Guideline: Biosolids Management in the Northern Territory

ntepa Northern Territory Environment Protection Authority

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Acronyms	Full form
BCC	Biosolids Contaminant Concentration
CLAR	Contaminant limiting application rate
CoC	Contaminant of concern
DLPE	Department of Lands, Planning and Environment
Dry wt.	Dry weight
EIL	Ecological investigation level
EMP	Environmental Management Plan
EPA	Environment Protection Authority
GED	General environmental duties
HEPA	Heads of EPAs
HIL	Human health-based investigation level
MASCC	Maximum allowable soil contaminant concentration
MCL	Maximum contaminant load
mg / kg	Milligram per kilogram
MPN	Most probable number
NATA	National Association of Testing Authorities
NEMP	National Environmental Management Plan
NLAR	Nutrient Limiting Application Rate
NT	Northern Territory
NT EPA	Northern Territory Environment Protection Authority
PFAS	Per- and poly-fluoroalkyl substances

Acronyms	Full form
PFHxS	Perfluoro hexane sulfonate
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctane sulfonate
PFU	Plaque forming units
Power and Water	Power and Water Corporation
t	Tonne
WSP	Water stabilization pond
WwTP	Waste water treatment plant

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1. Introduction

This Guideline has been prepared by the Department of Lands, Planning and Environment (DLPE) for the Northern Territory Environment Protection Authority (NT EPA) with advice from the Power and Water Corporation (Power and Water) to enable the beneficial reuse of biosolids in the Northern Territory under the *Waste Management and Pollution Control Act 1998* (the Act) and the Waste Management and Pollution Control (Administration) Regulations 1998.

Biosolids have beneficial properties, however, if not carefully managed, may pose risks to human health and the environment. This Guideline provides a method for biosolids reuse which incorporates a classification system based on contaminant and pathogen concentrations that restricts the use of biosolids according to the level of risk while meeting the requirements of the Act. The purpose of this Guideline is to enable the sustainable and safe use of biosolids in the Northern Territory, in a way that meets the requirements of the General Environmental Duty (GED) under section 12 of the Act.

This Guideline is applicable to the following entities:

- Producers – Operators of wastewater treatment plants (WwTPs) or waste stabilisation ponds (WSP) and associated on-site and off-site biosolids storage/treatment facilities.
- Transporters – Operators, contractors, councils or farmers who transport biosolids.
- End users – Any entity reusing biosolids for an allowable use identified within this Guideline.

DLPE should be contacted for advice regarding the proposed reuse of biosolids for a purpose other than those identified within this Guideline.

1.1. Biosolids

Biosolids are a product of the sewage treatment process that are rich in nutrients and organic matter which are beneficial for soil conditioning while also having beneficial energy properties. Biosolids contain levels of nitrogen, phosphorus and organic matter with potassium, trace elements and beneficial bacteria which have the potential to improve soil fertility, structure and water retention. In addition to the beneficial uses of biosolids application to soils, biosolids can be used in the production of energy. Several methods can be applied to biosolids for energy production. These include the production of biofuel, gasification to produce high energy gases and pyrolysis to produce biochar and pyrolysis gas.

This Guideline *does not apply* to other wastes such as: septic wastes, untreated sewage sludge, industrial or food processing sludge, animal manures or abattoir wastes or household organic waste.

1.2. Objectives

This Guideline has been developed to meet the following Objectives:

- To provide a framework to enable the sustainable and beneficial reuse of biosolids.
- To identify the statutory obligations and responsibilities of producers, transporters and end users of biosolids to ensure that relevant regulatory requirements are met.
- To provide biosolids quality standards to enable the safe beneficial reuse of biosolids that will protect agricultural products, human and animal health and the environment.
- To provide best management practices to support sustainable, practical and safe beneficial reuse of biosolids.
- To provide suitable controls to protect human and environmental health post application.

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- To provide best practice methods for monitoring, reporting and record keeping systems to demonstrate compliance with the GED under the Act and this Guideline.

1.3. Literature Reviewed

This Guideline is based on current expectations of biosolids management in line with other Australian jurisdictions. A summary of the available biosolid guidelines used to inform this Guideline is provided in **Table 1.** Further detail regarding the development of this Guideline is provided in **Appendix 4**.

Table 1 Biosolid Guidelines Considered in the Development of this Document

Jurisdiction	Report Name	Year in Effect	Reference
Northern Territory	National Water Quality Management Strategy. Guidelines for Sewerage Systems Biosolids Management. (Note: Australian Guidelines assumed applicable in the NT)	2004	NRMMC (2004)
Australian Capital Territory	ACT Waste Management Strategy. Towards a sustainable Canberra. Reducing waste and recovering resources to achieve a sustainable, carbon-neutral Canberra. 2011–2025.	2011	ACT ESD (2011)
New South Wales	Environmental Guidelines: Use and Disposal of Biosolids Products.	1997	NSW EPA (1997)
Queensland	End of Waste Code Biosolids (ENEW07359617). Waste Reduction and Recycling Act 2011. (Version 2.03). (Note: Version 1.0 released in 2019)	2023	QLD DES (2023)
South Australia	Guidelines for the Safe Handling and Reuse of Biosolids in South Australia.	2020	SA EPA (2020)
Tasmania	Tasmanian Biosolids Reuse Guidelines.	2020	EPA Tas (2020)
Victoria	Guidelines for Environmental Management. Biosolids Land Application.	2004	EPA Vic (2004)
Western Australia	Western Australian Guidelines for Biosolids Management.	2012	WA DEC (2012)

1.4. Statutory Framework

Waste, including sewage sludge and residues including nightsoil and septic tank sludge, as well as soils contaminated with heavy metals, are classified as 'listed wastes' as defined by the Act and associated regulations. It is important to note that biosolids differ from sewage sludge in that they are dried, treated and stabilized prior to use and are not a 'listed waste'. Therefore, approval and/or licensing by the NT EPA is not required in accordance with the Act when treating, storing, transporting, or reusing biosolids.

However, even though biosolids are not a 'listed waste', entities handling biosolids from treatment and storage through to transport and reuse are required to always comply with the Act including the general environmental duty (GED) under Section 12. This Guideline provides direction on meeting GED requirements under Section 12 of the Act. Other guidelines to assist proponents to avoid environmental impacts are available on the NT EPA website.

Figure 1 outlines how the handling and application of biosolids following this Guideline can be used to meet the requirements under Section 12 of the Act. It remains the responsibility of the entities handling biosolids to always comply with relevant Northern Territory legislation[1].

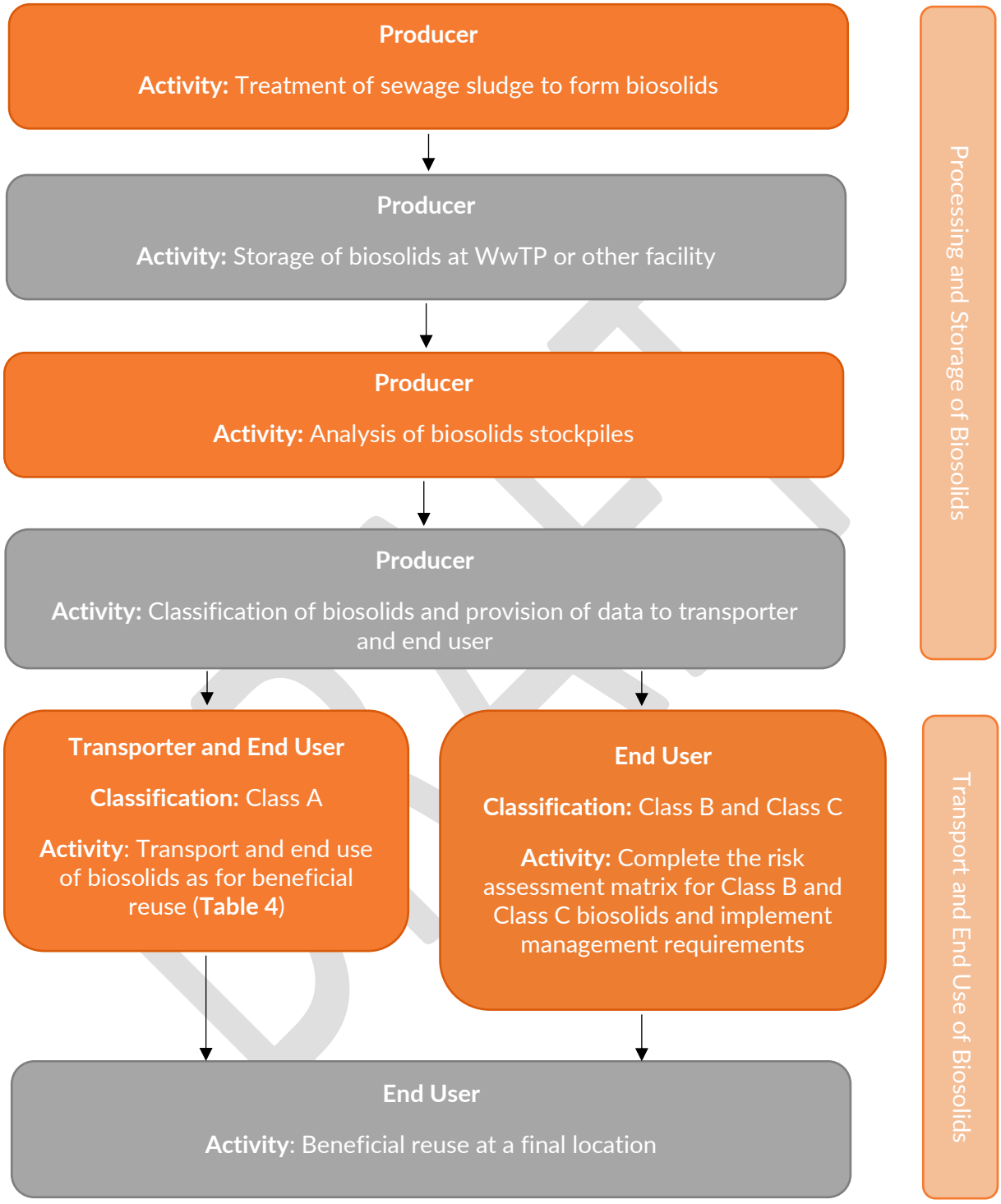

Figure 1 Compliance requirements for the production and end use of biosolids material under Section 12 of the *Waste Management and Pollution Control Act 1998*

[1] This information is correct at the time of publication of this Guideline.

