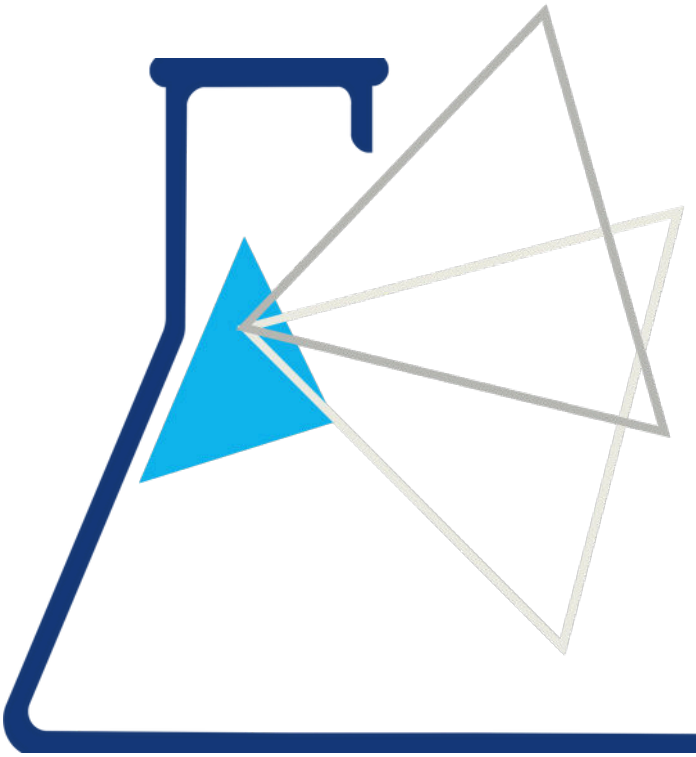

Prepared for: Australian Organics Recycling Association (AORA)

NSW EPA Draft Biosolids RRO/RRE Independent Review

October 2025

SESL_5588_1490_2025

DOCUMENT RECORD

Document Title:	NSW EPA Draft Biosolids RRO/RRE Independent Review
Prepared for:	Australian Organics Recycling Association (AORA)
Postal Address:	PO Box 585, Hove SA 5048
Commissioned by:	John McKew
Position:	National Executive Officer

Environmental Consultant:	SESL Australia Pty Limited
Address:	16 Chilvers Road, Thornleigh NSW 2120
Australian Business Number:	70 106 810 708

Site Owner:	N/A
Site Address:	N/A
Lot & Deposited Plan	N/A

Document Version:	Final 2.0
Document Reference:	5588_1940_2025
Main Author:	Simon Leake
Qualifications:	B Sc (Ag) Hons, ASSSI, CPSS
Technical Reviewer:	Samantha Grant-Vest / Jane Koo
Qualifications:	B Env, B Hort / MEnvScMgt
Final Reviewer:	Simon Leake
Qualifications:	B Sc (Ag) Hons, ASSSI, CPSS

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

TABLE OF CONTENTS

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

DOCUMENT TABLES IN TEXT

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

ABBREVIATIONS

CLBAR	Contaminant-Limiting Biosolids Application Rate
COC	Contaminants of Concern
EoW	End of Waste
EILs	Ecological Investigation Levels
EPA	Environmental Protection Authority
HHCB	Galaxolide
HILs	Health Investigation Levels
HSLs	Health Screening Levels
LGA	Local Government Area
LOR	Limit of Reporting
MASCC	Maximum Allowable Soil Contaminant Concentration
MRL	Maximum Residue Limit
NATA	The National Association of Testing Authorities
NEMP	National Environmental Management Plan
NEPM	National Environment Protection (Assessment of Site Contamination) Measure 1999 (amended April 2013), Canberra
NLBAR	Nitrogen Limited Biosolids Application Rate
NOAEL	No Observable Effect Level
NSW	New South Wales
PFAS	Per- and Polyfluoroalkyl Substances
PFOS	Per-fluorooctane Sulfonate
POEO	Protection of the Environment Operations
PPB	Parts Per Billion
PPM	Parts Per Million
RRO	Resource Recovery Order
RRE	Resource Recovery Exemption
RPD	Relative Percentage Difference
RSC	Residual Soil Concentrations
QLD	Queensland
SESL	SESL Australia Pty Limited
SSV	Soil Screening Values
STP	Sewage Treatment Plant
TDI	Tolerable Daily Intake
TPH	Total Petroleum Hydrocarbons
TRH	Total Recoverable Hydrocarbon
UK EA	United Kingdom Environmental Agency

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

1 INTRODUCTION

Prior to the introduction of land-based reuse of biosolids in the late 1980's ocean outfall was virtually the only way of disposing of the solids from sewage treatment in coastal cities. The consequences at Manly and Maroubra could be seen and smelled on any day of the week. Landfills will not accept them in sludge form and are reluctant to accept even dried cake due to odour issues. Landfill of putrescible organic waste produces methane, a potent greenhouse gas. Agriculture is, by a large margin, the greatest market for the beneficial reuse of biosolids and contributor to the elimination of ocean outfall. Mining has not taken up much direct biosolids reuse as the workforce objects to the odour issues. There is some take up of composted biosolids however mine rehabilitation is very cost sensitive.

Ocean outfall is no longer permitted and the only alternative, if agriculture were prevented from taking biosolids, would be landfill.

1.1 Background

The NSW EPA has conducted a review of the existing NSW Biosolids Environmental Guidelines: Use and Disposal of Biosolids Products (hereafter Biosolids Guidelines) through 2022-2023. This culminated in the NSW Biosolids Regulatory Review Technical Findings Report (EPA 2023). The purpose of this review was mainly focussed on examining existing threshold levels in the current Biosolids Guideline and also to examine the need to introduce additional controls over certain emerging contaminants of concern (COCs).

After a process of industry feedback in 2023, the review has now resulted in the issue, in draft form for comment, of a revision of the resource recovery order and exemption (RRO and RRE) for biosolids called "The biosolids order 2025" and "The biosolids exemption 2025".

These function in essentially the same way as the previous RRO and RRE but they also introduce several new aspects:

- New maximum allowable soil contaminant concentration (MASCC) for PFOS + PFHxS and PFOA.
- New absolute maximum concentration in biosolids for PFOS + PFHxS and PFOA for Grade A/B and for Grade C.
- There is no differentiation between Grades A and B and these levels are the same as the MASCC.
- Margin of safety 2 has been chosen for individual thresholds and applied to MASCC values.
- A requirement to test biosolids for HHCB, Triclosan, Br1-Br9 and BR10, linked to advisory maximum levels and MASCC that may be applied in future.
- A requirement to pre-test soils for the new organic contaminants as well as the metals and organics listed in the current Biosolids guideline.
- A way of calculating the application rates based on the new organic contaminant thresholds not exceeding the MASCC's by the consumer.
- A requirement that, if the application rate is calculated to be less than 15 dt/ha the consumer must engage an expert to make a report demonstrating the application is beneficial.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

- A requirement that, if the biosolids meets the Grade C criteria no more than 50 dt/ha may be applied.
- Return of biosolids and soil testing results to the EPA for any contaminant that requires an MASCC is now compulsory within 6 months of application of the biosolids. The usual requirement to provide all records upon request still applies.
- Expert reports where proposed applications are deemed not beneficial are also now to be provided to the EPA.

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

2 NEW EMERGING CONTAMINANTS – PFAS

Conditions 7.7 to 7.11 appear to facilitate the use of loading rate calculations to be used if levels of contaminants exceed Grade C or Column 3 of Table 1 of the RRO. However, Table 1 on page 3 of the "Biosolids chemical study fact sheet" clearly shows that if the contaminant exceeds Grade C no agricultural use is permissible. This is reinforced by Table 3-6 of the *NSW Biosolids Environmental Guidelines, Use and Disposal of Biosolids Products* (hereafter the Biosolids Guidelines) which indicates only Grades A, B and C may be used in Agriculture. Contrary to Table 1 of the Biosolids chemical study fact sheet Grade D (which does not appear here) may be used in forestry, soil rehabilitation landfill and surface land disposal.

