ANZBP Preliminary Report on Microplastics Risk for the Australian and New Zealand Biosolids Industry

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Executive Summary

Biosolids land application returns valuable nutrients to soils. In Australia and New Zealand, the application of biosolids to land is in line with national and state regulations and guidelines designed to protect human health and the environment. Research on microplastics in other countries is not directly transferable to the Australian/New Zealand context, for a number of reasons, in particular, the source control of inputs to sewage systems. The ANZBP is aware of current Australian research into the impacts of microplastics and welcomes further investigation. In particular, there is a need for standardised analysis methods, and broader analysis of Australian sources. Despite the lack of certainty on Australian and New Zealand biosolids microplastics concentrations and loads, preliminary analysis indicates that the contribution of microplastics in soils from biosolids land application is unlikely to cause appreciable risk to environmental or human health. Controlling the source of all plastics entering the environment is a complex but important global and regional goal. The ANZBP supports the reduction of plastic use in consumer and particularly sewerable products and substitution of plastics in consumer products with sustainable alternatives.

The Australian New Zealand Biosolids Partnership (ANZBP) supports the water industry to sustainably use biosolids. Biosolids contain organic carbon which is valuable for soil structure and health, and important nutrients including nitrogen and phosphorus that are beneficial for soils, and can replace the use of artificial fertilizers, reducing reliance on petrochemical and mined nutrient sources.

Biosolids also contain micro-nutrients e.g. copper, zinc, calcium, magnesium, iron, molybdenum and manganese that are essential for healthy crop and pasture production. In the ANZBP's 2018-19 Biosolids End-Use Survey, 67% of Australia's biosolids were used in agriculture. This is a huge improvement from when biosolids were historically discarded as waste in landfills. Striving

towards a ‘circular economy’, communities can use biosolids to help close the nutrient and carbon loop.
The source of biosolids is from treatment plants that receive wastewater from households and urban industries and therefore they may contain low concentrations of a range of micro-pollutants. Stringent regulations protect the receiving environment by setting the maximum concentration that is considered ‘safe’ for that application, however, sometimes contaminants appear that are not yet regulated. Several water utilities pro-actively support research to measure potential pollutants that are unregulated, to ensure they are confident in the sustainability and safety of their biosolids reuse programs.

Recently, there has been media concern about micro-plastics making their way into our waterways and oceans and onto agricultural land via the application of biosolids. This has been headlined by very real concerns with the effect of micro-plastics in rivers and oceans entering the food chain of aquatic ecosystems, and studies of microplastics in soils suggesting effects such as reduced fertility or weight gain of soil invertebrates[1,2].

With respect to the relevant soil studies however, the effects reported were observed at soil/litter microplastic concentrations greater than 10% and up to 60%, well above any realistic concentration that might result from the application of biosolids to agricultural land. Other studies[3] found no effect on food ingestion rate, defecation, rate, food assimilation rate and efficiency, body mass change, mortality and energy reserves of isopods exposed to 0.4% microplastics for 14 days; a concentration that is also higher than expected in routine biosolids practice. More work on microplastics in soil at relevant concentrations is warranted so risks can be appropriately assessed.

There are many pathways for microplastics to enter the environment, including litter, road runoff, compost, and potentially via treated effluent release or from biosolids land application[4]. Sewage treatment plants are designed to give some level of treatment for large pieces of plastic (typically pieces larger than 5mm are caught in the preliminary screening step), however, microplastics are very difficult to remove from biosolids due to their small size (<5mm). Reliable estimates of the load of micro-plastics are difficult due to lack of standardised analysis methodologies [5,6]. One Australian study investigating wastewater treatment plant effluent, Ziajahromi et al. (2017) highlighted the difficulty in comparing results between research papers, especially as some methods led to between 22% and 90% of the suspected microplastics being confirmed as non-plastic in nature[6]. Both the Global Water Research Alliance (2018) and the United Kingdom Water Industry Research Limited (2019) have stressed the need for a harmonised method for analysis of microplastics with robust Quality Assurance systems[7,8].