1.5. How to Use this Guideline

There are three main steps to using this Guideline:

- **Step 1**: Classification of the biosolids.
- **Step 2**: Complete the Biosolids Risk Assessment Matrix accompanying this Guideline which is mandated for Class B and Class C biosolids and voluntary (good practice) for Class A biosolids.
- **Step 3**: Follow necessary requirements for beneficial reuse of biosolids to demonstrate compliance with the GED under Section 12 of the Act.

Each step is detailed below.

Step 1: Classification of the Biosolids

Biosolids are to be sampled and categorised by the entity producing the biosolid as close to the end-product condition as possible prior to removal from the treatment or storage site. This is an important step as characterizations will change throughout the treatment process as pathogen concentrations reduce during treatment and drying. Allowable uses for biosolids are outlined in **Table 2**.

Table 2 Biosolids Allowable Use

Class of Biosolids	Allowable Use
Class A	Unrestricted use, which may include: • Home lawns and gardens • Urban landscaping • Agriculture • Forestry • Site Rehabilitation • Energy production
Class B	Uses restricted to the following: • Urban landscaping • Agriculture • Forestry • Site rehabilitation • Energy production
Class C	Uses restricted to the following: • Energy production

This process will assess the contaminant and pathogen concentrations of the biosolids, which will then determine the overall biosolids classification. Relevant contaminant and pathogen concentrations are shown in **Table 3** and **Table 4**. The producer may use the Biosolids Risk Assessment Matrix in this step to assist in classifying the biosolids stockpile and help identify potential suitable uses for the stockpile to assist the end user.

Table 3 Contaminant Concentrations

Contaminant (mg/kg dry wt)	C1	C2	C3
Cadmium	≤3.0	≤20	>20
Chromium Total [(1)]	≤100	≤250	>250
Copper	≤150	≤2,500	>2,500
Mercury	≤1	≤4	>4
Zinc	≤300	≤2,500	>2,500
Fipronil	≤0.02	≤8.0	>8.0
Bifenthrin	≤8.0	≤600	>600
PFOS + PFHxS	≤0.0011	≤0.031	>0.031
PFOA	≤0.005	≤0.13	>0.13
[(1)]Cr(VI) is unlikely to occur in biosolids as it is a strong oxidising agent.			

Table 4 Pathogen Concentrations

Pathogen	P1	P2	P3
E. coli	<100 MPN/g	≥100 MPN/g ≤1,000 MPN/g	>1,000 MPN/g
Enteric virus	<1 PFU/50g	≥1 PFU/50g	-
Helminth ova	<1 viable ova/50 g	≥1 viable ova/50 g	-
Burkholderia [(1)]	No detects/50g	1 detects/50g	>1 detects/50g
Naegleria	No detects/50g	1 detects/50g	>1 detects/50g
[(1)] North of Tennant Creek only			

If the producer has any reason to suspect any other contaminants/pathogens in addition to those listed in tables above are present in the biosolids then it is incumbent on the producer to conduct appropriate testing and risk assessment as required. This is particularly relevant for PFAS considering that a significant amount of precursor compounds[2] are typically found in biosolids (HEPA 2022). The need to sample for additional contaminants should be considered on a case-by-case basis and reflect the inputs into the individual WwTP (e.g. trade waste inputs) (NRMMC 2004).

Non-biodegradable materials were not identified as being contaminants of concern in biosolids as these are generally removed by screens prior to sewage entering WwTPs. Non-biodegradable materials are discussed further in **Section 2.2**.

None of the Australian State and Territory biosolid guidelines consulted referred to contaminant limits for microplastics. As such there are no available guidelines for microplastics from Australian jurisdictions to adopt as contaminant limits for microplastics for use in the Northern Territory. This may change for future biosolids guidelines (refer to further discussion on microplastics in **Appendix 4-2.2**).

[2] PFAS precursors are complex PFAS compounds and polymeric PFAS compounds that can break down to release PFOS, PFHxS, PFOA and other longer and shorter alkyl chained PFAS.

All contaminant and pathogen concentrations listed in **Table 3** (C1) and **Table 4** (P1) must be met for the biosolids to be classified as Class A for unrestricted use. In this instance, end users will require a copy of the Biosolids Reporting Form (**Appendix 1**) from the producers.

If one contaminant or pathogen exceeds the limit, then the biosolids are classified as Class B or Class C and will require completion of the Biosolids Risk Assessment Matrix as outlined in **Table 5**.

Table 5 Biosolid Classification and Requirements for Risks Assessments

Class of Biosolids	Contaminant Concentrations	Pathogen Concentrations	Risk Assessment Matrix Required.
Class A	C1	P1	No
Class B	C1	P2	Yes
Class B	C2	P1	Yes
Class B	C2	P2	Yes
Class C	C3	P1	Yes
Class C	C3	P2	Yes
Class C	C1	P3	Yes
Class C	C2	P3	Yes
Class C	C3	P3	Yes
Note: Class C biosolids are intended for energy production only and will be destroyed in this process			

Step 2: Conduct the Risk Assessment on Class B and Class C Biosolids

End users proposing to conduct beneficial reuse of Class B or Class C biosolids must undertake a site-specific risk assessment to determine whether the biosolids can be safely reused at their site. A Biosolids Risk Assessment Matrix is available on the NT EPA website as an Excel file to assist end users with this step: Include link. Refer to **Section 7** for further information on the Biosolids Risk Assessment Matrix.

Where the risk assessment demonstrates that the Class B biosolids are unable to be safely applied to land by the end user, further treatment or blending with other materials may be required to lower contaminant or pathogen concentrations[3]. If biosolids are classified as Class C, then further treatment or blending with other materials may also be conducted to change the classification. In these cases, the assessment process will need to be repeated from **Step 1** for the resultant biosolids by the end user and appropriate records are maintained.

Producers may use the Biosolids Risk Assessment Matrix to assist with classification of biosolids, however it is the end users of the biosolids who are responsible for identifying the need for completing the Biosolids Risk Assessment Matrix and to retain the records of Class B biosolids applied to their land.

[3] Biosolids products are a blend of multiple products including biosolids. Blending is a common practice across all Australian jurisdictions to reduce high metals concentrations such that biosolids may be used as a beneficial resource rather than be sent as waste to landfill (refer to **Appendix A4-3.5**).

Step 3: Follow Necessary Requirements for Beneficial Reuse of Biosolids

Follow the outcomes identified in the Biosolids Risk Assessment Matrix to meet management and reporting requirements for the safe beneficial reuse of these biosolids for land applications.

2. General Requirements for the Management of Biosolids

Biosolids guidelines developed for use in Australian jurisdictions incorporate a conservative approach to biosolids management to ensure that the risks of public or environmental health issues associated with the beneficial reuse of biosolids are minimal. This is the approach taken in this Guideline and it should engender public confidence in the protection of public and environmental health.

2.1. Vector Attraction Reduction

Biosolids need to be treated in a way to reduce the possibility of transmission of pathogens by flies, mosquitos or other insects, birds, rats or other vermin. The transmission of pathogens is required to be controlled with the application of any of the following:

- Chemical or physical conditions such as heat, increased pH and drying which significantly reduce microbiological activity.
- Physical barriers to reduce the potential for contact between vectors and biosolids.
- Application of a biological treatment process which breaks down volatile solids.

2.2. Non-biodegradable Material

Biosolids have the potential to contain non-biodegradable material such as plastic, rubber or other similar foreign materials. These undesirable foreign materials can have negative effects on the beneficial reuse of biosolids. However, physical removal is generally achieved through effective screening and grit removal during the pre-treatment process upon sewage entering WwTPs.

2.3. Occupational Health and Safety

Biosolids have the potential to contain contaminants, biological material (endotoxins) and infectious microorganisms that can cause disease or otherwise be harmful to exposed personnel. Therefore, care should be taken when handling biosolids. The following precautions are recommended:

- All workers handling and potentially exposed to biosolids in areas where they have been applied should be educated about the potential risk of harm associated with exposure to biosolids. These workers should have relevant immunizations such as tetanus and hepatitis C.
- Cuts and abrasions should be covered with waterproof dressings prior to handling biosolids. Hands should be washed, and nails scrubbed prior to eating, drinking, going to the toilet or smoking and at the end of the working day.
- Suitable footwear and gloves should be worn during work with biosolids.
- Showering facilities should be made available for employees.
- To avoid problems with dust, protective eyewear should be worn. If dust is considered a problem, suitable masks or respirators conforming with the Australian Standard (*AS/NZS 1715:1994: Selection, use and maintenance of respiratory protective devices*) should be worn.
- Clean soiled work tools after use and change into clean clothing.

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2.4. Record Keeping

To demonstrate compliance with the GED under Section 12 of the Act, producers, transporters and end users, should maintain records (and updated if new information becomes available) for each batch of biosolids being handled and reused. Specific record keeping requirements for each entity is provided below.

3. Requirements for Producers

The biosolids producers are responsible for the treatment, storage and analysis of biosolids to ensure that the risks associated with stockpiling biosolids within a facility area are managed to meet the GED under Section 12 of the Act.

The producer should manage the storage of biosolids to ensure that the content of each stockpile can be traced back to the specific batch or batches of biosolids that the stockpile is comprised of. Any biosolids removed from site should be able to be linked to the test results for that batch. Stockpiles of biosolids should be physically separated and individually signposted in a storage area. The sign(s) should clearly mark out the area and be durable enough to remain until the stockpile is removed. Several signs may be required.

A physical gap between stockpiles is sufficient; a constructed barrier is not required.

Generally, biosolids produced daily will be stored in piles produced each month, with these piles being consolidated into one stockpile prior to sampling. WSP desludging will result in separate stockpiles for each pond.

Biosolids stockpiles may be stored on hardstand pads, in hoppers, in storage bays, covered, uncovered, in lagoons and a variety of other options. The requirements for all types of storage are:

- Biosolids should be stored so that they cannot inadvertently move off the storage site, such as during a large rainstorm. This may be achieved through creating physical earth or concrete barriers, shaping the site to contain moving biosolids, diverting stormwater so that it cannot enter stockpile areas or providing fixed containment such as storage bunds or hoppers.
- Storage bases should prevent leachate and runoff from entering the ground water and should have a minimum permeability of 10^{-9} m/sec (32 mm/year).
- Leachate and run off from the area should be collected and returned to an appropriate point in the treatment train at the WwTP, WSP or into a catch pond.
- Stored in a manner that does not cause an environmental nuisance[4].
- Storage in a manner that does not attract vectors. Vector attraction is discussed in **Section 2.1**.

To demonstrate compliance with the GED, the producer of the biosolids should ensure that the classification of the resource has been determined according to the biosolids quality characteristics listed in **Table 3** Contaminant Concentrations and **Table 4** Pathogen Concentrations prior to supplying to the end user.

