Fact Sheet 3 - Land Application of Biosolids

This Fact Sheet has been prepared by the Australian and New Zealand Biosolids Partnership.

The intent of these Fact Sheets is to provide interested groups and individuals with information about aspects of the treatment and management of biosolids.

This Fact Sheet explains:

- What biosolids are
- The typical nutrient characteristics of biosolids
- The benefit of land application of biosolids
- Who can apply biosolids to land
- Who regulates biosolids
- Some of the risks associated with land application of biosolids and how these are mitigated

What are Biosolids?

Biosolids are treated sewage sludges. Sewage sludge is the solids that are collected from the wastewater treatment process but which have not undergone further treatment. Sludge normally contains up to around 3 % solids. Biosolids are a product of the sewage sludge once it has undergone further treatment to reduce disease causing pathogens and volatile organic matter significantly, producing a stabilised product suitable for beneficial use. Biosolids, normally contain between 15 % to 90 % solids. Biosolids are carefully treated and monitored and they must be used in accordance with regulatory requirements.

What is in biosolids?

Biosolids are mainly a mix of water and organic materials that are a by-product of the sewage treatment processes. Most wastewater comes from household, kitchens, laundries and bathrooms. Biosolids may contain:

- Macronutrients, such as nitrogen, phosphorus, potassium and sulphur and
- Micronutrients, such as copper, zinc, calcium, magnesium, iron, boron, molybdenum and manganese

Biosolids may also contain traces of synthetic organic compounds and metals, including arsenic, cadmium, chromium, lead, mercury, nickel and selenium. These contaminants limit the uses to which biosolids can be put, with all applications regulated by appropriate government authorities in each State and federally. Australia has one of the strictest regulatory regimes for biosolids application and use in the world.

How does the nutrient value of Biosolids compare to other fertilisers?

The nutrient content of some organic fertilisers compared to Biosolids is shown below[1]:

Nutrient source	Nitrogen %	Phosphorus %
Animal by-product		
Dried blood	13.0	1.0
Bone meal, steamed	3.0	11.0
Dried fish meal	10.0	3.0
Tankage, animal	7.0	4.0
Blood and bone, Bailey's	5.0	3.0
Manures		
Cattle manure	2.0-5.0	0.7
Horse manure	2.0-8.0	0.5-1.5
Poultry manure	5.0-15.0	1.3
Pig manure	7.0	1.7
Biosolids (dried)	2.0	0.9
Organic 2000 Turf StartTM	4.0	1.0
Organic 2000 Turf RestoreTM	8.0	1.0
Dynamic LifterTM	3.0	2.5

What are some of the potential benefits when using Biosolids?

Biosolids are rich in nutrients and organic matter so is a good natural fertiliser as well as being a soil amendment to enhance the land. The nutrients, including nitrogen and phosphorus (two elements essential for crop growth), and micronutrients, such as copper, zinc and iron, release slowly during plant growth.

Among their benefits, biosolids can:

- **Improve crop production** Land application of biosolids that meet strict quality criteria help improve, replenish and maintain healthy soil by adding important nutrients, boosting soil water-holding capacity and reducing topsoil runoff, all of which serve to increase crop yields. The largest component of biosolids is organic matter. It works as a soil conditioner to promote necessary bacterial activity, loosening clay and improving the consistency of sandy soils. The improved texture of these treated soils promotes dense, healthy root growth, allowing better nutrient uptake by plants.
- **Reduce soil erosion and protect water quality** Land application of biosolids can reduce soil erosion as the organic matter in biosolids binds with soil particles, thereby retaining nutrients and improving water quality. The end results are improved soil properties which enhance root growth and increase the drought resistance of vegetation thus further reducing soil erosion**.**

[1] ***Modified from:***

- ¾ DEPWRC (2001) *'Environmental guidelines for the establishment and maintenance of turf and grassed areas.'* Department of Environmental Protection Water and Rivers Commission, Western Australia, Perth.
- ¾ Johnston K (1996) *'Turf Irrigation and Nutrient Study - Turf Manual.'* Royal Australian Institute of Parks and Recreation - W.A. Region 1996.

