the material to 12 after 2 hours of contact.

Manure: organic matter, mostly derived from animal faeces

Maturation: The conversion and amendment of the rapidly biodegradable components in the organic material (e.g. sludges and manures) to substances similar to soil humus that slowly decompose. Compost that is insufficiently mature will reheat and generate odours in storage and upon rewetting. It may also inhibit seed germination by generating organic acids and inhibit plant growth by removing nitrogen as it decomposes in the soil.

Most probable number (MPN): A sample analysed by dispersion in an extracting solution, by excessive dilution, and then using statistical analysis based on the positive or negative growth for each sample.

NP/NPE: nonylphenols and nonylphenolethoxylates are surfactants.

Nuisance: Something which is noxious, dangerous or offensive.

Organic product: A good quality product manufactured from a mixture of natural organic material.

Pastoral land: Grazed land, including land used for dairy, beef, sheep and deer production.

Pathogens: Disease-causing micro-organisms such as certain bacteria, viruses and parasites.

PFOA: Perfluorooctanoic acid is a synthetic surfactant and commonly used in the emulsion polymerization of fluoropolymers.

PFOS: Perfluorooctanesulfonic acid is another fluorosurfactant and commonly used in stain repellents.

PFU: Plaque-forming unit.

pH: A measure of the hydrogen ion concentration in a solution. On the pH scale of 0–14, a value of 7 represents a neutral condition; decreasing values (below 7) indicate increasing hydrogen ion concentration (acidity); increasing values, above 7, indicate decreasing hydrogen ion concentration (alkalinity).

Phyto-availability: The availability of substances (e.g., metals, nutrients) for plant uptake.

Phyto-toxic effects: Adverse toxic effects of contaminants on plant growth and development.

Producer of organic products: A person or organisation that either produces organic material by operating a product manufacturing facility (e.g., a composting, heat-drying, lime stabilisation or digestion plant) or who manufactures a blended product from organic materials.

Protozoa: Small, single-celled animals including amoebae, ciliates and flagellates.

Resource Recovery: is the selective extraction of disposed materials for a specific next use, such as recycling, composting or energy generation in order to extract the maximum benefits from products, delay the consumption of virgin resources and reduce the amount of waste generated.

Sensitive sites: Sites at which organic material should not be applied due to the ecological, social or cultural values associated with them.

Sewage sludge: The unstabilised organic solid material settled out from domestic and industrial wastewater during the treatment process. It contains pathogens, organic material, nutrients, metals and other chemicals from residential (human waste) and commercial properties, and tradewaste discharges. Sewage sludge is an unavoidable product of wastewater treatment. Untreated sewage sludge would not meet the stabilisation and/or contaminant grades defined in this Guide and cannot be beneficially used without further treatment and stabilisation.

SOUR: Standard oxygen uptake rate.

Urban land: Domestic gardens, lawns, public parks and gardens, golf courses, sports fields, turf farming, land rehabilitation.

VAR: Vector attraction reduction (see below).

Vectors: Organisms such as rodents and insects that are attracted to putrescible organic matter and that may spread disease by carrying and transferring pathogens.

Vector attraction reduction: Processes by which organic material is treated to remove or reduce substances that attract vectors.

Verified: Independently checked or audited.

Vermicompost: Mixture of vermicast and partially unprocessed organic matter.

Vermicomposting: The use of earthworms to convert organic waste into fertilizer.

Vermicast: (also called worm castings, worm humus or worm manure) Solid organic product resulting from the transformation of compostable organic materials in a controlled vermiculture process, which complies with the characteristics of Table 3.1, NZS4454:2005

Wahi tapu: Maori sacred site.

Waste: an unwanted or undesired material or substance left over or used inefficiently from a manufacturing process (industrial, commercial, or agricultural operations,) or from commercial activities.

Worm Tea: (or compost tea) is a liquid fertiliser made by steeping finished compost in water.

WSP: Waste stabilisation pond.

WWTP: Wastewater treatment plant.

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