[4] Environmental nuisance is defined in section 4 of the Act as (a) an adverse effect on the amenity of an area that: (i) is caused by noise, smoke, dust, fumes or odour; and (ii) unreasonably interferes with or is likely to unreasonably interfere with the enjoyment of the area by persons who occupy a place within the area or are otherwise lawfully in the area; or(b) an unsightly or offensive condition caused by contaminants or waste.

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The producer will provide all information and the classification of the biosolids in the Biosolids Reporting Form to the end user (**Appendix 1**).

Producers relinquish responsibility of biosolids management once biosolids have been removed from the producers' site by the transporter (including end-users organised transport).

3.1. Sampling and analysis for batch production

Sampling to determine the classification of the biosolids must be carried out on samples that are representative of the biosolids when they are in the condition intended for final use. Generally, this will be at the end of processing. Sampling, analysis and classification must be conducted prior to the biosolids leaving the production site.

3.1.1 Analysis

All analysis will be conducted by a laboratory accredited with the National Association of Testing Authorities (NATA)[5] or an equivalent certification.

Analysis of all biosolids contaminants and pathogens listed in **Table 3** and **Table 4** will be required.

3.2 Sampling

Producers are responsible for ensuring:

- A person with suitable experience and qualifications relevant to collecting field samples will undertake the sampling using approved Australian Standard collection and preservation methods.
- Each stockpile of treated, blended or composted biosolids must be individually assessed.
- Individual grab samples will be collected from within the stockpile (~0.3 m from the surface) not from the weathered surface.
- Individual grab samples will be taken every 100 t (dry wt), five of these grab samples will be combined to form one composite sample therefore, three composite samples will represent 300 t (dry wt). A minimum of three composite samples should be analysed from each stockpile. The number of samples will be determined from the total volume of the stockpile. **Figure 2** shows the sampling requirements for a stockpile of 300 t (dry wt.).
- The end concentration of each analyte will be calculated using the mean + 1 standard deviation.

Information should be obtained from the laboratory regarding sample collection, volumes required, preparation, storage, preservation, holding times and transport. *Australian Standard AS 4482.1– 2005: Guide to the investigation and sampling of sites with potentially contaminated soil - Part 1: Non-volatile and semi-volatile compounds* also provides useful information.

Re-analysis must be undertaken if the stockpile has not been used within three years of analysis.

[5] Burkholderia analysis is not NATA accredited and is generally not available for routine analysis of environmental samples.

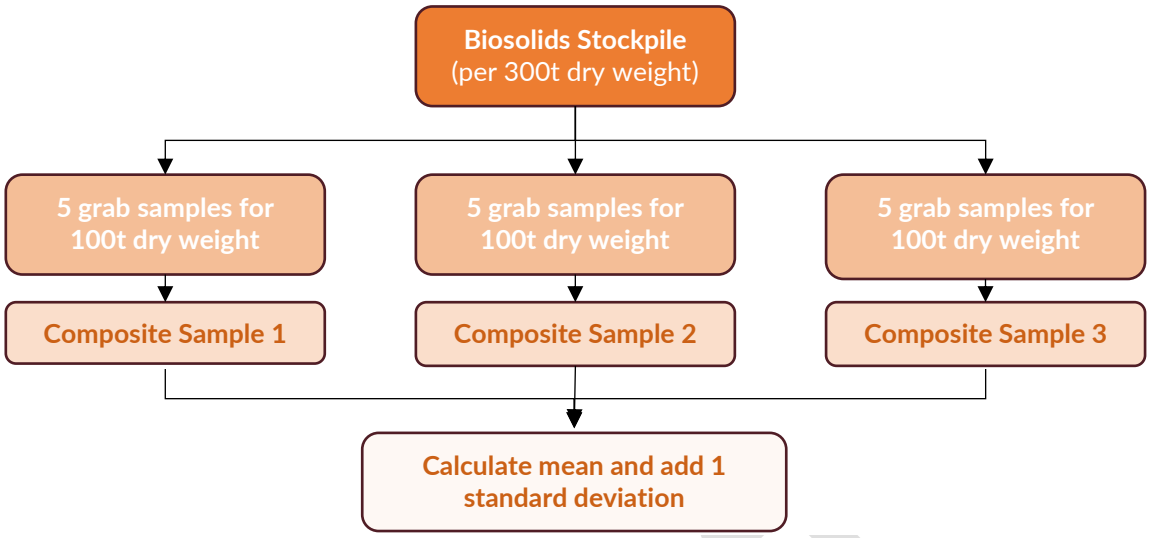

Figure 2 Stockpile sampling requirements

3.2. Records

To demonstrate compliance with the GED, producers of treated biosolids should maintain records for a minimum of five years of all batches of treated biosolids. Records should include:

- Source, quantity, and date of sewage sludge removal from lagoon or WwTP location and management of storage area.
- Type and dates of treatment.
- Analytical results for classification.
- Communications with transporters and end users.

4. Requirements for Transporters

Biosolids transporters are advised to discuss the classification of the biosolids and destination with the producer and end user of the biosolids.

To meet the requirements of the GED, the Class B and Class C biosolids should be handled in a manner that prevents their release into the environment during transport. This can include the following:

- Receipt of the Biosolids Reporting Form.
- Drivers should be trained in safe handling of biosolids procedures.
- The biosolids should have a solids content >75%.
- Transport routes should be chosen to minimise public nuisance (i.e. odour) in urban and rural areas.
- Loads should be covered using industry standard dust procedures.
- Vehicles used to transport biosolids should be cleaned prior to leaving the delivery site. The washdown water should not enter the stormwater system and vehicles should not be cleaned while parked on farm drives or other compacted areas where there is a risk of long-term ponding.

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4.1. Records

To meet the requirements of the GED, transporters of treated biosolids should maintain records for a minimum of five years of all batches of treated biosolids. Records should include:

- Biosolids Reporting Form
    - Source of treated biosolids
    - Quantities of biosolids transported
    - Dates of biosolids transported
    - Destination
- Transport route.

5. Requirements for End Users for Class B Biosolids

To meet the requirements of the GED, end users must comply with this section, where the proposed reuse of Class B biosolids involves application to land i.e. urban landscaping, agricultural, forestry and/or site rehabilitation.

Biosolids end users are advised to hold discussions with the Class B biosolids producer and obtain written confirmation of the classification of the biosolids (**Biosolids Reporting Form – Appendix 1**).

Prior to application of Class B biosolids, landholders or occupiers of adjoining land within 400 m of the proposed application site should be informed of the proposed application and records of the consultation must be maintained.

5.1. Storage of Biosolids

All entities are responsible for ensuring that the following storage restrictions are met at their properties:

- The end user should not store the biosolids prior to application for a period of greater than 90 days.
- The biosolids should not be stored within the buffer distances listed in **Table 6** Minimum Buffer Zones to Sensitive Receptors (refer to **Section 5.3.1** below).
- If the biosolids are to be stored for longer than 24 hours, the area used to store the treated biosolids should be bunded to prevent any surface water run-off from entering or leaving the bunded area.
- Any surface water that is collected within the bunded area should be irrigated on the application area in a manner that prevents release to natural waterways.
- Preferentially, the biosolids should be stored at the application site.

5.2. Site Suitability

An assessment of site suitability is required to determine the existing nutrient and contaminant concentrations to assist with the determination of the assimilative capacity of the soil in accordance with the Guidelines for the Safe Handling and Reuse of Biosolids in South Australia (SA EPA, 2020): Appendix 3. For ease of use, this information is included in the Biosolids Risk Assessment Matrix to provide the application rate for the site (biosolids t/ha).

The end user should also consider a range of information on the site selected for biosolids application to inform the Biosolids Risk Assessment Matrix.

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The following inputs are required to complete the Biosolids Risk Assessment Matrix:

- Determination of the soil pH at depths 0 – 10 cm and 10 – 45 cm.
- Determination of soil profile to 100 cm. Vertical section through soil layers including: texture, colour, clay content and chemical composition.
- Determination of groundwater level (standing water level) during both the wet and dry seasons.

Appropriate management practices should also be adopted to ensure sustainable and safe use of biosolids as identified in the Biosolids Risk Assessment Matrix.

5.3. Land Application

To meet the requirements of the GED, biosolids should be applied to soils so that no adverse impacts will occur to groundwater or surface waters. The biosolids should be spread on the land at a uniform rate and incorporated into the soil within 36 hours of being spread. The Biosolids Risk Assessment Matrix has a default value of 10 cm incorporation depth.

5.3.1. Buffer Distances

Table 6 identifies the minimum buffer distances that should be maintained between the application areas and sensitive receptors, to demonstrate compliance with the GED.

Table 6 Minimum Buffer Zones[1] to Sensitive Receptors (QLD DES 2023)

Sensitive Receptor	Minimum Buffer Distance (m)		
	Upslope [3]	Flat (≤3%)	Downslope (>3%)
Surface waters	5	50	100
Farm dams	5	20	30
Drinking water bores	100[2]	100[2]	100[2]
Farm driveways, forest roads and fence lines	5	5	5
Native forests and other significant vegetation types	5	10	10
Animal enclosures, property boundaries or land used for food production	25	50	25
Occupied dwelling	50	100	50

[1]Buffer zones must be stable and covered with suitable vegetation that will limit the transfer of the biosolids from the application area to adjoining areas.

[2]Research conducted by Power and Water and their consultants has shown that this is an acceptable buffer.

[3]Upslope refers to the situation where the sensitive area is upslope/upstream of the biosolids application area.

5.3.2. Minimum Depth to Groundwater

The minimum depth to groundwater restrictions outlined in **Table 7** must be met prior to application of biosolids to demonstrate compliance with the GED. **Table 7** provides information based on the clay content (permeability, and porosity) for the protection of groundwater. To obtain information to comply with **Table 7** the soil profile should be examined to a depth of 100 cm.

Table 7 Depth to Groundwater Restrictions (SA EPA 2020)

Average clay content % (0-100 cm)	Minimum depth to seasonal high-water table
>35 %	1.5 m
25 – 35%	2.0 m
15 – 25%	3.0 m
10 – 15%	4.0 m
5 – 10%	5.0 m
<5%	8.0 m

5.3.3. Application Rate

The application rate is set to minimise the risk of high concentrations of available metals being present in the soil at any time and taken up by crops. A maximum annual application rate for biosolids ensures that the amount of contaminant applied to the site does not exceed the maximum contaminant load (MCL) and that the addition of nutrients does not exceed agronomic rates. The Biosolids Risk Assessment Matrix calculates the application rate based on cadmium, chromium, copper and zinc concentrations in the biosolids and receiving soils and provides the application rate and volume of biosolids to meet the site requirements.