- **Enrich tree plantations** Biosolids can promote tree growth and increase forest productivity for certain tree species. Biosolids used on pine stands can shorten pulpwood and lumber production cycles, particularly in marginally productive soils. Because biosolids enhance vegetation growth wildlife populations also benefit from more abundant understorey vegetation.
- **Conserve landfill space** The use of biosolids through land application and other methods offers an environmentally sound alternative to disposal thereby conserving landfill space for non recyclable materials.
- **Improves economic returns** Farming areas with marginal soil characteristics can improve productivity by the addition of biosolids, which generate an income from what would otherwise have been a cost to dispose.
- **Provide topsoil for land used for recreational uses** In dry climates composted biosolids provide much need organic material to increase soil moisture retention and promote plant growth.

What quantity of Biosolids is produced?

There are approximately 360,000 dry tonnes of biosolids produced annually in Australia and New Zealand.

How are biosolids classified?

Biosolids are classified in specific State, Territory or national Guidelines. Development of these Guidelines is usually the responsibility of regulatory agencies responsible for the environment. Primarily there are usually two parameters examined when determining the classification of biosolids: the treatment (microbiological) grading and the contamination grading.

Most Australian State guidelines and the New Zealand national guidelines have specify three or four treatment grades and two or three contaminant grades. The overall combined grade (treatment and contaminant) is usually linked to the different ways in which Biosolids may be used or applied. Blending of lower grades of biosolids with higher grades or with other materials such as green waste may occur in some circumstances to reduce overall contamination.

Grade specifications can be checked with the relevant Guidelines

What are the different forms of biosolids?

Biosolids is a general term for treated sewage sludges. More specific terms that describe the four most common forms of biosolids are:

- **Biosolids cake** - raw sludge is stabilised biologically (most commonly by anaerobic digestion) and the liquid biosolids are dewatered to produce biosolids ‘cake'. The cake varies between 15 to 30 % solids for consistency, with the balance being water. The cake can be dried further by air drying. A similar result occurs with lagoon stabilisation and air drying.
- **Biosolids pellets** - raw sludge or liquid biosolids are dewatered to approximately 20% total solids then further heated in a dryer and dried to 95% total solids and then pelletised.

- **Lime amended biosolids** - raw sludge or biosolids are first dewatered followed by stabilisation with the addition of lime.
- **Composted biosolids** - dewatered raw sludge or biosolids are composted, typically with other organic materials, to produce a high quality product suitable for use in domestic gardens as well as public parks and gardens.

Why put biosolids on land?

Biosolids contain organic matter and nutrients which improve soil fertility and the quality and structure of soil. They also contain micronutrients such as copper, zinc and iron and can reduce the need for fertilisers. As many commercial fertilisers are produced using hydrocarbons, the price of such fertilisers is rising, adding to the attractiveness of Biosolids under the right conditions. The application of biosolids returns nutrients to the land, thereby completing the nutrient cycle.

Biosolids also aid forestry and land rehabilitation at mining sites by conditioning and fertilising the soil.

Who can apply biosolids to land?

Land application may be undertaken by a water authority, a contractor engaged by a water authority, or a landowner.

Some classes or qualities of biosolids can be applied with minimal restrictions as environmental and health risks are negligible.

Lower classes or qualities of biosolids can also be applied to land, but there may be restrictions on the amount applied each year. Just like fertiliser, if applied too heavily they can have detrimental impact on the environment.

How are biosolids transported?

Dewatered biosolids are generally transported to the land application sites in covered or enclosed trucks. In the same way commercial fertilisers are transported, biosolids are usually delivered prior to crop planting. Good practice requires cleaning any excess biosolids from the exterior of the vehicle prior to transportation and after unloading.

What are some of the concerns and risks arising from land application of biosolids?

When conducted according to regulations, years of research has shown that land application of biosolids is safe. However, concerns do still remain regarding soil and groundwater contamination from trace elements, toxic chemicals, and potentially harmful disease-causing organisms. In response to these concerns, the EPA in the United States of America conducted a comprehensive risk assessment that evaluated the health risk to the general population as well as to a highly exposed individual. To date, there have been no documented cases of negative impacts to human health when a biosolids program has met all the federal and state requirements.

This is the same for Australia. There is no evidence that the beneficial use of biosolids has led to negative human health impacts. To be absolutely sure, the Australian water industry is

undertaking further detailed research and risk assessment. Additionally, various Environmental Management Systems and Quality Management Systems are employed. The water industry in Australia and New Zealand complies with regulatory requirements and Guidelines put in place by relevant regulatory authorities in the various Australian States and Territories and federally, and in New Zealand, providing further levels of safety and risk minimisation.

Will the metals and pollutants in biosolids enter the food chain?