Table 1

Column 1	Column 2	Column 3	Column 4
Contaminants#	**Absolute maximum concentration** **Contaminant grades A & B** (µg/kg 'dry weight')	**Absolute maximum concentration** **Contaminant grade C** (µg/kg 'dry weight')	**Maximum allowable soil contaminant concentration (MASCC)** (µg/kg 'dry weight')
1. PFOS+PFHxS	0.55	15	0.55
2. PFOA	1.5	40	1.5
3. HHCB* (Galaxolide)	NA^	NA	NA
4. Triclosan*	NA	NA	NA

#Soil testing for PBDEs may apply in the future. Indicative thresholds are provided in the notes to the exemption.

Fig. 1 – Table 1 of the Draft Biosolids Exemption 2025.

Table 1 of the Biosolids chemical study fact sheet broadly aligns with Table 3-6 of the Biosolids Guidelines.

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

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	☑	☑	☑

Fig. 2 – Table 1 'Table of permissible land application sites for different biosolids classifications' of the Biosolids Fact Sheet (NSW EPA, 2025).

This table firmly reinforces that disposal to landfill is the only option for biosolids exceeding Grade C requirements. This contradicts the wording of the RRE.

While the proposed new structure of the RRO and RRE looks workable, the EPA states in page 3 of the Biosolids chemical study fact sheet:

> "*As noted above, we sampled biosolids from 75 STPs [sewage treatment plants]. 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*."

This means that 55 sampled STPs or 73% did not meet the criteria for land application to agriculture.

Figure 3, page 3 of the Biosolids chemical study fact sheet (EPA 2025), illustrates how many STP Biosolids do not meet the new Grade C requirements.

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

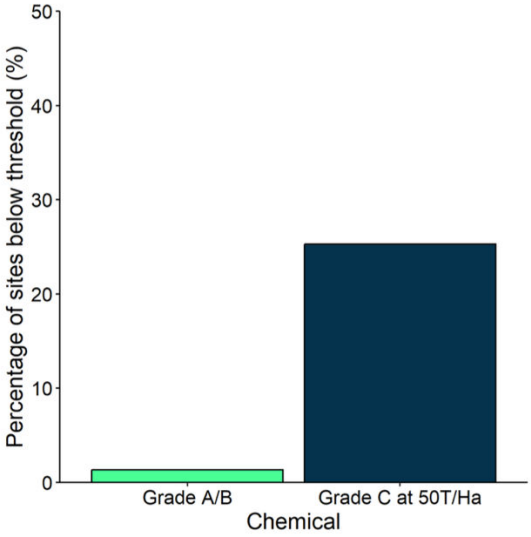

Fig. 3 – Figure 3 'Percentage of STPs that met the proposed new chemical requirements for Grade A/B and C biosolids' of the Biosolids Fact Sheet (NSW EPA, 2025).

It subsequently states you can still apply to Agricultural land with CLBAR:

> "*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.*"

Agricultural use may still occur if a biosolids exceeds Grade C contaminant level for the contaminants in Table 1 Column 3 of the RRO if the CLBAR calculations show that MASCC remain below those set in Column 4.

In the current Biosolids Guidelines if anything exceeds Grade C then it becomes Grade D. Table 3-6 of Biosolids Guidelines makes it clear that "Agriculture" is not an allowable use of Grade D biosolids. This prohibition in agriculture is also evident from Table 1 of the Fact Sheet that appears right next to the statement that you can do CLBAR for use in agriculture where contaminants exceed Grade C.

This Biosolids chemical study fact sheet is misleading or at least confusing. The information it presents indicates that only about 27% of biosolids will be suitable and allowable for use in agriculture. The somewhat vague wording about using loading rates calculations if it exceeds Grade C for the new contaminants is contrary to the wording of the current Biosolids Guidelines and this needs to be clarified.

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

The EPA do not give the results of their sampling of 75 STP's in their " Biosolids chemical study fact sheet" report, only summarised statistics. The "NSW Biosolids Regulatory Review Technical Findings Report (EPA 2023) (Technical Report) gave some limited findings from an earlier sampling exercise of 20 STPs showing:

- 3.2 to 77 µg/kg for PFOS;
- <2.7 to 24 µg/kg for PFOA; and
- <0.1 to 3.8 µg/kg for PFHxS.

With averages:

- PFOS + PFHxS = 32 µg/kg with 95th percentile 75 µg/kg.
- PFOA 7.2 with 95th percentile 18 µg/kg.

Clearly the great majority of these would fail the new maximum Grade C concentration of 15 ug/kg for PFOS + PFHxS and all would fail Grade A/B maxima. Since we don't have the actual data, it is not possible to say what percentage would fail, but it looks like a significant majority.

A further complication occurs at 7.10. This presumably relates to highly contaminated biosolids where the CLBAR calculations show that only application rates below 15 dry tonnes/ha can occur. There follows a slow and costly solution that requires an expert report demonstrating these low application rates are still beneficial. This would become increasingly cost prohibitive the lower the application rate.

The proportion of biosolids likely to require this expert report pathway is unknown. By reverse engineering the CLBAR at Table 6 below we can see that the levels would have to be up at around 37.5 ug/kg for PFOS + PFHxS and 100 ug/kg for PFOA, levels that were not seen in the EPA data set.

From what data EPA has put forward, no information is provided on the distribution of STPs failing the Grade C criteria or what proportion would come up with CLBARs of less than 15 t/ha and what impact that might have. For example, it could be certain STPs, perhaps linked to industrial areas, that always fail the Grade C criteria. It could be that some meet Grade C but cannot be used for composting for use in amenity landscaping where the compost must meet Grade A/B maxima. It could be that some rural STPs always meet Grade C and no issues occur for them.

With the level of data EPA has at hand the potential effect on this industry could be severe but is simply insufficient to conduct any kind of precise industry impact assessment as to the distribution of the damage and which particular operators will be most affected.

Studies from the northern hemisphere commonly report the presence of these chemicals in untreated soils with no known exposure routes. Costello and Lee (2020) report: "*A recent review by Vedagiri et al. of soils in North America with no known PFAS point sources found background levels of PFOS and PFOA ranged from 0.018 to 2.55 ng/g (n=38 studies) and 0.059 to 1.84 ng/g (n=40), respectively. A global survey of 32 PFAS in soils taken from 62 locations with limited to no anthropogenic impact revealed PFAS presence in every sample; long-range transport was identified as the source.*"

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

Many of these studies show higher levels in soils than those proposed in the new RRO and RRE.

2.1 Comparison with Other Australian Guidelines

Table 1 compiles the current published guidelines relevant to biosolids or PFAS chemicals in soil.

Table 1 – Current Australian guidelines for PFAS in soil.

Criterion	PFOS + PFHxS (µg/kg)	PFOA (µg/kg)
NEMP 3.0 Residential with garden/accessible soil (HIL A)	3	60
NEMP 3.0 Residential with minimal opportunities for soil access (HIL B)	2,000	20,000
NEMP 3.0 Public open space (HIL C)	1,000	10,000
NEMP 3.0 Ecological direct exposure	1,000	10,000
NEMP 3.0 Ecological indirect exposure	3 (140 in specific cases)	3
QLD End of Waste Code	2	4
NSW EPA Draft Biosolids RRO/E	0.55	1.5

In Section 8.7.1 of the PFAS NEMP 3.0, it states:

> "*The direct exposure ecological soil guideline applies specifically to the protection of organisms that live within, or in close contact with soil, such as earthworms and plants. This direct exposure value can be used to assess the possibility of direct harm to these organisms."*

On page 2 of the EPA biosolids chemical review fact sheet, page 2, EPA state:

> "*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*"

As Table 1 shows, the NEMP thresholds for further investigations (HIL: Health Investigation Level) are orders of magnitude higher than the NSW EPA Draft RRO in an urban environment and several orders of magnitude lower than the national guideline for ecological protection. Even where the growing of some food (10%) is contemplated in a residential situation, the levels of PFAS are more than 5 times lower in the RRO/E. The Grade A/B levels do not seem to bear any comparison with the NEMP 3.0 as stated in the fact sheet.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

The industry is left in a situation where the RRO will not permit application of biosolids in an unrestricted manner (e.g. composted biosolids in residential sites or public parks) if they exceed 0.55 ug/kg of PFOS + PFHxS or 1.5 ug/kg of PFOA; when the national guideline says you do not even have to consider health investigation unless these areas exceed 3 and 60 µg/kg respectively in a residential situation with access to growing food. The lack of consistency between guidelines is even more stark in public open spaces where 1,000 and 10,000 ug/kg would be tolerated under the national approach (NEMP 3.0) and yet composted biosolids exceeding 3 and 60 ug/kg for PFOS + PFHxS and PFOA respectively, cannot be applied.