5.3.4. Time of Application

The following restrictions apply to the time of application by end users:

- Wet season application of biosolids should be avoided and application should not occur during rain events.
- Biosolids should be applied to fallow land as close as possible to sowing.
- Biosolids should not be applied in strong winds where odours or dust may be carried beyond the buffer area or property boundary.
- The biosolids must not be applied to land within the timeframes listed in **Table 8.**

Table 8 Land Use and Harvesting Timeframe Restrictions (QLD DES 2023)

Land Use		Timeframe in which the resource must not be applied
Human food crops	Harvested parts do not touch the biosolids	30 days prior to harvesting
	Harvested parts touch the biosolids but are above the land surface (e.g. lettuce)	18 months prior to harvesting
	Harvested parts are below the surface of the land (e.g. ginger, garlic, carrots)	5 years prior to harvesting
Animal feed and fibre crops		30 days prior to harvesting
		30 days prior to grazing by animals [(1)]

Land Use		Timeframe in which the resource must not be applied
Animal withholding		90 days prior to grazing by lactating[2] newborn animals
Turf		1 year prior to harvesting
Public access	Where there is high potential for public exposure	1 year prior to access
	Where there is low potential for public exposure	30 days prior to access

[1] Poultry and pigs must not be allowed to graze on biosolids application areas.

[2] Including milk for human consumption (goats, camels, sheep, cows)

6. Requirements for End Users for Class C Biosolids

To meet the GED, end users should comply with this section where biosolids have been classified as Class C and the proposed use is energy production.

Biosolids end users are advised to hold discussions with the Class C biosolids producer and obtain written confirmation of the classification of the biosolids.

Appropriate management practices should be adopted to ensure sustainable and safe use of biosolids, in accordance with the GED, including:

- Site specific risk assessment
- Holding/storage times
- Emissions
- Contaminants in waste products
- Upper limits of contaminants to be determined by the end user based on the facility specifications and location.
- The siting and design of the energy production facility shall be determined by the end user.

6.1. Storage of Biosolids

All entities are responsible for ensuring that the following storage restrictions are met at their properties:

- The end user should not store the biosolids prior to use for a period of greater than 90 days.
- The area used to store the treated biosolids should be bunded to prevent any surface water run-off from entering or leaving the bunded area.
- Any surface water that is collected within the bunded area should be managed in a manner that prevents release to natural waterways.

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7. Risk Assessment Process[6]

A Biosolids Risk Assessment Matrix must be completed for the beneficial reuse of biosolids classified as Class B for applications to land and Class C for energy production. This is required as the Class B and Class C biosolids do not meet the unrestricted use criteria and may have the potential to cause harm to the environment or to human health. The Biosolids Risk Assessment Matrix will identify risks and provide direction on the safe reuse and management requirements for the Class B and Class C biosolids. Class A biosolids do not require a risk assessment, however, the completed Biosolids Reporting Form is required to be maintained by the end user, to demonstrate compliance with the GED.

The Biosolids Risk Assessment Matrix comprises of five sections as follows:

1. User information including the end user's name, address and contact details.
2. Site information as listed in **Section 4.1** of this Guideline to provide site-specific details regarding land use, land slope and clay content of local soils.
3. Biosolids details with information on the stockpile including its identification, volume, date, production location and reporting details completed by the producer. The Biosolids Reporting Form (**Appendix 1**) will be made available by the producers to the transporters and end users, which will contain details of the biosolids, including, contaminant and pathogen concentrations and subsequent classification. Laboratory analytical results will be attached to the form.
4. Contaminant and Pathogen Concentrations, which are inputs taken directly from the Biosolids Reporting Form prepared by the producer, including the laboratory report of analytical data for the contaminants and pathogen.
5. Biosolids Risk Assessment Matrix – Identifying Limitations for Use of Class B biosolids for application to land. This section of the matrix serves to provide limitations on the use of Class B biosolids for application to land as outlined in **Section 4.1** and **Section 6** of this Guideline.

Management measures for Class B biosolids will be specified based on the information provided, contaminant and pathogen concentrations, and the answers to questions when identifying limitations.

The Biosolids Risk Assessment Matrix must be completed by the end user, as a way to demonstrate compliance with the GED. The producer may use the matrix spreadsheet to assist in classifying the biosolid stockpile and help identify potential suitable uses for the stockpile if needed.

The Biosolids Risk Assessment Matrix should be maintained by the end user for a minimum of five years to demonstrate compliance with the GED.

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[6] An interactive risk assessment spreadsheet is available, allowing the end user to populate fields with site specific data to determine the suitability of use of biosolids at their location and identify any appropriate risk management measures which should be implemented.

8. References

ACT ESD (2011). ACT Waste Management Strategy. Towards a sustainable Canberra. Reducing waste and recovering resources to achieve a sustainable, carbon-neutral Canberra. 2011–2025. Environment and Sustainable Development (ESD), ACT Government.

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EPA Vic (2004). Guidelines for Environmental Management. Biosolids Land Application. Publication 943, April 2004. EPA Victoria (EPA Vic).

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NRMMC (2004). Guidelines for Sewage Systems Biosolids management. National Water Quality Management Strategy. November 2004. Natural Resource Management Ministerial Council (NRMMC).

NSW EPA (1997). Environmental Guidelines: Use and Disposal of Biosolids Products. EPA 97/62. Reprinted 2000. New South Wales Environment Protection Authority (NSW EPA).

NSW EPA (2014). Waste Classification Guidelines. Part 1: Classifying Waste. State of New South Wales Environment Protection Authority.

NSW EPA (2023). Environment Protection Authority NSW Biosolids Regulatory Review. Technical Findings Report. July 2023. State of New South Wales Environment Protection Authority.

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SA EPA (2020). Guidelines for the Safe Handling and Reuse of Biosolids in South Australia. August 2020. South Australia Environment Protection Authority (SAEPA).

Taylor S. and Di Marco P. (2003). Health-based Investigation level for bifenthrin in soil. Proceedings of the Fifth National Workshop on the Assessment of Site Contamination. Environmental Protection and Heritage Council.

WA DEC (2012). Western Australian Guidelines for Biosolids Management. Western Australia, Department of Environment and Conservation (WA DEC). December 2012.

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Appendix 1 Biosolids Reporting Form

This form is to be completed by the Producers for each batch of biosolids before the biosolids can be reused in accordance with this Guideline. A copy of this form must be provided to transporters and end users receiving biosolids from each batch, to demonstrate compliance with the GED.

Information Required	Details
Report number	
Person supplying Information	
Position	
Contact details	
Date	
WwTP that produced biosolids	
Unique Batch Identifier	
Initial Batch Size (tonnes)	
Initial Date Stockpiled	
Method of batch treatment	
Has this batch been combined with other materials before grading?	
Pathogen Classification (on this date or most recent)	
Solids content	
pH	
Biosolids received by	
Contact details	

Results of Contaminant Analysis (mg/kg dry weight)

Contaminant	No of Samples	Mean (m)	Standard Deviation (s)	Batch BCC (m+s)	Classification
Cadmium					
Chromium (total)					
Copper					
Mercury					
Zinc					
Fipronil					
Bifenthrin					
∑PFAS					
				Final Classification	
				Risk Assessment Required	Yes ◯ No ◯

Laboratory analytical results attached **Yes** ◯ **No** ◯

Appendix 2 General Environmental Duty Checklist

Checklist for Biosolids Management	
Responsibilities for the producers, transporters and end users of biosolids to comply with GED under Section 12 of the *Waste Management and Pollution Control Act 1998*	
Requirements for producers, transporters and end users of biosolids	
Occupational health and safety risks to workers handling biosolids have been managed via appropriate training, personal protective equipment, hygiene protocols and immunizations for relevant communicable diseases.	Yes/No/Not Applicable
The transmission of pathogens has been controlled via chemical or physical conditions, physical barriers and/or biological treatment processes.	Yes/No/Not Applicable
Records have been maintained and updated for a minimum of five years in accordance with the record keeping requirements identified within this Guideline.	Yes/No/Not Applicable
Requirements for producers of biosolids	
The treatment, storage, handling and analysis of biosolids have been managed in accordance with **Section 2** of this Guideline.	Yes/No/Not Applicable
Biosolids that have the potential to contain contaminants/pathogens in addition to those listed in **Table 3** and **Table 4** of this Guideline have been subject to appropriate testing and risk assessment.	Yes/No/Not Applicable
Biosolids were classified in accordance with **Table 5** of this Guideline.	Yes/No/Not Applicable
The completed Biosolids Reporting Form has been provided to the transporter and end user.	Yes/No/Not Applicable
Requirements for transporters of biosolids	
The completed Biosolids Reporting Form has been obtained from the producer and the classification of the biosolids has been discussed with the producer and end user prior to transporting the biosolids.	Yes/No/Not Applicable
Class A, Class B or Class C biosolids have been managed in a manner to prevent their release into the environment during transport.	Yes/No/Not Applicable
Requirements for end users of biosolids	
The completed Biosolids Reporting Form has been obtained from the producer and the classification of the biosolids has been discussed with the producer.	Yes/No/Not Applicable
For the reuse of Class B biosolids in urban landscaping, agriculture, forestry and site rehabilitation a Biosolids Risk Assessment Matrix[7] has been completed to identify site specific requirements for the application of biosolids.	Yes/No/Not Applicable
Prior to the application of Class B biosolids to land, landholders or occupiers of adjoining land within 400 m of the application site have been informed of the proposed application of Class B biosolids and records of the consultation have been maintained.	Yes/No/Not Applicable
The reuse of Class B biosolids has been managed in accordance with **Section 5** of this Guideline.	Yes/No/Not Applicable
The reuse of Class C biosolids for energy production has been managed in accordance with **Section 6** of this Guideline.	Yes/No/Not Applicable

[7] An interactive risk assessment spreadsheet is available on the NT EPA website, allowing the end user to populate fields with site specific data to determine the suitability of use of biosolids at their location and identify any appropriate risk management measures which should be implemented.

Appendix 3 Justifications

Justification –Table 3

The land end use terminology listed in **Table 3** were selected from those used across Australian jurisdictions and includes the addition of Class C for energy production.

Justification – Table 3

The metals listed in **Table 3** for classification of biosolids are based on the recommendations of the AWA Position Paper, The Management of Biosolids in Australia (AWA, 2012) that four metals (cadmium, copper, chromium and zinc) should be used for classification. The metal concentrations selected for C1 biosolids are generally amongst the lowest concentrations used across Australian jurisdictions[8]. Total chromium has been selected as the contaminant to test for as chromium III is the contaminant most commonly found in biosolids.

