WATER UK

Recycling of Biosolids to Agricultural Land

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Water UK, 1 Queen Anne's Gate, London, SW1H 9BT www.water.org.uk

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Summary

Purpose

This briefing pack provides information for stakeholders and the public about the recycling of treated sewage sludge, commonly known as biosolids, to agricultural land. The information covers regulatory and statutory requirements, treatment of sewage sludge, scientific research and the benefits of using biosolids in agriculture.

The main points in the briefing are:

1. Application of biosolids to agricultural land is recognised as the Best Practicable Environmental Option in most circumstances by the EU and the UK Government. It is a sustainable practice and provides the best possible alignment with the principles of the waste hierarchy.
2. Biosolids recycle a range of plant-available and soil-extractable nutrients of significant value to agriculture. The use of biosolids also improves soil structure, drainage and available water capacity and so benefits the environment and agriculture.
3. Biosolids form less than 5% of organic materials used for this purpose with farm animal manure and slurry, compost and industrial organic material comprising over 95%.
4. The water industry has been producing increasing amounts of biosolids annually (*c.* 1.4 m tonnes dry solids in 2008) and has also increased its reliance on recycling biosolids to agriculture (to 77%).
5. Current controls on the recycling of biosolids to agriculture are covered by the 1986 EU Sludge Directive (86/27/EEC), implemented in the UK through The Sludge (Use in Agriculture) Regulations (1989) and supported by codes of practice.
6. Biosolids are also recycled in accordance with the principles of *Hazard Analysis and Critical Control Point* (HACCP) and The Safe Sludge Matrix, which provides a voluntary framework of good practice focussed on food safety and stakeholder re-assurance. It is anticipated that The Safe Sludge Matrix will receive statutory backing within a revision of The Sludge (Use in Agriculture) Regulations.
7. Biosolids are the most researched and well regulated of organic materials applied to land. A significant amount of research (*c.* £9m in the last 15 years) and ongoing research has and will continue to investigate all aspects of biosolids recycling to land to ensure it is considered safe to humans, animals and the environment.
8. Statements of support from a range of stakeholders including EU, Government, Environment Agency, research and other organisations, endorse the safe and sustainable use of biosolids recycling to agricultural land.

Conclusions

Recycling biosolids to land is a controlled and well-regulated process and, provided the controls are followed, presents minimum risk to humans, animals and the environment. The development of The Safe Sludge Matrix and the anticipated amended regulations provide additional re-assurance for a process that is already strictly controlled.

Recycling biosolids to land is a sustainable option, utilising its beneficial properties by providing nutrients and organic matter for soil and plants. It is supported by the Government at a national and European level.

The European Commission declares there are no reported cases of human, animal or crop contamination due to the use of sludge on agricultural soils following the provisions of the Directive 86/278/EEC and although risk zero does not exist in human activities, it appears that the provisions of the Directive have been quite effective in preventing the spreading of pollution because of the use of sludge. *(Report from the Commission to the Council and the European Parliament on the implementation of Community waste Legislation Directive, Directive 86/278/EEC on sewage sludge, For the period 1998-2000).*

http://europa.eu/legislation_summaries/other/l28135_en.htm

(COM (2003) 250 final)

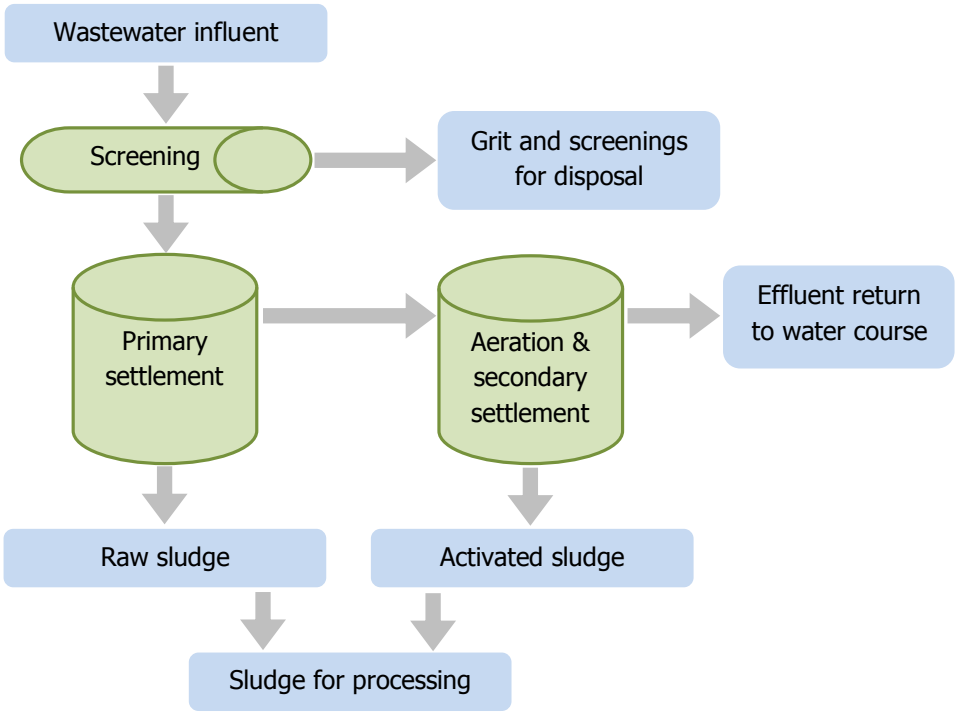
What are biosolids?