Protecting human and stock health is a cornerstone of the various Biosolids Guidelines in place in Australia and New Zealand. These Guidelines are usually endorsed by relevant Departments of Health or related regulatory authorities. The Guidelines ensure there is no harmful build-up of metals or pollutants in the soil or in crops.

Many of the trace metals in biosolids are also present in conventional fertilisers and manure. These substances are non-toxic at the low concentrations and low rates at which they are applied.

Will land application of biosolids pollute ground or surface water?

When applied according to state, federal or national guidelines and good farming practices, Biosolids will not impact on groundwater or surface water quality.

As with any fertiliser, the chief groundwater issues are nitrogen and phosphorous. Unlike many commercial fertilisers, about 85% of the nitrogen in biosolids is present in a slow-release organic form, making biosolids less likely to cause groundwater pollution from the release of nitrates (the mobile form of nitrogen) or phosphates. In addition, many guidelines ensure soil pH is taken into account and is managed in establishing the suitability of a site for land application to prevent movement of metals through the soil.

Guidelines for land application of Biosolids usually specify site selection criteria, stormwater controls at the site as well as operating practices to minimise stormwater runoff under extreme events. Please refer to State, Territory and national Guidelines for further detailed information. Links to most of these can be found here

Does the application of Biosolids pose a health risk?

Good hygiene practices are essential for persons coming in contact with biosolids. As in many other fertilisers and soil amendments, human sickness may result from exposure to chemicals, toxins or pathogenic organisms. Biosolids may contain some or all of these at various stages, particularly at the time of production. However, there are many barriers available to protect us from these.

The potential health concerns for users of biosolids are excessive levels of toxic metals or chemicals, or presence of potentially pathogenic micro-organisms (e.g.: viruses and bacteria).

All producers of biosolids are required to monitor their product for contaminants. Guidelines published by State, Territory and national governments in Australia and New Zealand ensure that good practice is followed when Biosolids are applied to agricultural land. In these circumstances, there is no danger to health from the resulting crop.

The wet material may provide a suitable environment for organisms, and care is required to ensure the health of workers during transportation and application of moist material. After application to farmland, the biosolids decompose quickly into the soil (exposure to sunlight and drying causing rapid die-off of any remaining pathogens) and naturally occurring bacteria become dominant.

Only the highest quality material is able to be used in circumstances such as composting or application to leaf crops. Generally, biosolids are applied to broadacre and grain crops where the time between application, sowing of seeds and harvesting of mature crops can be from three to six months. In the case of grain crops, the crop itself will be subject to further refinement to produce flour and other products.

As is the case with many other foods or products used in conjunction with food production, there are ongoing concerns about various chemicals: that they may be present in very tiny concentrations, or their effects have not yet been identified. It is important to note there have been no identified cases of death or illness from exposure to biosolids that have been used appropriately, in line with relevant Guidelines.

Protecting human health is a cornerstone of the Biosolids Guidelines in place in Australia and New Zealand. These Guidelines are usually endorsed by relevant Departments of Health or related regulatory authorities. Biosolids applied in accordance with Guidelines to grow crops or graze stock for human consumption present negligible risk to the consumer.

Is it safe to eat food that has been grown using biosolids?

This is one of the major factors considered in formulating State, Territory and national Guidelines. Provided that Biosolids are used in accordance with the Guidelines there is no greater risk associated with biosolids application than with other commercial fertilisers.

The USA has conducted more than 30 years of scientific research including a US Environmental Protection Authority risk assessment of biosolids use. These studies included the independent evaluation of how biosolids could directly or indirectly affect human health and the environment and established minimum safe concentrations for biosolids applications to land. It concluded that if correctly managed biosolids application to land has no adverse environmental or health impacts.

Similar research has been conducted throughout Australia in the past 15 years.

Can the health of native or domestic animals be affected if they come into contact with biosolids?

Typically the pathogens found in sewage are sourced from human waste and the vast majority are removed during processing of the biosolids. Most of these pathogens, in particular viruses, do not infect other animals as they are specific for humans. However, a few pathogens, such as some strains of the protozoan parasite Cryptosporidium, can infect certain domestic animals, including cattle and the bacterium Salmonella is known to infect young chickens. This is why the various Biosolids Guidelines recommend a withholding period of 30 days before stock is allowed to graze or domestic fowl allowed access to land once Biosolids have been applied.

This withholding period is not required for domestic animals such as dogs and native wildlife as they cannot become infected with these human pathogens.