For C1 metal contaminant limits, values adopted are based on those published in the Queensland End of Waste Code (QLD DES 2023) and the C2 metal contaminant limits are based on those published in the Tasmanian Biosolids Reuse Guidelines (EPA Tas, 2020) and/or the national biosolids guideline (NRMMC 2004).

AWA (2012) suggest that the pesticides chlordane and dieldrin be included in the suite, however, investigations into the pesticides used in the Northern Territory indicate that fipronil and bifenthrin are the most common pesticides used for termite control that may enter the sewage system. The inclusion of these pesticides should be reviewed on a regular basis. The Class A concentration for fipronil is the screening guideline developed by EnRisks (2019) for the ecological investigation level (EIL) and the Class B and Class C concentration is two times the human health-based investigation level (HIL) derived by EnRisks (2019). The Class A concentration for bifenthrin is the EIL for soils derived by EnRisks (2019) and the Class B and Class C concentration is two times the HIL listed in Taylor and Di Marco (2003).

The PFAS compounds PFOS + PFHxS and PFOA have been included in **Table 3** as biosolids are recognized as containing PFAS concentrations and the sewage treatment process can, in some instances, increase the PFAS concentration in the treated sewage when compared to the untreated sewage concentration (PFAS NEMP Draft version 3.0 (NEMP 3.0), HEPA 2022). The contaminant limits are the maximum allowable soil contaminant concentrations (MASCC) for unrestricted use based on a 1-fold margin of safety from PFAS NEMP 3.0 (HEPA 2022, Table 11). The C1 contaminant limits for PFOS + PFHxS and POFA and below or at the low end of the range in limits of reporting for PFAS in biosolids (0.005 – 0.020 mg/kg) from the NEMP 3.0 (HEPA 2022)[9].

The C2 contaminant limits for PFOS + PFHxS and PFOA are the biosolids thresholds for restricted settings based on a 1-fold margin of safety from PFAS NEMP 3.0 (HEPA 2022).

Justification – Table 4

The pathogens listed in **Table 4** have been selected based on those commonly in use across Australian jurisdictions, in particular the *E. coli* criteria are used in biosolids guidelines across all

[8] The adopted metal contaminant limits C1 are based on lowest value of the soil ecological investigation levels interim urban (EIL-I/U) human health criteria for a residential setting (HIL-A) from the 1999 version of the NEPM. They are mostly based on the EIL-I/U as they are typically much lower than the HIL-A values.

[9] The maximum allowable soil contaminant concentrations (MASCC) based on a 1-fold margin of safety for PFOS (0.0011 mg/kg) reported in PFAS NEMP 3.0 (HEPA 2022) is lower than the limit of reporting value adopted, whereas the MASCC for PFOA is the same value.

Australian jurisdictions. The criterion for enteric virus is that listed in the SA EPA (2020) being the most recent criteria listed. The helminth criteria selected is listed in WA DEC (2012).

This Guideline includes specific pathogen values for Burkholderia[10] bacteria, cause of the disease melioidosis, and *Naegleria fowleri* in biosolids generated north of Tennant Creek as these are endemic to Northern Australia. As both these pathogens have the potential to cause fatalities a non-detect limit has been applied to Class P1 biosolids.

Justification – Table 5

Table 5 shows the requirements for a risk assessment to determine if Class B biosolids can be applied for beneficial reuse on the selected land or Class C biosolids can be used for energy production. A Biosolids Risk Assessment Matrix has been included in this Guideline to consider those contaminants above the criteria for C1 which may have potential to adversely impact the environment and/or human health. The Biosolids Risk Assessment Matrix is included to address the presence of PFAS in the biosolids and for other contaminants and pathogens above the C1 and P1 criteria.

Justification – Section 3

The sampling requirements shown in **Section 3** are based on the SA EPA (2020) requirements for biosolids from lagoon sludge using a batch treatment method. Each stockpile is treated as a separate batch for the process of classification.

Justification – Section 5.3

The SA EPA (2020) guidelines provide a method in Appendix 3 that provides calculations to determine the biosolids application rate to ensure that:

- The amount of contaminant supplied to the site does not exceed the maximum contaminant load and the maximum annual cadmium load (Contaminant Limiting Application Rate, CLAR)
- The addition of nutrients from biosolids does not exceed agronomic rates (Nutrient Limiting Application Rate, NLAR).

The application rate is set to minimise the risk of high concentrations of available metals being present in the soil at any time and taken up by crops. The maximum biosolids application rate will be determined by the lower of the CLAR and the NLAR. The Biosolids Risk Assessment Matrix calculates the application rate for each site for the end user.

[10] Currently Burkholderia analysis is not NATA accredited.

Appendix 4 Biosolids Management – Inputs to the NT Biosolids Management Guideline

A comparison of the information provided in biosolids management documents from Australian jurisdictions is provided in this appendix.

A4-1. Objectives of Biosolids Management Guidelines

The Biosolids Management Guideline for the Northern Territory was developed to assist in the management of biosolids to minimise the risks of biosolids entering the environment as required under the *Waste Management and Pollution Control Act 1998* (the Act) and the Waste Management and Pollution Control (Administration) Regulations 1998. Recent State and Territory guidelines include regulatory requirements as indicated in the objectives of each jurisdiction's biosolids management documents summarised below in **Table A4-1.** Therefore, the objectives of the NT guidelines cover the human and environmental health aspects and the regulatory requirements. A commitment to reducing waste and enabling full resource recovery was also included.

Table A4-1 Objectives of Management Documents from Other Relevant Australian Jurisdictions

Reference	Objective
NRMMC (2004)	The purpose of this document is to provide national guidelines and a uniform approach to the management of biosolids with the focus on the beneficial use of biosolids as a resource, however, where available, relevant State/Territory guidelines should be consulted for more detailed requirements.
ACT ESD (2011)	The goal of the ACT Waste Management Strategy 2011–2025 is to ensure that the ACT leads innovation to achieve full resource recovery and a carbon neutral waste sector.
NSW EPA (1997)	These guidelines will help planners, designers and operators of sewerage systems, and those involved with the processing and end-use of biosolids products, by establishing requirements for the beneficial use and disposal of biosolids products to land in NSW.
QLD DES (2023)	No objectives provided.
SA EPA (2020)	This guideline will assist the producers and end users of biosolids meet their general environmental duty under the *Environment Protection Act 1993*, and were developed using current and historical understanding of the safe and reliable production, handling and management of biosolids.
EPA Tas (2020)	To set biosolids quality standards which adequately protect human and animal health, the environment and soil quality whilst providing practical options for the beneficial use of biosolids. To ensure the use of best management practices to support sustainable, practical and safe beneficial use options for biosolids. To set out the legal framework within which sewage sludge and biosolids are regulated and detail the statutory obligations of relevant parties to ensure that relevant regulatory requirements are met.
EPA Vic (2004)	The overall objective of this guideline is to maximise the sustainable use of biosolids, by documenting good practice for matching biosolids quality with end use activities and minimising any associated risks.

Reference	Objective
WA DEC (2012)	These guidelines provide information and guidance on appropriate management practices for the careful use of biosolids for land application on agricultural, forestry, mine-site rehabilitation and land care programs.

A4-2. Biosolids Classification

Each jurisdiction reviewed uses a different set of criteria for classifying biosolids based on chemical contaminant concentrations and presence of pathogens. All jurisdictions use a grading system that allows for specific end uses of biosolids depending on their classifications. However, similarly to classification criteria, the grading systems are not consistent across jurisdictions. The following aspects have been investigated further:

- Gradings for end use (**Section A4-2.1**)
- Contaminant limits (**Section A4-2.2**)
- Pathogen limits (**Section A4-2.3**)

A4-2.1. Biosolid Gradings

Biosolid gradings across jurisdictions for unrestricted use and a combination of different restrictive uses (A to E) for the jurisdictions considered are shown below in **Table A4-2**. There is a varied approach across jurisdictions to biosolids grading thus making direct comparisons is not straightforward. Only the biosolids grading as done in Western Australia (WA DEC 2012) is equivalent to the process outlined in the National guideline (NRMMC 2004).

The gradings approach adopted in the NT Biosolids Management Guideline is relatively straightforward and similar to the grading process adopted in recent guidance from South Australia (SA EPA 2020) and Tasmania (EPA Tas 2020) as shown in **Table A4-2**. This straightforward approach was adopted to improve ease of application and allow use by less experienced users. Ease of application of the guidelines to meet legislative requirements was retained as the preferred option in the NT Biosolids Management Guideline.

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Table A4-2 Summary of Biosolid Gradings from Different Jurisdictions

Jurisdiction	Unrestricted Use	Restricted Use A	Restricted Use B	Restricted Use C	Restricted Use D	Restricted Use E
Uses	• Home lawn and gardens • Public contact sites • Urban landscaping • Agriculture • Forestry • Soil and site rehabilitation • Landfill	• Public contact sites • Urban landscaping • Agriculture • Forestry • Soil and site rehabilitation • Landfill	• Agriculture • Urban landscaping • Forestry • Soil and site rehabilitation • Landfill	• Agriculture • Forestry • Soil and site rehabilitation • Landfill	• Forestry • Soil and site rehabilitation • Landfill	• Composting and/or Landfilling
Pathogen Gradings						
NRMMC 2004	P1	P1, P2 or P3	P1, P2 or P3	P1, P2 or P3	P3	P4
NSW EPA 1997	A	A	B	-	B	C
QLD DES 2023	A	A	B	B	-	-
SA EPA 2020	A	-	B	-	-	Fails B
EPA Tas 2020	A	-	B	-	-	Unclassified
EPA Vic 2004	T1	T2 or T3	T2 or T3	T2 or T3	T3	-
WA DEC 2012	P1	P1, P2 or P3	P1, P2 or P3	-	P3	P4
Contaminant Gradings						
NRMMC 2004	C1	C1 or C2	C1 or C2	C1 or C2	C2	C3
NSW EPA 1997	A	B	C	-	D	E
QLD DES 2023	A	B	C	C	-	-
SA EPA 2020	A	-	B	-	-	Fails B
EPA Tas 2020	A	-	B	-	-	Unclassified
EPA Vic 2004	C1	C2 or C3	C2 or C3	C2 or C3	C3	-
WA DEC 2012	C1	C2	C2	-	C2	C3

- = No specific grading for this combination of uses. Refer to the unrestricted use category or one of the other restricted use categories.
Pathogen Grading Legend: P1, generally equivalent to T1 and A = Very low pathogen levels with minimum regrowth potential. P2, generally equivalent to T2 and B = Low pathogen levels but with some pathogen regrowth potential. P3, generally equivalent to T3 = Low-medium pathogen levels with some regrowth potential; established processes that achieve significant pathogen reduction. P4, generally equivalent to C = Medium-high or unknown pathogen levels with minimum pathogen reduction.
Contaminant Grading Legend: Contaminant grades contain increasing contaminant concentrations as one progresses from C1 to C3 or from A to E.