The NEMP 3.0 is silent on the matter of soil in agricultural settings but it would appear that the NSW EPA considers urban settings more sensitive than agricultural settings; whereas the NEMP seems to consider them far more tolerant. On the face of it, the EPA's approach unnecessarily excludes biosolids products from these landscaping uses.

Queensland has brought in "end of waste" regulations relating to biosolids that provide "trigger values" for soils post biosolids application (refer to Table 2).

Table 2 – PFAS trigger values in soil (adapted from Clause 7.26, QLD End of Waste Code).

Contaminant	Trigger Value (mg/kg)
PFOS	0.001
PFOS + PFHxS	0.002
PFHxS	0.003
PFOA	0.004
PFBA, PFPeA, PFHxA	0.001
Sum C_6 – C_{14} Perfluoroalkyl carboxylic acids	0.01
Perfluoroalkyl sulfonamides	0.001
N:2 Fluorotelmer Sulfonic acids	0.004

The "trigger value" is the level of PFAS chemicals found in the soil post-application considering the pre-application soil test, analysis of the biosolids for PFAS chemicals and calculating the predicted PFAS with consideration of the agronomic application rate.

They do not have maximum limits in the contamination gradings of the biosolids, but require monitoring of the biosolids for these chemicals prior to application on soils and calculated application rates to avoid exceeding these levels.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

This approach clearly considers PFAS loading rate and does not automatically assume the content of PFAS in the biosolids would end up as the MASCC in the soil, which is a completely unrealistic scenario because biosolids are incorporated into the soil resulting in significantly lower residual soil PFAS concentrations.

It is also obvious that the QLD trigger values for PFOA at 4 µg/kg are similar to NSW EPA Draft RRO but are significantly (about 4 x) higher for PFOS + PFHxS at 2 µg/kg. The EOW code does not define "trigger value" other than requiring the user to notify the "chief executive" of any exceedance, presumably triggering either an investigation into potential health effects and their mitigation, or prosecution for an offence.

2.2 Other Jurisdictions

A study entitled "PFAS in biosolids: A review of international regulations" of Mar 3, 2021 (Hall et al, 2021) published the following table.

Table 3 – Summary regulations related to PFAS and biosolids for European countries (adapted from Table 5 in Hall et al. 2021).

Country	Reference	Soil Limit		Fertiliser Limit	
		mg/kg	ng/g	mg/kg	ng/g
Denmark	NICOLE (2016) Also pers comm June 2020, Danish MST	0.4[1]	400[1]		
Germany	NICOLE (2016)			0.1[3]	100[3]
The Netherlands	RIVM (2020)	0.0009 (PFOS) 0.0008 (PFOA)	0.9 (PFOS) 0.8 (PFOA)		
Sweden	Sahlin (2017)	Sensitive land use 0.003[2] Less sensitive land use 0.02[2]	3[2] 20[2]		

[1] The sum of 12 PFASs: PFBS, PFHxS, PFOS, PFOSA, 6:2 FTS, PFBA, PFPeA, PFHpA, PFOA, PFNA, PFDA.

[2] The sum of 11 PFASs: Same as the Denmark and German limits but excluding PFOSA.

[3] Sum of PFOS and PFOA.

The closest guideline directly related to biosolids is the German Fertiliser limit of 100 µg/kg (ng/g) compared to the NSW EPA 0.55 ug/kg for the addition of PFOS and PFOA.

In the United Kingdom, their Environmental Agency has recently published (EA, 2023) Soil Screening Values (SSVs) for the management of land applied wastes as per Table 4 below:

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

Table 4 – Soil screening values for PFAS in land applied wastes (UK EA, 2023)

Criterion	Maxima (µg/kg)
PFOA	19
PFOS	13
Triclosan	130

These are an order of magnitude higher than the EPA proposed levels.

The Canadian Food Inspection Agency (https://inspection.canada.ca/en/plant-health/fertilizers/notices-industry/2023-05-19) has brought in 50 ppb (µg/kg) of per-fluorooctane sulfonate (PFOS) as a maximum in biosolids sold as fertiliser in Canada. This is about two orders of magnitude lower than the NSW EPA A/B contamination grade. They have no limit for PFOA.

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

3 BIOSOLIDS GRADING & CLBAR CALCULATIONS

3.1 CLBAR at 15 tonnes/ha

It is illustrative to do CLBAR for the Grade A & B and Grade C contaminant levels from Table 2 of the Order and the "indicative levels" for HHBC and Triclosan from the Notes to the Order.

Residual Soil Concentrations (RSC) following biosolids application are calculated for a 75 mm incorporation depth and the A, B and C maximums. Note: incorporation to 150mm depth is also common.

Table 5 – CLBAR for the Grade A & B and Grade C contaminant levels at 15 t/ha dw.

Contaminant	Grade A&B Max	C Max	RSC		MASCC
			A/B Max	C Max	
PFOS + PFHxS	0.55	15	0.008	0.23	0.55
PFOA	1.5	40	0.023	0.60	1.5
HHCB (Galaxolide)	750	20000	11.3	300	750
Triclosan	65	1700	0.98	25.5	65
Br-1-BR9	5.1	140	0.077	2.1	5.1
Br10	9200	1300000	138	19500	48000
Application rate t/ha	15				

It shows that applied at the 15-tonne rate Grade C biosolids the top 75 mm of topsoil would still remain very comfortably under the MASCC. The methodology behind the choice of 15 t/ha is not clear. The calculations show that many multiple applications could be applied if biosolids were at the Grade A/B contaminant level.

At Clauses 7.8, 7.9 and 7.10 of the Exemption, it discusses what happens if CLBAR calculations show that less than 15 tonnes can be applied. It is worth calculating what the contaminant level would need to be if this scenario were to occur. This is shown in Table 6.

Table 6 – Calculated concentrations in biosolids required if 15 t/ha causes MASCC to be exceeded.

Contaminant	C Max	Actual Max Conc	Calculated RSC at C max	MASCC
PFOS + PFHxS	15	37.5	0.56	0.55
PFOA	40	100	1.50	1.5
HHCB Galaxolide	20000	50000	750	750
Triclosan	1700	4300	65	65
Br-1-BR9	140	340	5.1	5.1
Br10	1300000	3,250,000	48750	48000

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

Contaminant	C Max	Actual Max Conc	Calculated RSC at C max	MASCC
Application rate t/ha	15			

This indicates that, to be limited to 15 t/ha due to CLBAR calculations, the actual contaminant levels would need to be around 2.5 times higher than the maximum Grade C levels. Such levels were not seen in the EPA survey of STP's but maxima of 77 ug/kg for PFOA and 27.8 for PFOS+PFHxS were seen. This indicates a sizeable proportion would be restricted to levels just above 15 t/ha and would preclude repeat application for possibly many years. How favourably this would be looked on by the farming community is not known but market resistance could be expected.

3.2 Limiting Grade C to 50 t/ha

7.11 states: "For biosolids meeting contaminant thresholds in Column 3 of Table 1 of the biosolids order 2025", a consumer must not apply the biosolids above a maximum application rate of 50 dry t/ha." It is worth illustrating the MASCC at the Grade A, B and C maxima using CLBAR calculations at 50 t/ha as presented in Table 7.

Table 7 – MASCC at the Grade A, B and C maxima using 50 t/ha application rate.

Contaminant	Grade A&B Max	C Max	RSC		MASCC
			A/B Max	C Max	
PFOS + PFHxS	0.55	15	0.028	0.75	0.55
PFOA	1.5	40	0.075	2.00	1.5
HHCB (Galaxolide)	750	20000	37.5	1000	750
Triclosan	65	1700	3.25	85.0	65
Br-1-BR9	5.1	140	0.255	7.0	5.1
Br10	9200	1300000	460	65000	48000
Application rate t/ha	50				

It can be seen the RSCs exceed the MASCC if biosolids at the Grade C maxima are applied at 50 t/ha. The condition at 7.11 of the RRE limiting Grade C application to 50 t/ha is not necessary, the actual application rate for all biosolids would be determined by the measured contaminant levels and a comparison of NLBAR and CLBAR in the normal course of applying the method. If the levels were up near the Grade C levels the CLBAR would show that RSC levels are likely to be exceeded with more than 50 t/ha.