Background

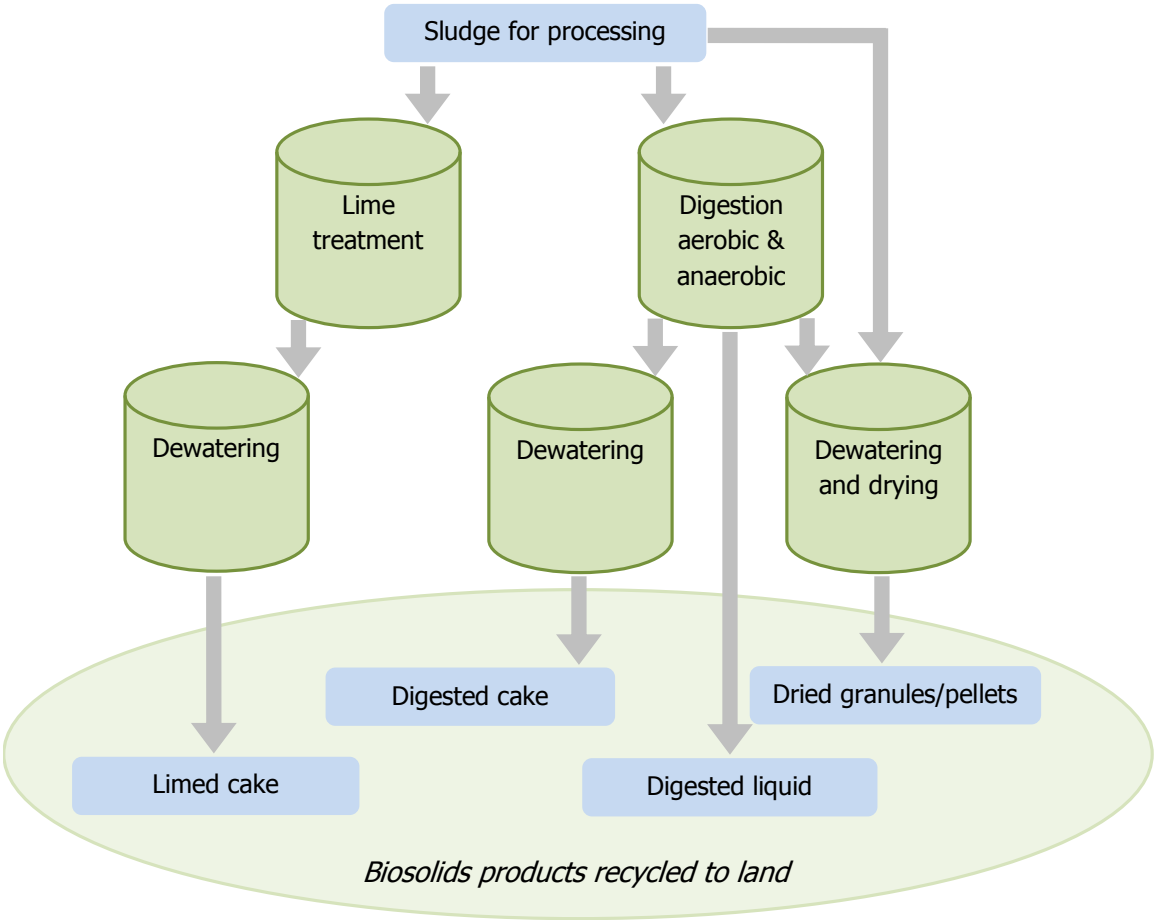
Treated sewage sludge, also known as biosolids, has been recycled to agricultural land for many decades in the UK, Europe, the USA and other parts of the world. In the EU it is recognised as the Best Practicable Environmental Option (BPEO) in most circumstances, adding plant nutrients and humus-forming material to enrich the soil, and is supported by the UK Government and European Commission.

