Biosolids chemical study

The NSW Environment Protection Authority (EPA) has tested the chemical properties of biosolids. The findings will guide new strategies for regulating biosolids.

Biosolids are organic waste produced from sewage treatment processes. They are typically organic matter from mixtures of human waste and other material that enters household drains. They often include industrial inputs ('trade wastes').

About 80,000 dry tonnes of biosolids are produced in NSW each year. They are tested, graded and classified according to the standards outlined in the Biosolids Guidelines. If they meet these standards, biosolids can then be used as a soil amendment in accordance with the Biosolids Order 2014 and the Biosolids Exemption 2014.

Since the Biosolids Guidelines were last updated, new chemicals have emerged as potential risks to human health and the environment. Our ability to test for and identify these chemicals has also improved.

Our testing gathered evidence for a science-based strategy for the use of biosolids.

Figure 1 Example of biosolids

Findings and next steps

Our testing found that the chemicals present in modern biosolids are limiting their ability to be beneficially reused on land.

Any regulatory approaches to improve the chemical quality of biosolids should consider:

- reducing or eliminating the sources of these chemicals before they enter sewerage systems
- treatment technologies to effectively reduce or eliminate chemicals from biosolids before they are applied to land.

We are working with community and industry to implement a new regulatory approach for biosolids. We will consider all potential regulatory options, such as:

- new treatment technologies (e.g. thermal processing)
- alternative uses for outputs (e.g. the use of biochar in industrial applications).

We are consulting on a draft of a new biosolids order and exemption. These instruments are aimed at addressing the risks associated with chemicals in biosolids.

Details of the study

We designed the study to give a snapshot in time of the chemical properties of biosolids generated by a broad range of sewage treatment plants (STPs). We examined biosolids from 75 different STPs across the state for 351 unique chemical analytes and attributes.

NSW Environment Protection Authority. ISBN 978 1 923328 14 3 | EPA 2025P4584 | August 2025

We selected different types of STPs

We chose a range of STPs to capture the variability that exists between catchment environments, material inputs and sewage treatment methods. This let us explore the potential of regulatory strategies that consider factors such as site location, catchment size, trade waste acceptance and treatment method.

We tested a broad range of chemicals

Chemicals we included were:

- all chemicals currently required to be tested in the Biosolids Guidelines
- all chemicals with proposed regulatory thresholds from the biosolids issues paper
- additional chemicals associated with pharmaceuticals, plastics, fire retardants, agriculture, personal care products, and other industries.

The NSW EPA adopts a precautionary approach to regulating waste streams. We studied a broad range of chemicals to get a holistic understanding of the properties of biosolids.

Figure 2 Sampling

We gathered extra data

We complemented our sampling and testing by:

- asking all STP operators to supply all sampling and testing data collected over the last 6 years
- asking our colleagues in other jurisdictions for data so that we could compare contaminant concentrations.

We assessed against published criteria

We assessed new chemical contaminants against the criteria in:

- the NSW Biosolids Regulatory Review Issues Paper
- The PFAS National Environmental Management Plan (NEMP) 3.0.[1]

Chemical contaminants determine where biosolids can be applied to land

The EPA is consulting on a draft biosolids order and exemption. This outlines a proposed biosolids grading scheme based on the concentrations of PFAS and PBDEs listed in the draft biosolids order, as well as monitoring requirements for triclosan and Galaxolide to understand the impact of including future regulatory thresholds whilst allowing industry time to transition, adapt and respond.

Combined with existing grading requirements, this proposed grading scheme would determine where biosolids can be applied to land as a soil amendment. Table 1 (next page) shows suitable uses for each grade.

[1] HEPA 2025, *PFAS National Environmental Management Plan Version 3.0*, Heads of EPA Australia and New Zealand 2025. CC by 4.0. as updated from time to time

Table 1 Table of permissible land application sites for different biosolids classifications

Application site	Grade A/B	Grade C	Disposal
Home lawns & gardens	☑	☒	☒
Public contact sites	☑	☒	☒
Urban landscaping	☑	☒	☒
Agriculture	☑	☑	☒
Forestry	☑	☑	☒
Soil and site rehabilitation	☑	☑	☒
On site disposal	☑	☑	☒
Reprocessing	☑	☑	☒
Landfill	☑	☑	☑

We found the new contaminants are prevalent

As noted above, we sampled biosolids from 75 STPs. Of these 75 sites, just one met the proposed Grade A/B thresholds for all new contaminants. Biosolids from 19 STPs met the requirements for Grade C land uses at an application rate of 50 t/Ha.