A standardised approach to detecting microplastics in water and soil matrices, can then lead to targeted research into any potential harm that may be caused by their presence, and ways to reduce the load of microplastics going into the environment. Source control has historically been the only effective means to control contaminants in biosolids, and we strongly support this for microplastics also. This may include domestic filtering technologies (e.g to remove fibres from laundry wastes), reduced use in personal care products, and substitution with bioderived, biodegradable polymers. Ziajahromi et al. (2017) stated that while microplastic beads from personal care products had received attention, synthetic fibres from clothing may be a bigger issue. Researchers have attempted to relate fibre shedding to washing machine conditions (e.g. temperature and detergent use) and to fabric types, however, the relationships appear complex[9,10].

However, managing the source of all plastics in the environment is a complicated task. International studies have even documented atmospheric deposition of microplastics in urban areas[11]. In 2017-2018, Australians used over 3.4 million tonnes of plastic in a variety of consumer products with 'bioplastics' usage at less than 100 tonnes, and a recycling rate of only 9.4% [12]. Further research into the substitution of plastics with sustainable alternatives in consumer products, such as bioderived, biodegradable polymers, and campaigns aimed at keeping synthetic products out of wastewater systems (e.g. 'flushable wipes' and cotton buds) will go some way to help. Estimates of plastic waste from Australia and New Zealand are 117 and 159 grams per person per day[13], which is a figure both countries are aiming to reduce by implementing programs to reduced reliance on plastic, move to more sustainable products, and increased recycling efforts. For comparison, these are lower than estimates of plastic waste from the USA (286 g/person/day) and some European countries for example the UK, Germany and Ireland (266, 224, 199 g/person/day, respectively) based on data collected by the World Bank (which does have some caveats on its data due to collection methods varying between countries) [13].

In 2017-2018, the Australian agricultural industry used 2.7% of the country's total plastic (90,000 tonnes) for a variety of uses (including flexible films for what is known as 'plastic mulch' or wrapping of bales etc, twine and rope, irrigation pipe and other agricultural applications) with a recycling rate of 7%[12]. Despite documented benefits of plastic 'mulch' for water use efficiency and crop yield, studies have shown breakdown of plastic used in agriculture can also contribute to soil macro and micro plastic load (in international studies). No information could be found on the relative loads of microplastics from various sources (on-farm practices, aerial deposition or biosolids use) in the Australian/New Zealand context.

Further research into microplastic abundance in Australian and New Zealand biosolids and soils is required. Haleyur (2019) incorrectly quoted the ANZBP as the source of the estimate of 'between 2,800 to 19,000 tons of microplastics are applied to Australian agro-ecosystems each year through biosolids'[14], and have since apologised. Instead, this figure can be attributed to Ng et al (2018) who estimated the load of micro-plastics in the Australian context[15] using European per capita estimates from an opinion piece by Nizzetto, Futter and Langaas (2016), which was not peer reviewed, and made order of magnitude estimates utilising Danish particle count information[16].

While the quantum supports further research, un-peer reviewed estimates should not be used to infer actual loads, and certainly not in different geographical regions. As an example, typically stormwater runoff from rooves, pavements and roads is handled separately from wastewater in Australian/NZ utilities, and according to a European study, wear of car and truck tyres contributes over ten times the load of microplastics compared with microfibers from clothing[17]. Australian studies have also shown microplastics entering the environment from stormwater runoff[18]. Instead of inferring results from international studies, we support the use of direct measures on Australian wastewater samples, by particle counts[6] or preferably, chemical quantification[19], which allows analysis of the entire matrix.

The ANZBP recognises the growing concern and media attention over microplastics in the natural environment[20] (e.g. Daly, 2019), and that negative impacts of microplastics on the marine environment have been well-documented. The ANZBP is aware of current research by local universities and welcomes further Australian and New Zealand research into microplastic abundance, methods of load reduction and impact in the agricultural context (using local data). Responsible management of biosolids requires a consideration of potential issues from a number of perspectives: environmental, economic and social. Management decisions based on a single issue will always result in an unbalanced outcome.

Overall, consideration of the environmental, economic and social benefits of biosolids land-application provides multiple benefits through recycling of valuable nutrients to depleted soils, reduced reliance on petrochemical and mined sources of plant nutrients, and cost-effective management of municipal wastewater, with no known major detrimental effects to soil, plants, the food chain, human health or soil and water organisms in the past 20 years of modern biosolids reuse standards and monitoring in Australia and New Zealand. Until further information indicates otherwise, the ANZBP believes these benefits outweigh risks of biosolids land-application due to microplastics.

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