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

3.3 Derivation of Unrestricted Use Levels

In the NSW Biosolids Guideline Review (Dept of Planning and Environment, 2023) it is stated:

> "*The derivation of these* [unrestricted use] *thresholds assumes an unrestricted use biosolids can be land applied as a topsoil (i.e. with no restriction on application rate). Therefore, they assume no dilution of the biosolids into the soil*."

This risk pathway with biosolids could almost certainly never occur. Rooting depth for pasture for example is usually around 300 mm deep and the scenario of applying to this depth so plant roots are entirely confined to growing in the biosolids is so unlikely as to be impossible. 300 mm deep of biosolids is 3000 m^3 or about 2000 tonnes per hectare. At 2.5% N this would be 50,000 kg N/ha when the maximum permissible limit is 1200 kg N/ha.

The NSW Biosolids Guideline Review also states:

> "*Where human health pathways were identified as the key exposure pathway, nationally accepted tolerable daily intakes (TDIs) minus background exposure) have been used (Table 4)."*

However, it is not clear how it was used. Does it assume, for example, that all food intake in a day comes from biosolids treated land which is at the MASCC and that the food grown will provide the entire 0.02 mg/kg body weight/day the person imbibes? This would be a vanishingly small risk pathway even for children growing up on a dairy farm where biosolids were applied.

Also, the NSW Biosolids Guidelines do not permit the growing of food, grazing or public access on land to which biosolids is surface applied. Table 4-8 (Fig. 4 below) makes this very clear:

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

TABLE 4-8

Activity Constraints Specifically For Restricted Use 2– Stabilisation Grade B Biosolids Products on Agricultural Land[1]

Item	Activity Constraints
Human Food Crops	1. Where harvested parts touch the biosolids/soil mixture but are above the land surface, e.g. lettuce, the crop should not be grown for 18 months after biosolids application.
	2. Where harvested parts are below the surface of the land, e.g. carrots, the crop should not be grown for five years after biosolids application.
	3. Where harvested parts do not touch the biosolids/soil mixture, the parts shall not be harvested for 30 days after biosolids application.
Animal Feed & Fibre Crops	4. Should not be harvested for 30 days after biosolids application.
Animal Withholding	5. Animals should not be allowed to graze the land for 30 days after biosolids application.
	6. Lactating (including milk for human consumption) and new-born animals should not be allowed to graze the land for 90 days after biosolids application.
	7. Poultry and pigs should not be grazed on biosolids application areas.[2]
Turf	8. Turf grown on land to which biosolids have been applied should not be harvested for one year after biosolids application.
Public Access[3]	9. Where there is a high potential for public exposure, access should be restricted by fencing and signing for one year after biosolids application.
	10. Where there is a low potential for public exposure access should be restricted for 30 days after biosolids application.

Fig. 4 – Table 4-8 of the NSW Biosolids Guidelines.

Further, an incorporation depth of 7.5 cm is assumed in all NLBAR and CLBAR calculations. In practice famers usually apply to 15 cm (called the plough layer) so even 7.5 cm is conservative.

No realistic risk pathway occurs using the assumption that all the topsoil is biosolids. This would be a clear breach of several aspects the regulations which state, in the current Exemptions which states:

> "7.2 *The biosolids and biosolids products must only be applied to land as a soil amendment in compliance with the Biosolids Guidelines and "The biosolids order 2025*"."
>
> and:
>
> *"Failure to comply with the conditions of this exemption constitutes an offence under clause 91 of the Waste Regulation."*

Different risks scenarios including **composted biosolids** may be assessed but the altered nature of these materials brings into question the transfer assumptions used in the risk modelling. It is not clear if these considerations have been taken into account in determination of regulatory thresholds.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

The only possible scenario in which this exposure route could occur would be when growers use beds of pure biosolids compost, or soil mixes containing high levels of such compost as a "raised bed" type of garden. SESL has never come across this in commercial growing, such use of compost would be uneconomic, but it could possibly occur in urban farming. Given this would be a very minor market share it seems like a very blunt instrument to knock out the entire urban compost market, which is around 12.5% of the biosolids use in NSW/ACT, to protect what must be a very minor section.

Given the parameters will effectively stop all compost use in the urban market based on entirely predictive food chain transfer modelling using a very unlikely risk scenario the regulator should be required to show some reasonable duty of care and diligence by calibrating them using diagnostic experiment.

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

4 OTHER ISSUES WITH THE RRO/RRE

While 7.3 of the Exemption states you have to measure them in soil, it does not actually say you have to measure triclosan and Galaxolide in biosolids it just says NA. Does this mean you do have to measure them? It is ambiguous and it should clearly be stated that they are or are not required to be measured in biosolids.

4.1 Laboratory Testing Costs

The testing of the complete suite detailed in the Draft Biosolids RRO will have significant financial implications for industry. Costings for biosolids testing as per the draft RRO have been obtained from three major labs and are summarised as follows (all costs excluding GST):

- Envirolab Pty Limited (NATA #2901) - $1138.50 per sample (NATA accredited for all analyses).
- ALS Laboratory Group (NATA #825) - $1387.73 per sample (Triclosan will be non-NATA).
- Eurofins (NATA #1261) - $2350.40 per sample (all analyses non-NATA).

The cost per sample alone will be a significant deterrence for processors.

4.2 Analytical uncertainty of PFAS testing

There are analytical uncertainties that are associated with PFAS testing, particularly in a biosolids matrix. The NSW EPA's draft RRO/E intends to enforce low maxima for compliance, however does not seem to consider that there are multiple factors that may impact the testing of PFAS in biosolids samples and therefore should not be considered the most reliable metric by which the reuse of biosolids is permitted.

4.2.1 Variability in extraction procedures

Sample preparation and extraction on a biosolids matrix can vary between labs, and between batches due to moisture content of the particular sample, laboratory-specific protocols and standard operating procedures, and client-specific requirements. Some may be treated as an aqueous matrix, and some may be treated under typical solid matrix sample extraction procedures. Some laboratories may implement altered procedures and methodology for biosolids matrices to avoid any damage to laboratory equipment. Variability in methodologies may impact the overall amount recalcitrant compounds are able to be extracted from the sample.

4.2.2 Laboratory equipment

Laboratories are primarily focused around measuring long-chain PFAS compounds through the use of Liquid Chromatography-Mass Spectometry (LC-MS), whereas the shorter-chain compounds are much more difficult to detect and are more likely to have a toxicological impact. The detection limits on most laboratory equipment to date, whilst improving with constant advancement, cannot detect the shorter compounds with sufficient accuracy.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

Gas Chromatography-Mass Spectrometry (GC-MS) is more suited to the detection of volatile and semi-volatile PFAS compounds. Currently, the OTM 50 is the sole published methodology for GC-MS and the commercial viability of this testing is highly limited. This is why the majority of commercial labs will use LC-MS as the default instrument for PFAS analysis.

4.2.3 Potential for contamination

Due to the ubiquitous nature of PFAS, there is a high potential for contamination during processing and analysis due to laboratory items and equipment commonly containing PFAS (ie. Solvent lines, methanol, PTFE products and containers). Most laboratories will have a kit on hand to replace PFAS-containing instrument components, which can reduce the introduction of PFAS to the samples being analysed however is not considered foolproof. This is not accounting for human error, whereby switching out technicians may increase the potential for contamination during analysis.

4.2.4 Analytical techniques to measure PFAS

There are several techniques used to measure PFAS, all with varying scopes, variability in detection limits, and pros/cons. These and their associated limitations are summarised as follows:

- USEPA 1633A
- Non-targeted analysis (NTA)
- Total oxidisable precursor (TOP) assay – precursors are chemically oxidised and therefore is unable to differentiate between telomer or sulfonamide precursors. Typically requires further dilution, affecting the Limit of Detection (LOD).
- Total organic fluorine (TOF)
- Extractable organic fluorine (EOF)
- Adsorbable organic fluorine (AOF) (also known under USEPA Method 1621) – not specific to PFAS, prone to false positives for totals.
- Particle-induced gamma-ray emission (PIGE) spectroscopy – similarly to AOF, it is not specific to PFAS, prone to false positives for totals. Cannot distinguish between organic and inorganic fluorine. There is no standard for PIGE operating conditions.