A4-2.2. Contaminant Limits

A compilation of contaminant limits from different Australian jurisdictions is provided below in **Table A4-3** for unrestricted use of biosolids and **Table A4-4** for restricted use of biosolids. These contaminant limits are compared with residential human and ecological health investigation levels in soil (HIL-A and EIL-I/U) from the 1999 version of the National Environment Protection Measure (NEPM) (the values from the 2013 version are provided in brackets).

It can be seen from the comparison in **Table A4-3** below that metal contaminant limits for unrestricted use in most cases are based on soil ecological investigation levels (EIL-I/U) from the 1999 version of the NEPM and are much lower than the applicable human health criteria (HIL-A). For chromium, the contaminant limits appear to be for chromium VI, rather than chromium III which is the dominant form of this metal expected in biosolids.

The contaminant limits are generally similar to or lower than ecological or residential criteria for a residential setting (some of which are relatively overdue for an update as they do not necessarily reflect the current science). For example, the HIL-A for lead is outdated as it is based on a target blood lead level of 10 ug/dL rather than the 5 ug/dL which is currently used in risk assessments in Australia.

The source of the contaminant limits for organochloride pesticides and polychlorinated biphenyls (PCBs) listed in Table A4-3 and Table A4-4 are unclear and may be based on limits of reporting.

PFAS criteria are available in some jurisdictions. In Victoria, it is understood that consultants have been requested to adopt PFAS criteria based firstly on reporting limits (as quoted in the Interim Position Statement on PFAS, EPA Vic 2020) and in more recent times from the draft National Environmental Management Plan (NEMP, version 3) released for public comment in 2022.

Agriculture is a permitted use of biosolids for unrestricted uses and most restricted uses. However, residential human and ecological health investigation levels from the NEPM do not consider agricultural scenarios and may not necessarily protect human health or ecology in these settings from contaminants that are bioaccumulative and persistent in the environment.

The contaminant limits adopted in the NT Biosolids Management Guidelines are broadly consistent with the other jurisdictions. Justification for the contaminant limits adopted in the NT Biosolids Management Guidelines is outlined in **Appendix 3**. It is noted that many contaminant limits are based on outdated human health and ecological guidelines, and these will be updated once Australian guidelines are updated.

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Table A4-3 Contaminant Limits (mg/kg) for Unrestricted Uses of Biosolids from Different Jurisdictions

Contaminant	HIL-A	EIL-I/U	Grade A	GradeC1	Grade C1 and RSCL	Grade C1	Grade A	Grade A	Grade A
Source	NEPC 1999 (NEPC 2013)		NSW EPA 1997	NRMMC 2004	EPA Vic 2004	WA DEC 2012	QLD DES 2023	SA EPA 2020	EPA Tas 2020
Uses	Residential	Interim Urban	Unrestricted						
Arsenic	100 (100)	20 (100)	20	20	20	-	20	-	20
Cadmium	20 (20)	3 (-)	3	1	1	1	3	1	1
Chromium (Cr VI)	100 (100)	1 (-)	-	100 – 400	-	-	-	1	-
Chromium (total) or Chromium III	12% (-)	- (190-400)	100	-	400	1	100	-	50
Copper	1000 (6000)	100 (60-800)	100	100 – 200	100 (150)	100	150	100	100
Lead	300 (300)	600 (1100)	150	150 – 300	300	200	150	-	150
Mercury	1500 (40)	1 (-)	1	1	1	-	1	-	1
Nickel	600 (400)	60 (30-560)	60	60	60	-	60	-	60
Selenium	- (200)	-	5	3	3	-	5	-	-
Zinc	7000 (7400)	200 (70-1300)	200	200-250	200 (300) [3]	-	300	200	200
DDT/DDD/DDE	200 (240)	- (180)	0.5	0.5	0.5	-	0.5	-	-
Aldrin	10 (6)	-	0.02			-	0.02	-	-
Dieldrin			0.02			0.02	0.02	-	-
Chlordane	50 (50)	-	0.02			0.02	0.02	-	-
Heptachlor	10 (6)	-	0.02	0.02 - 0.05	0.05	-	0.02	-	-
HCB	- (10)	-	0.02			-	0.02	-	-
Lindane	-	-	0.02			-	0.02	-	-
BHC	-	-	0.02			-	0.02	-	-
PCBs	10 (1)	-	0.3	0.05 - 0.3	0.2	-	Not detected	-	-
Fipronil (mg/kg dry wt) [3]	-	-	-	-	-	-	-	-	-
Bifenthrin (mg/kg dry wt) [3]	- (600)	-	-	-	-	-	-	-	-
PFOS + PFHxS (mg/kg dry wt) [4]	-	-	-	-	0.0011 [2]	-	-	-	-
PFOS	-	-	-	-	or <0.002 [1]	-	-	-	-
PFHxS	-	-	-	-	or <0.001 [1]	-	-	-	-
PFOA (mg/kg dry wt) [4]	-	-	-	-	<0.001 [1] or 0.005 [2]	-	-	-	-
∑PFAS	-	-	-	-	-	-	Monitor	-	-
Total Organic Fluorine	-	-	-	-	-	-	Monitor	-	-

Purple text indicates contaminants for which contaminant limits were adopted. Red text indicates this value is the same as the Contaminant Limit for C1 adopted in the NT Biosolids Management Guideline.
(1) Based on the Interim Position Statement on PFAS from EPA Vic (Publication 1669.4* October 2020).
(2) Based on a Margin of Safety of 1 as presented in Table 11 of PFAS NEMP V3 (draft document (HEPA 2022).
(3) Contaminant limits for Fipronil and Bifenthrin were adopted from the publicly available literature sources (EnRisks 2019)
(4) Contaminant limits for PFAS are the maximum allowable soil contaminant concentrations (MASCC) in the draft PFAS NEMP v3.0 (HEPA 2022)

Table A4-4 Contaminant Limits for Restricted Uses

Contaminant	HIL-A	EIL-I/U	Grade B	Grade C	Grade C2			Grade B	Grade C	Grade B	Grade D	Grade C3	Grade B
Source	NEPC 1999 (NEPC 2013)		NSW EPA 1997	NSW EPA 1997	NRMMC 2004	EPA Vic 2004	WA DEC 2012	QLD DES 2023	QLD DES 2023	SA EPA 2020	NSW EPA 1997	WA DEC 2012	EPA Tas 2020
Uses	Residential	Interim Urban									Site Rehabilitation, landfilling and/or Composting		
Arsenic	100 (100)	20 (100)	20	20	60	60	-	20	20	-	30	-	60
Cadmium	20 (20)	3 (-)	5	20	20	10	20	5	20	20	32	untested. > C2	20
Chromium (Cr VI)	100 (100)	1 (-)	-	-	500 – 3000	-	-	-	-	1	-	-	-
Chromium (total) or Chromium III	12% (-)	- (190-400)	250	500	-	3000	1	250	500	-	600		300
Copper	1000 (6000)	100 (60-800)	375	2,000	2500	2000	2,500	375	2000	2,500	2,000	untested. > C2	2,500
Lead	300 (300)	600 (1100)	150	420	420	500	2,500	150	420	-	500		420
Mercury	1500 (40)	1 (-)	4	15	15	5	-	4	15	-	19	-	15
Nickel	600 (400)	60 (30-560)	125	270	270	270	-	125	270	-	300	-	270
Selenium	- (200)	-	8	50	50	50	-	8	50	-	90	-	-
Zinc	7000 (7400)	200 (70-1300)	700	2,500	2500	2500	-	700	2500	2,500	3,500	-	2,500
DDT/DDD/DDE	200 (240)	-180	0.5	1	1	1	-	0.5	1	-	1	-	-
Aldrin	10 (6)	-	0.2	0.5			-	0.2	0.5	-	1	-	-
Dieldrin			0.2	0.5			0.5	0.2	0.5	-	1	untested. > C2	-
Chlordane	50 (50)	-	0.2	0.5			0.5	0.2	0.5	-	1		-
Heptachlor	10 (6)	-	0.2	0.5	0.5	0.5	-	0.2	0.5	-	1	-	-
HCB	- (10)	-	0.2	0.5			-	0.2	0.5	-	1	-	-
Lindane	-	-	0.2	0.5			-	0.2	0.5	-	1	-	-
BHC	-	-	0.2	0.5			-	0.2	0.5	-	1	-	-
PCBs	10 (1)	-	0.3	1	0.5	1	-	0.3	1	-	1	-	-
Fipronil (mg/kg dry wt) [3]	-	-	-	-	-	-	-	-	-	-	-	-	-
Bifenthrin (mg/kg dry wt) [3]	- (600)	-	-	-	-	-	-	-	-	-	-	-	-
PFOS + PFHxS (mg/kg dry wt) [4]	-	-	-	-	-	0.031 [2]	-	-	-	-	-	-	-
PFOS	-	-			-	or <0.002 [1]	-	-	-	-	-	-	-
PFHxS	-	-			-	or <0.001 [1]	-	-	-	-	-	-	-
PFOA (mg/kg dry wt) [4]	-	-	-	-	-	<0.001 [1] or 0.13 [2]	-	-	-	-	-	-	-
∑PFAS	-	-	-	-	-	-	-	Monitor	Monitor	-	-	-	-
Total Organic Fluorine	-	-	-	-	-	-	-	Monitor	Monitor	-	-	-	-

Purple text indicates contaminants for which contaminant limits were adopted. Red text indicates this value is the same as the Contaminant Limit for C2 adopted in the NT Biosolids Management Guideline,
(1) Based on the Interim Position Statement on PFAS from EPA Vic (Publication 1669.4* October 2020).
(2) Based on a Margin of Safety of 1 as presented in Table 11 of PFAS NEMP V3 (draft document (HEPA 2022).
(3) Contaminant limits for Fipronil and Bifenthrin were adopted from the publicly available literature sources (EnRisks 2019, Taylor and Di Marco 2003)
(4) Contaminant limits for PFAS are the biosolids thresholds for a restricted setting in the draft PFAS NEMP v3.0 (HEPA 2022)

PFAS

Many jurisdictions do not have PFAS concentration limits. As discussed above Victoria EPA are still in the process of deriving PFAS limits for biosolids. However, QLD DES (2023) has trigger values for PFAS to be met after application to land and again three months after application as shown in **Table A4-5**.