The chemical(s) that exceeded the reuse criteria differed between the different STPs. The biosolids contaminant grade was **not** influenced by sources of sewage, catchment size, catchment characteristics or STP treatment processes. This may indicate that there are sources of contamination entering the STPs from domestic sewage as well as from trade waste.

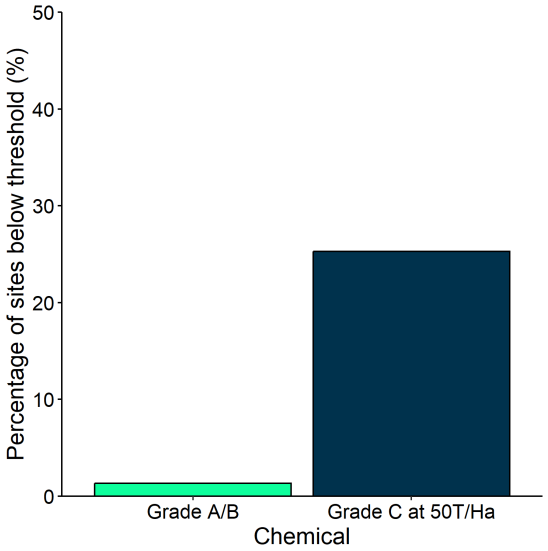

Figure 3 Percentage of STPs that met the proposed new chemical requirements for Grade A/B and C biosolids

How we propose to regulate new chemicals in biosolids

Grade A/B biosolids represent unrestricted use thresholds; Grade C indicates restricted use thresholds. Where the PFAS concentration in the biosolids fail to meet Grade C, they **may** still be suitable for application to agricultural land. It would be necessary to calculate the contaminant-limiting biosolids application rate (CLBAR), as set out in the Biosolids Guidelines and the draft biosolids order, to determine an appropriate application rate for agricultural use.

The proposed thresholds for PFAS reflect the *PFAS National Environmental Management Plan (NEMP) 3.0* with a margin of safety of two. The higher margin of safety is proposed for PFAS to account for the large number of unregulated PFAS compounds (including chemicals which may act as precursors to PFOS, PFHxS and PFOA) in the environment.

Figure 4 NSW EPA sampling a biosolids stockpile

Perfluoroalkyl and polyfluoroalkyl Substances (PFAS)

PFAS are fluorinated compounds that have been widely used in consumer and industrial applications, to give materials qualities such as grease and water resistance, and thermal stability. The PFAS NEMP 3.0 provides guidance on thresholds for three PFAS compounds (PFOS+PFHxS and PFOA) in biosolids.[2] However, there are thousands of different PFAS chemicals. Our understanding of these chemicals is increasing with time, and so too is our ability to test for them.

The biosolids we tested often exceeded the Grade A and B thresholds for PFAS. The concentration of PFOS+PFHxS were typically more limiting than that of PFOA. Concentrations of PFOS+PFHxS were also above the Grade C threshold at over 50% of STPs (Figure 5).

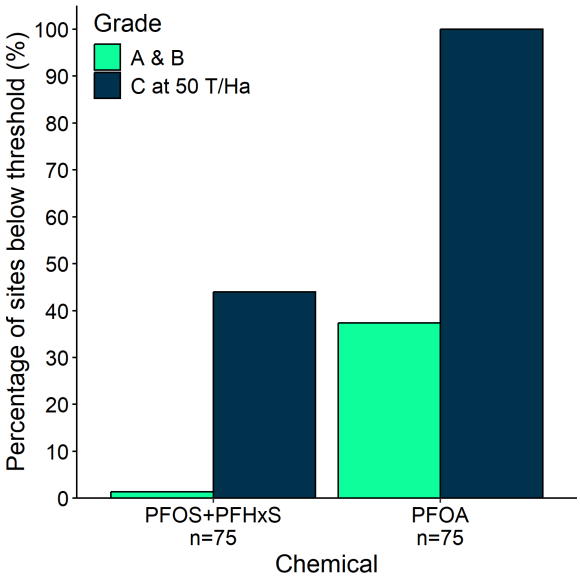

Figure 5 Percentage of STPs that met the proposed unrestricted and restricted use thresholds for PFOS+PFHxS and PFOA.