Results may vary depending on the supplier used and their associated accreditation, as well as equipment required. There is a lack of a universal analytical technique that will determine the levels of shorter chain PFAS compounds with sufficient accuracy.

4.2.5 Matrix interferences

Matrix interferences introduce considerable variation across samples/batches, largely common with the testing of non-homogeneous materials such as sludge. When tested under an aqueous matrix, contaminants can be co-extracted from the sample which causes interference, meaning further dilution of the sample may be required. Problems may arise with high organic content (typically associated with biosolids and especially

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

composted biosolids) for example, which has the potential to cause suppression of targeted analytes, therefore leading to poor recoveries.

Current PFAS extraction methods in sludge matrices also pose a consistent challenge, as the efficiency of extraction procedures are inconsistent – particularly in highly organic samples such as biosolids.

4.2.6 Internal laboratory QA/QC

Variability in internal laboratory quality assurance and quality control (QA/QC) impact the overall usability of the data. The LODs able to be achieved by the testing supplier may be impacted by dilution factors, and internal standard recoveries for method blanks, surrogates and duplicate samples. Acceptance levels for compliance differ across providers, particularly as certified reference materials are typically tailored to different PFAS methodologies. Significant QA/QC issues may result in unusable data.

4.3 Derivation of MASCC

It is stated in Table 5 of the Biosolids Review Report:

> *" 2 the PFOA unrestricted use biosolids thresholds were derived to protect ecological secondary consumers and are based on a soil screening criterion adjusted from the United Kingdom (UK EA 2017). "*

This report was republished in 2022 but Table 8 compares the EPA adopted MASCC values and upper limits for Grade A and B biosolids with the UK EA SSV methodology for the PFAS chemicals, as well as Triclosan from Appendix A of the UK EA (2020).

Table 8 – EPA RRO/E maxima and safety factors compared to UK EA (2020).

Contaminant	EPA NSW Factor	MASCC (µg/kg)	UK EA Assessment Factor	UK EA SSV (µg/kg)	Difference factor
PFOS + PFHxS	2	0.55	30	13	23.6
PFOA	6.67	1.5	90	19	12.7
Triclosan	2	32	30	130	4.1

Note that EPA state they used a safety factor of 2 from their Sept 2023 NSW biosolids regulatory review document. This may be right for PFOS + PFHxS but not for PFOA. Table 4 in that document (presented in Table 9 below) showed that a factor of 2 would have resulted in an unrestricted use threshold of 5 µg/kg but instead we have 1.5, a factor of 6.67 times lower. It is not explained how or why they go from as proposed factor of 2 to the much more restrictive 6.67.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

Table 9 – Risk-based contaminant thresholds for unrestricted use biosolids, restricted use biosolids and MASCC at three margins of safety (adapted from Table 4 in the NSW EPA Biosolids Regulatory Review, Sept 2023).[1]

Contaminant(s)	Margin of safety	Unrestricted use threshold[2]	Restricted use threshold	MASCC
PFOS + PFHxS	5	0.22	6.2	0.22
	2	0.55	15	0.55
	1	1.1	31	1.1
PFOA	5	2	54	2
	2	5	130	5
	1	10	270	10

[1] All concentrations are shown in µg/kg.

[2] Unrestricted use thresholds should be applied to the final biosolids products.

It is hard to see any comparison between the NSW EPA adopted MASCC and A/B Grade maxima with the UK EA SSV's. The NSW EPA levels are between 4 and 24 times lower than the UK levels. Also note that the UK EA uses an Assessment Factor (AF) that is used to **divide the No Observable Adverse Effect Level (NOAEL) from the laboratory data and that these range from 30 to 90 for these contaminant levels**. Thus, the PFOA SSV is 90 times lower than the NOAEL in soil for the chemical. The NSW EPA then arbitrarily applies a further factor of 2 making an overall factor of 180. The same halving applies to the PFOS + PFHxS. EPA NSW takes the UK EA SSV of 13, which already has a safety factor of 30 applied to it, and reduces it again by a factor of 23.6.

EPA states the levels chosen were "*adjusted from the United Kingdom (UK EA 2017)*" however the apparent lack of any relationship between EPA NSW and UK EA SVV numbers indicates any "adjustment" uses a methodology they have not explained. It is hard to critique the science behind this methodology when it is unknown. On the face of it there seems no relationship between the EPA numbers and UK EA numbers.

The issue is that not only do the EPA not seem to have taken the UK EA SSV values into account at all, but they state they divided it by 2 and then adopted this – not only as the MASCC but also to the Grade A and B maximum limit criteria in the biosolids waste.

4.4 Application of Margin of Safety

The NEMP 3.0, sections 15.4.3, explains how different 'margins of safety' (MoS) may be applied to risk assessments. A concern about precursors (diPAP class of chemicals in particular) is noted. However, the range of possible treatments applied to sewage and also upon stabilisation or composting of biosolids must also be considered. Many of these treatment processes will be highly effective in degrading diPAPs and other precursors (Alukkal 2025). Therefore, this consideration alone **does not justify** the application of higher margins of safety broadly applied to all classes of biosolids or biosolids products.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

If the EPA has invoked other considerations for choosing a higher margin on safety, on top of the many conservative measures already applied and confounding in their own modelling then this needs further explanation.

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

5 THE USE OF SOIL SCREENING VALUES AS MASCC

The NSW EPA states the proposed ecological risk levels, upper limits for receiving soil and biosolids, are derived from the UK EA (2020) Soil Screening Values (SSVs). While the above discussion brings this into question there is a more important aspect which is simply ignored. This UK EA document also clearly states right up front in the Executive Summary:

> "***SSVs cannot and should not be compared directly with the levels of chemicals in a waste or waste derived material***."

On page 2 of the UK EA document it states:

> *"SSVs **do not represent maximum permissible limits for chemicals in soil**. They are indicators to an assessor that soil concentrations above this level may pose an unacceptable risk to soil health and dependant wildlife. The likelihood of an increased risk may depend on:*
> - *the margin of exceedance*
> - *the uncertainty in ecotoxicity data on direct toxicity and secondary poisoning*
> - *the uncertainty in the measurement or estimate of the chemical level in soil including the natural variability of chemical concentration and soil properties*
> - *the specifics of a soil ecosystem and the importance of its different soil functions (for example, a soil used for growing crops has different requirements from a soil used to restore land for recreational use)*
> - *other site-specific factors such as organic matter content, soil texture and pH"*

The NEPM clearly states that HIL's should not be adopted as desirable or quality criteria for beneficial wastes:

> *2.1.2 Inappropriate use of investigation levels and screening levels*
>
> *"Investigation and screening levels are not clean-up or response levels nor are they desirable soil quality criteria. Investigation and screening levels are intended for assessing existing contamination and to trigger consideration of an appropriate site-specific risk-based approach or appropriate risk management options when they are exceeded. The use of these levels in regulating emissions and application of wastes to soil is inappropriate.*
>
> *The use of investigation and screening levels as default remediation criteria may result in unnecessary remediation and increased development costs, unnecessary disturbance to the site and local environment, and potential waste of valuable landfill space. Similarly, the inclusion of an investigation and screening level in this guidance should not be interpreted as condoning discharges of waste up to these levels."*

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

Not only does the NSW EPA do just what the UK EA warns against in their technical review in the draft RRO/E, but they also divide the SSV, which is already subject to an "Assessment factor" (literally, a safety factor of between 30 and 90) by a further safety factor of 2 and 6.67 as well.

According to the calculations, the A and B levels the EPA propose are far lower than they need to be to ensure a soil remains below the MASCC even with multiple applications at a 50 t/ha application rate.

The risk pathway that leads to the use of A and B maximum limits as the MASCC is not made clear but it would have to involve animals directly ingesting biosolids for some weeks or months, possibly to the exclusion of any other food. Assuming – for the sake of scoping this – the tolerable daily intake (TDI) is the same for animals as for humans, and the NEMP 3.0 uses 0.02 ug/kg body weight/day for PFOS + PFHxS, a growing steer at 400 kg could thus ingest 0.02 x 400 = 8 µg/day. If the biosolids were at 0.55 µg/kg dw and solids content was 30%, then the animal would have to ingest 8/0.55/0.3 = 48.5 kg of dewatered biosolids or 14.5 kg dw a day to meet its TDI.