The treatment process

Sewage sludge is produced from the treatment of wastewater and consists of two basic forms; raw primary sludge (basically faecal material); and secondary activated sludge (a living 'culture' of organisms that help remove contaminants from wastewater before it is returned to rivers or the sea).



The sewage sludge is transformed into biosolids using a number of complex treatments such as digestion, lime stabilisation, thickening, dewatering and drying.



A further document *Wastewater Treatment and Recycling* explaining the treatment process in more detail can be accessed at:
http://www.water.org.uk/home/policy/reports/recycling/wastewater-pamphlet

The final product

The treatment process reduces the water content of the sewage sludge, reduces its ability to produce gas and renders it virtually free from harmful organisms. Methane gas produced from digestion is captured and used for renewable energy and heat. The resultant biosolids are therefore easily transportable, less odorous and almost 100% pathogen free. Most treatments also reduce the volume of waste.

Under industry and stakeholder agreed guidelines (The Safe Sludge Matrix) sludge for recycling to agricultural land is treated to either *conventional* or *enhanced* standards dependent on the type of processing plant and proposed land application. Untreated sludge is not recycled to agricultural land.

Biosolids can be produced in cake, granular, pellet or liquid form and are spread over land before being incorporated into the soil or injected directly into the soil as liquid by specialist contractors. Application is always completed in accordance with The Safe Sludge Matrix and in conjunction with normal agricultural rotations.

All biosolids currently applied to agricultural land are applied in accordance with The Sludge (Use in Agriculture) Regulations and The Code of Practice for the Agricultural Use of Sewage Sludge. These regulations and the statutory code of practice ensure that applications to agricultural land are strictly controlled and that all applications are fully traceable and auditable. All land is tested prior to application and all heavy metal additions are modelled to ensure that levels remain within safe limits as set out in the regulations.

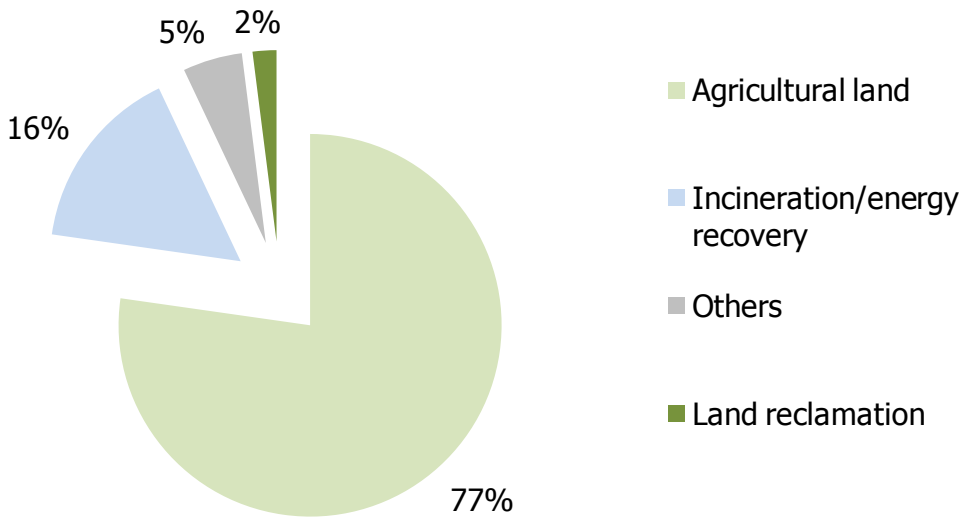
Non-compliant sludge, which fails to meet microbiological standards, will be segregated and undergo further treatment separately from the compliant product. The material may be returned to the start of treatment process and reprocessed; it may be subjected to an alternative treatment process (e.g. lime stabilisation) or it may be sent for incineration (sometimes with energy recovery) or disposed of in landfill. It may also be recycled to suitable land prior to growing industrial (non-food) crops or used in land reclamation projects for ecological improvement. This practice is regulated under the Environmental Permitting (England and Wales) Regulations 2007 and the Waste Management Licensing Amendment (Scotland) Regulations 2003, 2004 and 2006.