Table A4-5 PFAS Trigger Values (DES 2023)

Media	Contaminant	Trigger Value mg/kg
Soil	PFOS	0.001
	PFOS + PFHxS	0.002
	PFHxS	0.003
	PFOA	0.004
	PFBA, PFPeA, PFHxA	0.001
	Sum C9 -C14 Perflouroalkyl carboxylic acids	0.01
	Perfluoroalkyl sulfonamides	0.001
	N:2 Fluorotelomer Sulfonic acids	0.004

In addition, the NSW EPA released an Addendum to the Waste Classification Guidelines[11] in 2016 to address PFAS concentrations in waste that can be applied to biosolids as shown in **Table A4-6**.

Table A4-6 NSW EPA PFAS Classifications for Waste

Contaminant (1)	Maximum Values for Leachable Concentrations and Specific Contaminant Concentration when used together			
	General Solid Wastes (2)		Restricted Solid Wastes	
	Leachable Concentration	Specific Contaminant Concentration	Leachable Concentration	Specific Contaminant Concentration
	TCLP1 (mg/L)	SCC1 (mg/kg)	TCLP2 (mg/L)	SCC2 (mg/kg)
PFOS + PFHxS	0.05	1.8	0.2	7.2
PFOA	0.50	18	2.0	72

(1) PFOS and PFHxS are to be summed for comparison against the TCLP and SCC values
(2) Values are the same for general solid waste (putrescible) and general solid waste (non-putrescible)
TCLP = Toxicity Characteristic Leaching Procedure

[11] https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/wasteregulation/addendum-1-to-the-waste-classification-guidelines.pdf

Table A4-7 Criteria for PFOS + PFHxS and PFOA in Biosolids and MASCC (NEMP 3.0)

Criteria Type	Margin of Safety	PFOS + PFHxS (µg/kg)	PFOA (µg/kg)
Biosolids threshold restricted use	5	6.2	25
	2	15	65
	1	30	130
Biosolids threshold unrestricted use[1]	5	0.22	1.0
	2	0.55	2.5
	1	1.1	5
MASCC[2]	5	0.22	1.0
	2	0.55	2.5
	1	1.1	5

[1]The unrestricted use threshold may not be applicable in all jurisdictions. Where it is applicable, it should be applied to the final biosolids product for land application.
[2]Maximum allowable soil contaminant concentration

Microplastics

None of the Australian State and Territory biosolid guidelines consulted referred to contaminant limits for microplastics. This is partly due to a lack of standard analyses for microplastics across Australia and a lack of knowledge of potential adverse impacts caused by specific concentrations of microplastics. As such, there are currently no available guidelines for microplastics from Australian jurisdictions to adopt as contaminant limits for microplastics in the Northern Territory. This may change for future biosolids guidelines.

A4-2.3. Pathogen Limits

A comparison of the pathogen limits adopted across various jurisdictions is shown below in **Table A4-8** for both unrestricted uses (including residential) and restricted uses (including agriculture for food crops). It is noted that the name of the pathogen grade differs across jurisdictions (e.g. Grade A and B in NSW, QLD, SA and Tasmania, Grade P1 and P2 in NRMMC, WA and NT, and T1 and T2 in Victoria).

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Table A4-8 Pathogen Limits for final biosolid product (as dry weight)

Parameter	Units	Pathogen Grade						
Unrestricted Uses		**A**	**P1**	**T1**	**P1**	**A**	**A**	**A**
Source		NSW EPA 1997	NRMMC 2004	EPA Vic 2004	WA DEC 2012	QLD DES 2023	SA EPA 2020	EPA Tas 2020
E-coli	MPN per gram	<100	<100	<100	<100	<100	< 100	< 100
Faecal/Thermotolerant coliforms	MPN per gram	<1,000	<100	-	-	<1000	-	-
Salmonella species	per 50 grams	ND	<1	< 1	-	ND	< 1	ND
Enteric viruses	PFU / 50 grams	< 1	-	≤1 / 100g	<1 / 100g	<1 / 4g	< 1	< 1
Helminth ova	per 50 grams	< 1	-		<1 / 10g	<1 / 4g	< 1	<1
Burkholderia	per 50 grams	-	-	-	-	-	-	-
Naegleria	per 50 grams	-	-	-	-	-	-	-
Strongyloides & Hookworm	per 50 grams	-	-	-	<1	-	-	-
Coliphages	PFU / 10 grams	-	-	-	<10	-	-	-
Restricted Uses		**B** (1)	**P2 (P3)**	**T2**	**P2 (P3)**	**B (C** (1)**)**	**B**	**B** (1)
E-coli	MPN per gram	-	<1000 (<1000)	<1000	<1000 (<2000)	<100 (-)	<1000	-
Faecal/Thermotolerant coliforms	MPN per gram	-	<1000 (<1000)	-	-	<1000 (-)	-	-
Salmonella species	per 50 grams	-	<10 (-)	< 10	-	ND (-)	-	-
Enteric viruses	PFU / 50 grams	-	-	<2 / 10g	<2 / 10g	<1 / 4g	-	-
Helminth ova	per 50 grams	-	-	-	<1 / 10g	<1 / 4g	-	-
Burkholderia	per 50 grams	-	-	-	-	-	-	-
Naegleria	per 50 grams	-	-	-	-	-	-	-
Strongyloides & Hookworm	per 50 grams	-	-	-	<1 (<1)	-	-	-

ND = Not detected, MPN = Most probable number, PFU = plaque-forming unit
(1) Must meet any one of the requirements for pathogen reduction and vector attraction requirements

The pathogen limits adopted for unrestricted uses (Grade A, P1 and T1) are uniform across jurisdictions for each of the pathogens. For restricted uses (Grade B, C, P2, and T2) there is an upper pathogen limit for *E. coli* or thermotolerant coliforms in some jurisdictions (NRMMC, SA, Victoria, WA) whereas in other states any one of the requirements for pathogen reduction and vector attraction requirements need to be met.

The pathogen limits adopted in the Northern Territory are similar to those shown in NRMMC (2004) with the addition of pathogen limits for Burkholderia for biosolids generated north of Tenant Creek as this is endemic to Northern Australia causing the disease melioidosis. *Naegleria fowleri* has also been included as it is also endemic to the Northern Territory.

A4-3. Biosolids Management

Similar to the biosolids classification (**Section A4-2**), management of biosolids throughout the jurisdictions varies. The following quantitative limits are considered further below:

- Buffer distances
- Groundwater depth restrictions
- Withholding times
- Land slope restrictions

A4-3.1. Buffer Distances

There is no specific buffer distance provided in NRMMC (2004) for Australian jurisdictions. It is noted however that "*site management practices should be implemented to manage any environmental or health impacts*" including "*the establishment of buffers around the processing or application site e.g., adjoining properties, surface waters*" (NRMMC 2004).

Buffer distances for different 'sensitive receptors' adopted across various jurisdictions are shown below in **Table A4-9**; this Table shows that buffer distances vary considerably across the jurisdictions.

The buffer distances adopted in the Northern Territory are based on those adopted from Queensland (QLD DES 2023). In the NT and Queensland, they have been adopted for 'Flat land', 'Downslope', and 'Upslope'. In general, they are similar to or higher than buffer distances from other jurisdictions with some exceptions (e.g. 20 m for farm dams in NT, 25 m in Victoria and 100 m in WA).

Table A4-9 Buffer Distances (m)

Sensitive Receptor	QLD DES 2023	SA EPA 2020	EPA Tas 2020	EPA Vic 2004	WA DEC 2012
Flat (<3% or >2°) or slope not designated					
Surface waters	50	100	50	50	50, 100, or 400
Farm dams	20	-	-	25	100
Drinking water bores	100	-	250	100 / 250	100
Other bores	50	-	50	25 / 50	50
Farm driveways, forest roads and fence lines	5	5 or 50	5 or 50	5	5
Native forests and other significant vegetation types	10	-	10	25 / 100	200

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Sensitive Receptor	QLD DES 2023	SA EPA 2020	EPA Tas 2020	EPA Vic 2004	WA DEC 2012
Animal enclosures, property boundaries or land used for food production	50	-	-	10 / 50	50
Occupied dwelling	100	100	100	25 / 50	100 or 1,000
Residential zone	500	400	250	50 / 250	-
Upslope					
Surface waters	5	-	10	-	-
Farm dams	5	-	-	-	-
Drinking water bores	100	-	-	-	-
Other bores	50	-	-	-	-
Farm driveways, forest roads and fence lines	5	-	-	-	-
Native forests and other significant vegetation types	5	-	-	-	-
Animal enclosures, property boundaries or land used for food production	25	-	-	-	-
Occupied dwelling	50	-	-	-	-
Residential zone	250	-	-	-	-
Downslope (>3% or >2°)					
Surface waters	100	-	100	-	-
Farm dams	30	-	-	-	-
Drinking water bores	100	-	-	-	-
Other bores	50	-	-	-	-
Farm driveways, forest roads and fence lines	5	-	-	-	-
Native forests and other significant vegetation types	10	-	-	-	-
Animal enclosures, property boundaries or land used for food production	25	-	-	-	-
Occupied dwelling	50	-	-	-	-
Residential zone	250	-	-	-	-

A4-3.2. Groundwater Depth Restrictions

No specific minimum depth to groundwater values is provided in the National guidelines (NRMMC 2004). However, it is noted that "*the potential to pollute surface and groundwater will require restrictions on applications*" (NRMMC 2004).

NT has adopted the same groundwater restrictions (minimum depth to groundwater) based on clay content as South Australia and Tasmania, refer to **Table A4-10**.

Table A4-10 Minimum Depth to Groundwater (m) for Biosolids Application in Various Soil Types

Minimum depth to seasonal high-water table	SA EPA 2019 EPA Tas 2020	WA DEC 2012	EPA Vic 2004	
	Average clay content %	Soil type	Slope	Soil Permeability (Ks, mm/h)
1.5 m	>35 %	Clay	Severe (12-15%)	very high (Ks 50 – 100)
2 m	25 – 35%	Sand		
3 m	15 – 25%	Laterite	Moderate (6-12%)	low and high (Ks 0.5 – 2 or Ks 20 – 50)
4 m	10 – 15%	-		
5 m	5 – 10%	Sandy limestone	Slight (3-6%)	Moderate (Ks 2 - 20)
8 m	<5%	-		
Unsuitable	-	Gravel and hard rock	>15%	Very low and extreme (Ks < 0.5 or > 100)
	-	Karstic limestone		

Ks = Saturated hydraulic conductivity (Ks, mm/h) of most restrictive layer in top 90cm

There are some potential sites in the NT which could receive biosolids which are not suitable in other jurisdictions such as those with geology dominated with gravel and hard rock, and Karstic limestone or sites with very low and extreme soil permeability (Ks < 0.5 mm/h or > 100 mm/h). For example, in WA and Victoria, it is not suitable to place biosolids in geologies dominated by gravel and hard rock, and Karstic limestone in WA or very low and extremely permeable soils in Victoria.