This is completely unrealistic as:

- Ruminant feed intake is around 3.2% of body weight or 12.8 kg of dw forage a day;
- Ruminants are not attracted to biosolids and simply would not eat it;
- If the soil were at its MASCC of 0.55, the animal would have to ingest 48.5 kg of soil a day, an impossible scenario; and
- Animals are excluded from stockpile areas and freshly applied biosolids.

Exposure pathways must be based on realistic pathways that have some reasonable probability of occurring. Direct ingestion of biosolids is not a realistic exposure pathway that could ever happen in practice.

This approach linking the A & B grade levels to the MASCC is the primary reason directly resulting in 73% of biosolids not meeting these criteria based on completely predictive, model-based methodology and exposure risk pathways that are virtually impossible.

5.1 Predictive modelling vs Diagnostic measurements

In Section 3 of *UK EA (2022)* Methods of deriving SSV's, the document also states:

> "*Two approaches can be broadly distinguished (van Gestel 2012):*
>
> *1. a predictive approach that uses laboratory tests under standardised conditions to obtain toxicity data for targeted organisms and adverse effects to derive (no) effect levels*
>
> *2. a diagnostic approach that uses field studies to observe actual impacts on specific soil organisms and overall soil function and quality*[10]

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

> [10] *Understanding the effects of chemicals on soil quality and function through observation has also been used with an increasing interest in chemical mixtures (van Gestel 2012). The long-term sludge trials sponsored by Defra are an example of the diagnostic approach (UK WIR 2007). These data are also used to support the predictive approach as weight of evidence for deciding on the assessment factor.* "

It goes on to state that the UK EA approach has been "*primarily predictive*" but we take from the above quote that some field confirmation was done by "Defra". The NSW EPA have ignored the UK EA numbers, that carry some weight of diagnostic approach, and have adopted an entirely predictive approach not supported by any diagnostic approach from field data.

The PFAS NEMP 2.0 says:

> "*In relation to human exposure to PFAS, direct measurement of PFAS in foodstuffs is advisable for informing the conceptual site model. Timely sampling should be prioritised to obtain produce that is representative of human exposure, as precautionary advice (for example, ceasing bore water irrigation of vegetables and supply of bore water to stock) may result in a lack of suitable material to sample after the precautionary advice has been issued. This timely sampling should be done in a way that does not exacerbate exposure.*
>
> *For the development of the conceptual site model, modelling food uptake of contaminants provides an alternative to direct measurement in foodstuffs,* ***but there is limited availability of reliable transfer factors to estimate PFAS uptake from water, soil or vegetation into food products such as meat, eggs and plants.*** *Studies following recognised techniques for evaluating residue levels in produce are a potential source of new information.*" (our emphasis)

We note that none of the NSW EPA guideline levels refer to diagnostic or direct measurement of produce from soils treated with biosolids. For example, analysis of milk from biosolids treated dairy farms, analysis of pasture grass or cereal crops from biosolids treated grazing, and broadacre cropping properties treated with biosolids.

PFAS chemicals in biosolids are likely to behave in a very different manner to soluble chemicals added to soil. They will be adsorbed on organic matter and the literature shows reduced bioavailability. NEMP 3.0 states:

> *"The importance of site-specific data is heightened by the knowledge gaps that currently exist regarding the behaviour of PFAS in the environment. Research shows that the behaviour of PFAS in environmental media (for example, sorption in soil (Li et al. 2018) and* ***uptake from soil ... is variable and relatively unpredictable across a range of spatial scales, based on current knowledge****."* (our emphasis)

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

It would not be difficult to conduct foliage analysis of grazing properties subject to previous biosolids application to confirm or better inform the predictive modelling.

5.2 Soil Screening Values and Health Investigation Levels

The NEMP 3.0 gives guidance to the use of their guideline values at Section 8.1 "Considerations for using guideline values":

> "*The identification of PFAS above relevant guideline values acts as a **trigger to undertake further investigations** (such as site-specific risk assessment), as opposed to the assumption that harm will have occurred. The guideline values can also prompt consideration of management action to meet the environmental values and mitigate, where practicable, human health and/or ecological risks*."

In other words, these are not strict upper limits, demonstration of harm, or the need for site clean-up. They are a value that triggers further investigations. Such further work might include, amongst other things, analysis of biota for accumulation of the chemicals.

The Environmental Agency of the UK (EA 2023) introduces the term Soil Screening Values (SSV's) and define them as:

> '*... concentrations of chemical substances found in soils below which there [were] not expected to be any adverse effects on wildlife such as birds, mammals, plants and soil invertebrates, or on the microbial functioning of soils*.'
>
> and
>
> "*SSVs are levels of chemicals in soil below which there is unlikely to be any risk to its health and functions."*

In the report cited however they state:

> "*This report adapts SSVs for use in a different purpose, setting out their use in the technical assessment of the recovery of waste and waste-derived materials to land."*

Therefore, their report is specifically focussed on waste to land issues where PFAS (amongst other chemicals) are involved. They further define, at Section 1.2.2 how the process works:

> "*In most circumstances, if the predicted soil concentrations are at or below the relevant SSV then the chemical pollution risks to soil and wildlife from the proposed use of waste-derived materials will be low and acceptable. However, where the final soil level exceeds the SSV, it will be necessary for the applicant to provide further evidence (such as moving from GQRA*

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

to DQRA) to reassure the Environment Agency that no unacceptable impacts on soils remain across a broad range of potential scenarios."

Note: DQRA and GQRA stand for Detailed and Generic Quantitative Risk Assessment respectively.

This is not how an RRO/E mechanism works. Exceedance of the MASCC is an automatic breach of the law and would trigger fines or prosecution for pollution of land.

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

6 EFFECTS ON HUMAN HEALTH

The science behind the risk to human and environmental health is also not certain and no causal link to human disease has yet been established. The Federal government Environmental Health Standing Committee (enHealth) states the following in their Factsheet on PFAS (enHealth 2024):

> "*Current evidence suggests PFAS levels in the general Australian food supply are very low and regulation of PFAS chemical contaminants in the general food supply is therefore not required."*

More than 50,000 dry tonnes per year of Biosolids have been applied to land in NSW for over 20 years. This finding suggests that whatever contribution Biosolids is making to PFAS chemicals in the Australian food supply it is not making a significant contribution to the overall burden.

> and
>
> "*For most people, the level of exposure is likely to be small. No public health and safety issues with PFAS have been identified from the overall dietary exposure for the general Australian population."*

In relation to an apparent association of PFAS with certain health effects such as alterations in cholesterol, uric acid, thyroid activity they state "*However, these differences have generally been small and unlikely to cause significant negative health outcomes*."

In relation to potential increases in cancer risk they state: "*However, studies of these cancers remain conflicting and associations have only been observed in high exposure groups, such as workers in international factories where PFOA is produced."*

They conclude by saying: "*To date**, a causative relationship between the above health effects and PFAS exposure has not been established***."

An overall view is that there is no overwhelming epidemiological case for stopping the biosolids reuse industry. There is not even any direct diagnostic evidence it is contributing to the PFAS burden in Australian food. The EPA propose to virtually stop the industry in NSW based solely on highly dubious predictive modelling with no direct evidence of harm to the human food chain or even any epidemiological link to human health.

6.1 Comparative Exposure Routes

The exposure route of food consumption is the obvious one for biosolids application to land. The Australian Government Department of Health brought in Health Based Guidance Values for PFAS to assist industry in assessing and managing with site contamination.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

They use a Tolerable Daily Intake (TDI) approach and in a summary document (attached) they state it is 0.02 µg/kg body weight/day. Assuming a body weight of 70 kg and consumption of 350 grams dry weight of food consumption per day (as the only exposure route) for PFOS + PFHxS, the average concentration in the food would be-

0.02 x 70 / 0.35 = 4 µg/kg

A risk matrix for the likelihood of daily food intake of this level is presented in Table 9.

Table 10 – Risk matrix for daily food intake averaging 4 µg/kg dw from biosolids applied land.