Triclosan and Galaxolide[3]

Triclosan has both industrial and consumer applications as an antimicrobial agent, while Galaxolide is mainly used in consumer products as a synthetic musk fragrance.

Triclosan and Galaxolide are likely to enter an STP mainly through the use of personal care products such as perfumes, fabric softeners, cosmetics, toothpaste, cleaning agents and detergents in domestic settings. Triclosan can also enter STPs from industrial sources including facilities that manufacture materials that require preservative or anti-microbial qualities.

Most biosolids we sampled had concentrations of triclosan and Galaxolide that exceeded the Grade A/B thresholds that were proposed in the Issues Paper. The concentrations of triclosan also occasionally exceeded Grade C thresholds.

[2] PFOS+PFHxS are considered together and their individual concentrations summed for comparison with the threshold.

[3] Galaxolide is the trade name for HHCB – 4,6,6,7,8,8-hexamethyl-1,3,4,6,7,8-hexahydrocyclopenta[g]isochromene

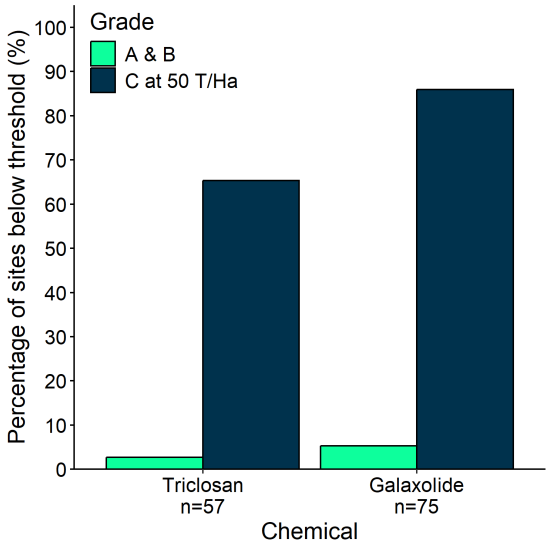

Figure 6 Percentage of STPs that met the unrestricted and restricted use thresholds for triclosan and Galaxolide.

Polybrominated diphenyl ethers (PBDEs)

PBDEs are flame retardants used to decrease the flammability of numerous consumer products made of plastics, foams and textiles. They are likely to enter STPs from manufacturing facilities or shedding (e.g. during washing).

The PDBEs that the EPA intends to regulate in biosolids are the sum of the Br1–9 fraction, which are diphenyl ethers with 1–9 bromine atoms, and Br10, which contains 10 bromine atoms. Our testing found that the Br1–9 fraction in biosolids was the most limiting. Only one site contained Br10 concentrations greater than the Grade A/B threshold.

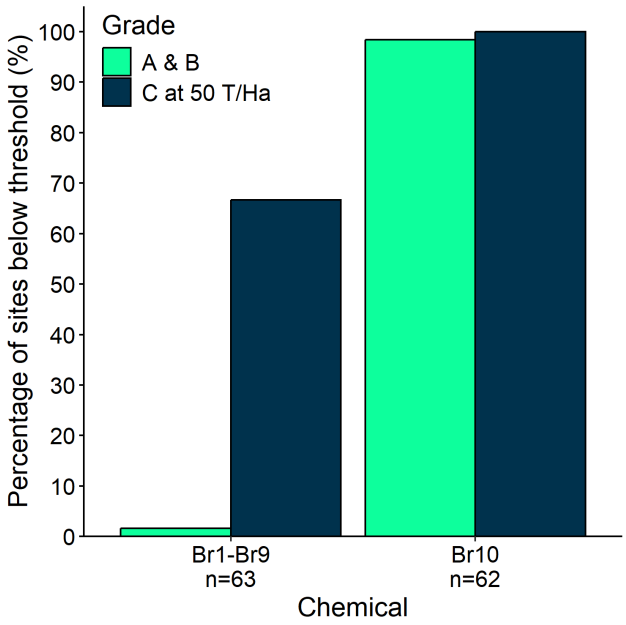

Figure 7 Percentage of STPs that met the Grade A/B and Grade C thresholds for PBDEs