Outline statistics

Output and recycling or disposal routes

Almost 1.4 million tonnes (dry solids) of sludge was produced in 2008 in the UK, of which 77% was recycled to agricultural land. A further 16% was incinerated (mostly with energy recovery) usually in parts of the country where land is less accessible. It is notable that incineration is the only real alternative to recycling to land.

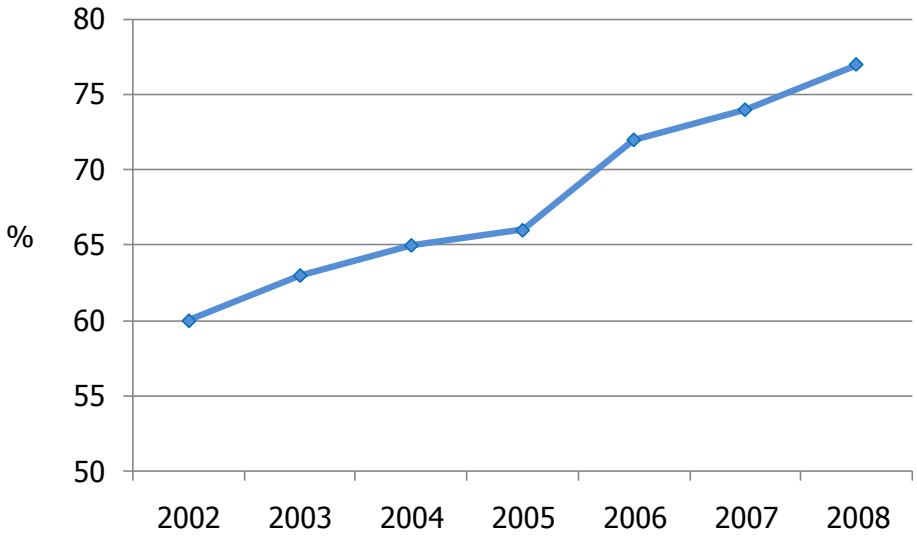
Sewage sludge routes in the UK, 2008



Reliance on agriculture

The UK water industry reliance on agricultural land for recycling biosolids has increased from around 60% in 2002 to 77% in 2008. This change reflects higher output amounts (from increased standards in wastewater treatment) and reducing amounts sent to landfill.

Reliance on agricultural land in the UK, 2002 - 2008



Use in agriculture

The *c.* 1.0 million tonnes (dry solids) of biosolids recycled annually (2008) in the UK make up less than 5% of total organic material going to agricultural land. The remainder of organic material applied to land (on a dry solids basis) comprises of farm animal manure and slurry (*c.* 83%), compost (*c.* 7%) and industrial organic material (*c.* 5%). The regulatory framework governing the safe use of biosolids is significantly more rigorous than that which controls the recycling of animal manures and slurry, composts or industrial organic material.

Regulations and controls

Regulatory framework

Recycling sludge is a highly regulated activity. Current controls are based on the 1986 EU Sludge Directive (86/278/EEC) which was implemented in the UK in 1989 through The Sludge (Use in Agriculture) Regulations. Some aspects of recycling to land are also controlled under The Environmental Permitting (England and Wales) Regulations 2007 and The Waste Management Licensing Amendment (Scotland) Regulations 2003, 2004 and 2006. A revision of the Sludge Directive is now under consideration with projected transposition around 2014/2015. Further information on the consultation process can be accessed at:
http://ec.europa.eu/environment/waste/sludge/index.htm

The regulations are supported by The Code of Practice for the Agricultural Use of Sewage Sludge (1996), which details all aspects of sludge recycling to land; setting application rates, information requirements and guidelines for best practice.

It is anticipated revisions to the regulations and the accompanying Code of Practice will be introduced by the Department for Environment, Food and Rural Affairs (DEFRA) for England and the Scottish Government and National Assembly for Wales for the devolved administrations.

The proposed amendments will include statutory enhancement of The Safe Sludge Matrix, introduce microbiological standards for the final biosolids product, formalise record keeping and introduce *Hazard Analysis and Critical Control Point* procedures (HACCP) to ensure improved quality control. The environment agencies will enforce the regulations, with a statutory duty to undertake audits of compliance with process standards and will continue to audit recycling operations. The proposed regulations will make statutory the existing controls that the industry currently voluntarily adheres to. The whole of the UK industry is compliant with The Safe Sludge Matrix and HACCP requirements, with internal audit and compliance procedures. These statutory controls will provide an added measure of security, with the regulator having specific enforcement powers to ensure compliance with the treatment and process control standards.