Scenario	Likelihood
Soil at 0.55 ug/kg leading to food bioaccumulating 4 µg/kg	Not likely
100% daily food consumption from soil at 0.55 µg/kg from biosolids application resulting in food at 4 µg/kg	Negligibly small
Only 10% daily food consumption from biosolids applied soil resulting in bioaccumulation to 40 µg/kg in food to meet 4 µg/kg daily average	Vanishingly small

Food Standards Australia New Zealand brought out a report with recommendations for "Perfluorinated Chemicals in Food." (attached) based on this TDI of 0.02 µg/kg body weight/day for PFOS + PFHxS and 160 ng/kg body weight/day for PFOA. They then applied a 30-fold uncertainty (safety) factor was applied to the NOAEL in rats. The came up with the guidance as presented in Figure 5.

ABN 70 106 810 708
LAB/POST 16 Chilvers Rd Thornleigh NSW 2120
NSW/ACT 1300 30 40 80
VIC 1300 44 60 35
QLD 1300 44 60 34
EMAIL info@sesl.com.au
WEB sesl.com.au

Table 1. Proposed trigger points for investigation

Food	Food classification	Proposed trigger points for investigation (µg/kg)		Derivation
		PFOS, PFOS+ PFHxS combined	PFOA	
Fish and Seafood	Crustaceans#	65	520	Children 2-6 years, median consumption
	Finfish (all)	5.2	41	Children 2-6 years, P90 consumption
	Fish liver#	280	2240	Population 2+ years, median consumption assumed to be 5 g (weight of one liver)*
Animal Products	Meat mammalian	3.5	28	Children 2-6 years, P90 consumption
	Milk	0.4 or LOD if higher	2.8	Children 2-6 years, P90 consumption
	Honey	33	264	Children 2-6 years, P90 consumption
	Offal mammalian#	96	765	Population 2+ years, median consumption
	Poultry eggs	11	85	Children 2-6 years, P90 consumption
Fruits and vegetables	Fruit (all)	0.6 or LOD if higher	5.1	Children 2-6 years, P90 consumption
	Vegetables (all)	1.1 or LOD if higher	8.8	Children 2-6 years, P90 consumption

 # occasionally consumed food, trigger points for investigation for crustaceans applied to molluscs due to the small number of consumers of molluscs
** no food consumption data available, source: FSANZ report on Edith River, Northern Territory 2013, https://dpir.nt.gov.au/__data/assets/pdf_file/0006/260187/TraceElementsNTFish.pdf*

Fig. 5 – Table 1 'Proposed trigger points for investigation' from Food Standards Australia New Zealand "Perfluorinated Chemicals in Food."

For biosolids application the most likely food product in this table would be mammalian meat. To reach these levels, an animal would have to consume grass from a biosolids treated paddock that could only show a maximum of 0.55 µg/kg for PFOS + PFHxS and 1.5 µg/kg for PFOA. This would mean a bioaccumulation factor of 3.5/0.55 = 636% for PFOS + PFHxS and 28/1.5 = 1867% for PFOA.

Not only would such bioaccumulation have to occur but the consumer would have to eat such meat every day for months, an impossibly low probability.

We again see an inexplicable disjunction between the EPA approach to risk analysis and that of highly expert food and health scientists.

The PFAS group of chemicals occur widely in common household products. The Hall et al (2021) review of biosolids regulations published the following table (Table 10).

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

Table 11 – 'A selection of published concentrations (ng/g) of PFAS in various solid materials'. Adapted from Table 1 in Hall et al (2021).*

Product/Material	Reported PFAS Concentration	PFAS Type	Reference
Cosmetics (foundation, eye shadow, face colour)	ND – 10,700 5,900	Total PFAS Total PFAS	Danish EPA 2018 Fujii et al 2013
Sunscreen	180 – 6,500 5,700	PFHxA PFOA	Fujii et al 2013 in Danish EPA Fujii et al 2013
Paper	34 – 2,200	diPAP	D'Eon et al 2009
Detergents/cleaning products	1.6 1.1 547,100	PFOS PFOA 8/2 FTOH	Kotthoff et al 2015
Household dust	7,637 71 30	ΣdiPAPs PFOS PFOA	De Silva et al 2012
Food packaging	<LOD – 275.84 Range 200 – 700	PFBA diPAPs and SdiPAPs	Microwave bags, Zafeiraki et al 2014 Trier, Granby and Christensen 2011

** Note that ng/g = µg/kg.*

It would appear that the exposure routes of applying eyeshadow, sunscreen, washing the dishes or consuming packaged food at thousands to hundreds of thousands of µg/kg could far outweigh the risk of consuming food containing 0.55 to 5 µg/kg of the same contaminants. How much of this would be absorbed through the skin? How much residual on the fingers or washed plates would be ingested later?

6.2 Future Contaminants of Concern

The draft RRO lists Triclosan and Galaxolide chemicals in Table 1 but not Br1-Br9 or Br10 and then gives a table in the Notes stating-

> "*Indicative limits that may be applied to Galaxolide, triclosan and PBDEs in the future*"

- and proceeds to give those "indicative limits" in a table.

Does this mean they need to be measured? Does a statement of possible future intent need to be flagged in a legal instrument?

Ignoring such questions, the level set for Triclosan is far more conservative than any other international guideline. Despite it being stated by the NSW EPA that they are based on the UK EA Soil Screening Values, the EPA have applied their factor of 2 to the UK EA SVV (which is 130) to arrive at their proposed 65 µg/kg when UK EA has already applied an assessment factor of 10 times lower than the NOAEL. The UK EA give no SVV for Galaxolide.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

7 SUMMARY AND CONCLUSIONS

The main conclusions regarding the NSW EPA Draft Biosolids RRO/RRE are as follows:

1. The wording over permissible agricultural uses for biosolids exceeding Grade C from Column 3 of the RRO should be improved to expressly state that Table 4-1 of Biosolids Guideline does not apply to the contaminants in Table 1 Column 3 of the RRO and RRE and are replaced by Clauses 7.6 to 7.10 of the RRE. Figure 3 of the "Fact Sheet" should also be changed to reflect this.
2. Almost no biosolids will meet unrestricted use grades A/B for the new PFAS chemicals criteria.
3. Almost no compost blending agents for biosolids composting such as GO and FOGO will meet unrestricted use grade meaning no composted biosolids will meet this grade.
4. This will effectively eliminate composted biosolids from urban landscape markets.
5. This impact is directly caused by linking the unrestricted use levels to MASCC levels. Such linkage uses a virtually impossible rick pathway for use in agriculture and a very unlikely one in urban food farming.
6. According to data presented by the NSW EPA about 73% of biosolids will exceed Grade C for the new PFAS chemicals criteria.
7. A sizeable proportion of biosolids surveyed would result in low application rates of just above 15 t/ha and would preclude re-application. The market resistance by farmers to such restrictions on application due to the presence of high levels of PFAS is unknown.
8. Insufficient data has been presented by the EPA to show the temporal or spatial distribution of these failures by individual STPs, i.e. the distribution of the impact, metropolitan vs rural and over time is unknown.
9. There is concern in the laboratory industry that uncertainties of measurement at the very low detection levels mean that reliable results cannot be obtained in a complex substance like biosolids or composted biosolids.
10. The impact on the biosolids composting industry has not been considered by the regulator.
11. The maximum levels set for PFAS chemicals in the Grade A/B unrestricted use category and the MASCC are more conservative than any equivalent international or Australian standard or guideline.
12. The methodology used for the derivation of the A/B and C grade biosolids PFAS chemicals criteria is obscure and unorthodox.
13. Maximum upper limits of contaminants for Grade A and B unrestricted use biosolids have been set as the same as final soil MASCC which does not follow any plausible risk pathway and is unorthodox according to international and national risk analysis methods.
14. The methodology used to arrive at the limits for PFAS chemicals in the Grade A/B unrestricted use is entirely predictive, based on modelling using unreliable and untested laboratory derived transfer factors from soil to biota. They have not been subject to any diagnostic or field experimental checks.
15. Predictive modelling methodology that is not tested by direct diagnostic measurements from the field should be considered untested and unproven.
16. The EPA has taken risk management approaches from other guidance documents that use trigger levels or screening values designed to prompt further investigation, and turned them into regulatory standards that operators can be prosecuted for exceeding, regardless of whether any harm occurs.