Restrictions on depth to groundwater are in place in the NT guidelines and are in line with other jurisdictions. Nonetheless, there are specific situations in which biosolids could be placed on a NT property which would not be considered suitable if placed in another jurisdiction (WA or Victoria). Therefore, the inclusion of an unsuitable category in the NT guidelines was not included.

A4-3.3. Withholding Times

A summary of withholding times following application of biosolids in various settings is provided below in **Table A4-11**. Similar withholding times are provided by each of the jurisdictions.

Withholding times were not specified in National or South Australian guidelines (NRMMC 2004, SA EPA 2020). Nevertheless, NRMMC (2004) states that "*a suitable withholding period should be observed post biosolids application before crops are harvested or animals are allowed to graze*".

Table A4-11 Withholding Times for Biosolids in Different Jurisdictions

Biosolid Use		QLD DES 2023	EPA Vic 2004	WA DEC 2012
Human food crops	*Harvested parts do not touch the biosolids*	30 days	30 or 90 days	Up to 30 days
	Harvested parts touch the biosolids but are above the land surface (e.g. lettuce)	18 months		
	Harvested parts are below the surface of the land (e.g. carrots)	5 years		
Animal feed and fibre crops (Poultry and pigs must not be allowed to graze on biosolids application areas)		30 days	30, 60 or 90 days	30 days
Animal withholding		90 days		45 days
Turf		1 year	1 year	1 year

Biosolid Use		QLD DES 2023	EPA Vic 2004	WA DEC 2012
Public access	*Where there is high potential for public exposure*	1 year	1 year	1 year
	Where there is low potential for public exposure	30 days		
Withholding time = Timeframe in which the resource must not be applied.				

A4-3.4. Land Slope Restrictions

In multiple jurisdictions there are restrictions on the placement of biosolids when the slope of the land is more than as follows:

- >10% for agriculture and >18% for non-agricultural purposes and land rehabilitation in NSW (NSW EPA 1997).
- >15% (>1:7 ratio) in Tasmania (EPA Tas 2020), Victoria (EPA Vic 2004) and Western Australia (WA DER 2012).

The National, South Australian and Queensland guidelines do not specify land slope restrictions. Nevertheless, in South Australia, it is stated that "*preventative measures must be taken to ensure that runoff and erosion is avoided*" (SAEPA 2020).

A land slope restriction was not applied in the NT guidelines.

A4-3.5. Blending of Biosolids

The biosolids product is a composted or blended material that includes biosolids as a component, i.e. a biosolid product can be a mix of several products (including biosolids) to form one product (without further treatment). The mixing of these different products together is referred to as blending. As outline in **Table A4-12** below, all available guideline consulted permitted the blending of biosolid products to improve the contaminant grade and/or to produce a material with more desirable properties where the blended biosolid product was resampled and regraded before use[12]. Blending is commonplace across jurisdictions as biosolids that allows for the concentration of potentially toxic elements in the biosolids (particularly metals) to be reduced. It is noted that blending has little impact on the reduction of pathogens in the product.

Blending to reduce a contaminant grade is therefore permitted within the NT biosolids guidelines as it maximises the potential reuse of biosolids, minimises the amount of biosolids being sent to landfill as waste, and is in line with this common practice employed in all other Australian jurisdictions.

[12] It is noted that whilst QLD DES 2023 does not specifically refer to blending it does state that "*Any biosolids which is determined to be non-compliant with Requirements (6.2.2) or (6.2.3), other than biosolids awaiting reprocessing for reclassification, is considered to revert to classification as a regulated waste*"(Requirement 6.2.4, QLD DES 2023). Biosolids awaiting reprocessing for reclassification is inferred to mean a biosolid product undergoing further blending to improve the contaminant or stabilisation grade and/or desirable property.

Table A4-12 Blending of Biosolid Products in Relevant Australian Jurisdictions.

Guideline	Is Blending Permitted to improve a contaminant grade?	Comment on Blended Products
NRMMC 2004	Yes. "*Processed biosolids are classified based on the characteristics of the final product, rather than on the grade of the biosolids received by the processor, i.e., processors could potentially treat an unstabilised and chemical grade C2 biosolids to a pathogen grade P1, chemical grade C1 product.*"	
NSW EPA 1997	Yes. "*A grade with low contaminant concentrations may be achieved by blending (diluting) with other acceptable materials or biosolids products".*	*To establish that a grade with lower contaminant concentrations has been achieved the biosolids should be re-sampled, analysed and regraded after blending*".
QLD DES 2023	Not specifically stated. However, non-compliant biosolids may be reprocessed for reclassification (refer to Requirement 6.2.4).	
SA EPA 2020	Yes. "*Biosolids can be blended with other materials into a product that has more desirable characteristics or properties for reuse than the 100% biosolids product. Biosolids are usually blended with other materials to dilute the concentration of contaminants such as metals in the biosolids*".	"*If blending occurs after grading, the blended product may require regrading*"
EPA Tas 2020	Yes. "*A contaminant grade may be improved by blending with other acceptable materials such as other biosolids, composted green waste, lime or other by-products*" and "*Biosolids can be blended with other acceptable materials or further treated to improve classification and/or produce a material with more desirable properties*"	"*The blended product must be re-sampled, analysed and re-graded in accordance with these Guidelines to determine the new contaminant grade*".
EPA Vic 2004	Yes. "*Mixing or blending of biosolids with other compatible materials is permitted*" and "*Processes such as composting, lime stabilisation or soil blending may result in a final product that meets the C1 provisions despite the initial biosolids material being C2*"	"*Provided the final product is re-sampled and conforms to the C1 criteria, the final product can be classified as C1*".
WA DEC 2012	Yes. "*A contaminant grade may be improved by blending or treating with other acceptable materials, such as composted green waste, lime or other by-products*".	"*The blended product must be re-sampled, analysed and re-graded to determine its new contaminant grade*".
(1) Note that NSW EPA's Environmental Guidelines: Use and Disposal of Biosolids Products stated that		

A4-4. Risk Assessment

The NT Biosolids Management Guidelines incorporate the requirement for a site-specific risk assessment based on the category and quality of the biosolids and the end use location. This enables site-specific mitigation actions to be incorporated into the reuse program. Risk assessment processes as applied across different Australian jurisdictions (and other relevant guideline documents) are outlined in **Table A4-12** below.

Biosolids management guidelines from other jurisdictions are based on mitigating identified risks to environmental health and human health. However, few guidelines incorporate the requirement for site specific risk assessments for biosolid reuse. The use of site-specific risk assessments for identification and mitigation of risks aligns with the ANZG (2018) water quality framework and the National Environment Protection (Assessment of Site Contamination) Measure 1999 (Amended 2013). The requirement for a site-specific risk assessment is required for Class B and Class C biosolids in the NT in the Biosolids Management Guidelines.

Table A4-12 Risk Assessment Processes for Biosolids Application Across Different Jurisdictions

Reference	Risk Assessment Process
NRMMC (2004)	The National guidelines discuss the risks of biosolid re-use and states that the document was developed based on mitigating the identified risks. The document identifies risks, mainly from using biosolids in agriculture and risks associated with food safety. The document states that further research is required before a qualitative risk assessment can be carried out on biosolid reuse. However, the document does recommend that risk assessments be carried out to better understand the risk to human health and environmental health from biosolid reuse.
Northern Territory Guidelines	The NT guidelines incorporate the requirement for a human health and/or ecological risk assessment if biosolids are classified as Class B and are to be transported and re-used as these may have the potential to cause harm to the environment and human health if risks are not identified and mitigated. Such a risk assessment is designed to be site specific and provide mitigation specific for that particular application. The guidelines provide direction on who and how the risk assessment must be conducted. The guidelines also provide an interactive risk assessment spreadsheet to enable the assessments and their results to be consistent and repeatable.
ACT ESD (2011)	This strategy provides actions to monitor the risk to the environment from landfill leachate and identifies potential risks to environmental health, human health and atmospheric pollutants from landfill gas emissions.
NSW EPA (1997)	This guideline has been developed to address and mitigate identified risks to human and environmental health. The contaminant limits were developed based on a risk assessment process, but the guideline document does not require the development of a risk assessment for each batch of biosolids. A more recent fact sheet released by NSW EPA (NSW EPA 2018[13]) on the application of biosolids to land requires that biosolids are shown to pose minimal risk of harm to the environment and human health but does not state that a risk assessment is required (nevertheless, this would be implied from the statements in the fact sheet).
QLD DES (2023)	This Code requires a written procedure that identifies potential risks of environmental harm from using the resource during routine operations and emergencies and incorporates control measures that minimise the potential for environmental harm which must be established and maintained.
SA EPA (2020)	The SA guidelines have been developed to minimise risks to environmental health and human health. Contaminant and pathogen concentration limits have been derived using a risk-based approach and mitigations to manage the risks are incorporated into the guidelines. There are no requirements for site specific risk assessments.
EPA Tas (2020)	The Tasmanian guidelines require that the producer of the biosolids conduct a risk assessment on the WwTP Catchment to screen for industrial and commercial premises

[13] https://www.epa.nsw.gov.au/-/media/epa/corporate-site/resources/recycling/18p1313-applying-compost-and-biosolids-to-land-fact-sheet.pdf?la=en&hash=6D37152BDC0FE0104CB1928325C06D387453FCEE

Reference	Risk Assessment Process
	which may contribute to contaminants not listed in the Guidelines. However, the guideline does not require a risk assessment to be conducted on the resultant biosolids. Contaminant and pathogen concentration limits in these guidelines have been derived using a risk-based approach and mitigations to manage the risks are incorporated into the guidelines. There are no requirements for site specific risk assessments.
EPA Vic (2004)	The Victorian Guidelines state that the environmental and human health risks posed by the end use are identified and assessed. This refers to a site-specific risk assessment for unrestricted and restricted grade biosolids. Contaminant and pathogen concentration limits have been developed and mitigations to manage the risks are incorporated into the guidelines. However, where the risk assessment indicates additional measures are necessary, appropriate extra precautions should be implemented.
WA DEC (2012)	The WA guidelines have been developed to facilitate responsible, beneficial use and to minimise the risk of any adverse effects on public health, animal health and the environment. The WA guidelines require a Review of Environmental Factors (REF) which provides the same information as a risk assessment with associated management plans for mitigation actions.

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