ABN 70 106 810 708 | LAB/POST 16 Chilvers Rd Thornleigh NSW 2120 | NSW/ACT 1300 30 40 80 | VIC 1300 44 60 35 | QLD 1300 44 60 34 | EMAIL info@sesl.com.au | WEB sesl.com.au

17. Current evidence is that Australian food chains are not affected by these chemicals stemming from biosolids application, or any other exposure pathway. The evidence is that Australian food is so unaffected that the food regulators do not believe any maximum residue limits (MRLs) for them is currently justified.
18. There is no epidemiological evidence that the Australian population is affected by these chemicals at any adverse effect level stemming from biosolids application or any other exposure pathway.
19. State and Federal government health authorities accept that there is no demonstrated causal link between the presence of these chemicals and adverse human health outcomes.
20. There is a lack of clarity in the draft RRO/RRE around the requirement to measure HHCB Galaxolide, Triclosan and Br1-Br9 and Br10 chemicals in biosolids. In its current form it would seem the requirement is advisory and their mention in an operating legal instrument is unusual and confusing.
21. Conditions at 7.9, 7.10 and 7.11. 7.11 are unnecessarily restrictive and in practice unnecessary as compliance with the intent of these conditions will occur during the normal course of NLBAR and CLBAR calculation.
22. EPA has not considered the comparative exposure pathways for these chemicals, from the many widespread household products that contain them, many in several orders of magnitude higher concentrations than in biosolids.
23. EPA has not weighed the demonstrated benefits of the current NSW biosolids reuse program against the risks from these widespread chemicals.
24. The EPA has not conducted any rigorous industry impact assessment and nor has it considered the environmental consequences of the alternatives to land application, notably landfill and the consequences of landfilling organic wastes on greenhouse gas emissions.

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

8 REFERENCES

Agilent Technologies (2025). *PFAS Testing: Is a Storm Brewing?* https://www.agilent.com/cs/library/brochures/ebook-analytical-scientist-pfas-food-5994-8301en-agilent.pdf

Alukkal (2025). Understanding treatment process effects on per- and polyfluoroalkyl substances in the municipal wastewater solids stream. Doctoral dissertation, Division of Environmental and Ecological Engineering, Purdue University Graduate School.

ANZG (2018). Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Governments and Australian state and territory governments, Canberra ACT, Australia.

Costello, M. C. S., & Lee, L. S. (2020). Sources, Fate, and Plant Uptake in Agricultural Systems of Per- and Polyfluoroalkyl Substances. *Current Pollution Reports*. https://doi.org/10.1007/s40726-020-00168-y

DCCEEW (2013). *NSW Biosolids Guideline Review – Threshold derivation for contaminants in biosolids – PFAS, HHCB, triclosan, chlordane and PBDEs*. https://hdp-au-prod-app-nswepa-yoursay-files.s3.ap-southeast-2.amazonaws.com/7817/4970/1955/CR_Biosolids_Guideline_Review_Report_-_Amended_2025_-_Final.pdf

enHealth (2012a). Australian Exposure Factor Guide. Environmental Health Subcommittee (enHealth) of the Australian Health Protection Principal Committee, Canberra, Australia.

EnHealth (2012b). Environmental Health Risk Assessment: Guidelines for assessing human health risks from environmental hazards, Department of Health and Ageing and EnHealth Council, Commonwealth of Australia.

Environmental Agency (2022). Derivation and use of soil screening values for assessing ecological risks Report – ShARE id26 (revised). United Kingdom. https://assets.publishing.service.gov.uk/media/61e7de5c8fa8f505985ef41c/Soil_screening_values_for_assessing_ecological_risk_-_report.pdf

Environment Protection Authority (2023) What's the GO with FOGO? Study of food and garden composts and other recovered organics in NSW. NSW Environment Protection Authority. Parramatta NSW.

Hall, A. M., & Braun, J. M. (2023). Per- and Polyfluoroalkyl Substances and Outcomes Related to Metabolic Syndrome: A Review of the Literature and Current Recommendations for Clinicians. *American Journal of Lifestyle Medicine*, 155982762311628-155982762311628. https://doi.org/10.1177/15598276231162802

Hall, H., Moodie, D., & Vero, C. (2021). PFAS in biosolids: A review of international regulations. *Water E-Journal*, *5*(4), 1–11. https://doi.org/10.21139/wej.2020.026

HEPA (2019). PFAS National Environmental Management Plan 2.0. https://www.dcceew.gov.au/environment/protection/publications/pfas-nemp-2

HEPA (2024). PFAS National Environmental Management Plan 3.0. https://www.dcceew.gov.au/environment/protection/publications/pfas-nemp-3

ITRC (2023). *11 Sampling and Analytical Methods – PFAS — Per- and Polyfluoroalkyl Substances*. (n.d.). Pfas-1.Itrcweb.org. https://pfas-1.itrcweb.org/11-sampling-and-analytical-methods/

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

National Environment Protection (Assessment of Site Contamination) Measure 1999 (April 2013) (NEPC 2013, Canberra).

Nilsson, S., Mueller, J. F., Rotander, A., & Bräunig, J. (2021). Analytical uncertainties in a longitudinal study – A case study assessing serum levels of per- and poly-fluoroalkyl substances (PFAS). *International Journal of Hygiene and Environmental Health*, *238*, 113860. https://doi.org/10.1016/j.ijheh.2021.113860

NSW EPA (2023b). *NSW Biosolids Regulatory Review: Issues Paper*. https://hdp-au-prod-app-nswepa-yoursay-files.s3.ap-southeast-2.amazonaws.com/2216/9276/7241/23p4440-nsw-biosolids-regulatory-review-issues-paper.pdf

NSW EPA (2023b). *NSW Biosolids Regulatory Review: Technical Findings Report*. https://hdp-au-prod-app-nswepa-yoursay-files.s3.ap-southeast-2.amazonaws.com/2516/9276/7552/NSW_Biosolids_Regulatory_Review__Technical_Findings_Report.pdf

NSW EPA (2025a). *Biosolids chemical study fact sheet*. https://hdp-au-prod-app-nswepa-yoursay-files.s3.ap-southeast-2.amazonaws.com/5117/5521/6426/25p4584-biosolids-chemical-study-fact-sheet.pdf

NSW EPA (2025b). *The biosolids order 2025* (Draft). https://hdp-au-prod-app-nswepa-yoursay-files.s3.ap-southeast-2.amazonaws.com/6917/5521/9573/Draft_Biosolids_Order_2025.pdf

NSW EPA (2025b). *The biosolids exemption 2025* (Draft). https://hdp-au-prod-app-nswepa-yoursay-files.s3.ap-southeast-2.amazonaws.com/8417/5521/9618/Draft_Biosolids_Exemption_2025.pdf

Standards Australia (2005) Australian Standard AS4482.1:2005 Guide to the Sampling and Investigation of Potentially Contaminated Soil (Part 1 & 2).

State of Queensland (2024). *Technical Report: Derivation of PFAS limits for products of organic material processing ERA 53 under the Environmental Protection Act 1994.* https://environment.qld.gov.au/__data/assets/pdf_file/0039/397956/technical-report-derivation-pfas-limits-era53a.pdf

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au

9 LIMITATIONS

This document has been prepared for the sole purpose providing an independent review and commentary in accordance with generally accepted consulting and scientific practice. No other warranty or guarantee, expressed or implied is made as to the advice indicated in this report.

This report is for the use of the named Client and any relevant authorities that rely on the information for development applications and approval processes. Any reliance on this report by third parties shall be at such parties' sole risk. This report shall only be presented in full and may not be used to support any other objective other than those set out in the report.

Nothing in this report should be taken to imply that SESL has verified or audited any of the information supplied to us other than as expressly stated in this report. We have assumed this information to be both adequate and accurate for the purposes of this report.

Where findings, observations and conclusions are based solely upon information provided by the client and/or a third party and SESL do not accept, to the maximum extent permitted by law, any liability for any losses, claims, costs, expenses, damages (whether in statute, in contract or tort for negligence or otherwise) suffered or incurred by the client or any third party as a result of or in connection with SESL's reliance on any such the information to the extent that such information is false, misleading or incomplete and SESL gives no warranty or guarantee, express or implied as to such findings, observations and conclusions.

If further information becomes available, or additional assumptions need to be made, SESL reserves its right to amend any statements or opinions made in this report.

ABN	LAB/POST	NSW/ACT	VIC	QLD	EMAIL	WEB
70 106 810 708	16 Chilvers Rd Thornleigh NSW 2120	1300 30 40 80	1300 44 60 35	1300 44 60 34	info@sesl.com.au	sesl.com.au