A copy of the Water UK HACCP guide can be accessed at:
http://www.water.org.uk/home/news/press-releases/use-of-tre-150404-1

The Safe Sludge Matrix

The Safe Sludge Matrix was developed to ensure the highest possible standards of food safety and to provide a framework that gives all food industry stakeholders confidence

that biosolids recycling to agricultural land is safe. This voluntary agreement has been in place throughout the UK since 1999.
The Safe Sludge Matrix included inputs from the environment agencies, DEFRA and the Food Standards Agency (FSA) and intensive consultation with other stakeholders such as the British Retail Consortium (BRC), National Farmers Union (NFU), Country Land and Business Association (CLA), food manufacturers and food processors.

As a requirement of The Safe Sludge Matrix, sewage sludge is treated by processes to generate either *conventional* or *enhanced* biosolids products, which are suitable for recycling to agricultural land. *Conventionally* treated sludge has been subject to a defined treatment process and standards that ensure at least 99% of pathogens have been destroyed. *Enhanced* treated sludge will be free from *Salmonella* and will have been treated so as to ensure that 99.9999% pathogens have been destroyed. In addition the use of untreated sludge on land growing food crops was phased out from December 1999.

The table below indicates the suitability of biosolid (sludge) types to crop groups.

CROP GROUP	UNTREATED SLUDGES	CONVENTIONALLY TREATED SLUDGES	ENHANCED TREATED SLUDGES
FRUIT	✗	✗	✓ (10 month harvest interval applies)
SALADS	✗	✗ (30 month harvest interval applies)	✓
VEGETABLES	✗	✗ (12 month harvest interval applies)	✓
HORTICULTURE	✗	✗	✓
COMBINABLE & ANIMAL FEED CROPS	✗	✓	✓
- GRAZED GRASS & FORAGE	✗	✗ (Deep injected or ploughed down only)	✓ (3 week no grazing and harvest interval applies)
- HARVESTED GRASS & FORAGE	✗	✓ (No grazing in season of application) (3 week no grazing and harvest interval applies)	✓

ADAS

NOTE: ✓ ***All applications must comply with the Sludge (Use in Agriculture) Regulations and DEFRA Code of Practice for Agricultural Use of Sewage Sludge.***

✗ ***Applications not allowed (except where stated conditions apply).***

Further information on specific crops within crop groups can be found in the full Safe Sludge Matrix publication.
www.adas.co.uk/Home/Publications/DocumentStore/tabid/211/Default.aspx

The water industry in effect enters into a contract with a farmer to supply biosolids. This contract requires the water industry to fulfil its obligations and duty of care under the various regulations and also requires the farmer to meet his obligations, in particular with respect to harvest intervals and crops grown in rotation. The relevant agencies audit the application of biosolids to agricultural land and will check to ensure that the farmer has been advised of his obligations; however, ultimately, it is the farmer's responsibility to ensure that he complies with his obligations.

Many operators insist on signed contracts with farmers. The anticipated revision to The Code of Practice for the Agricultural Use of Sewage Sludge will stress these obligations more clearly. In Scotland, further information on good farming practice is provided by the Scottish Government Environment and Rural Affairs Department (SGERAD) in the form of The Code of Practice for the Prevention of Environmental Pollution from Agricultural Activity (PEPFAA).

Cross Compliance

Cross Compliance, an outcome of reforms to the Common Agricultural Policy (CAP), means farmers must now qualify for subsidies provided under the Single Payment Scheme (SPS) (England & Wales) and Single Farm Payment Scheme (SFPS) (Scotland). Payments to farmers under the CAP are now dependent on the achievement and maintenance of baseline standards on environmental and public health, animal and plant health, and animal welfare.

Cross Compliance came into force on 1st January 2005 and The Sludge (Use in Agriculture) Regulations 1989 and Nitrate Vulnerable Zones Action Programme are included in Cross Compliance as a Statutory Management Requirement (SMR). As part of this the Environment Agency (EA) and Scottish Environment Protection Agency (SEPA) will have to report the outcome of their inspections to the Rural Payments Agency (RPA), in Wales to the Rural Inspectorate Wales (RIW) and in Scotland to the Scottish Government Environment & Rural Affairs Department (SGERAD). Being found to be 'non-compliant' could result in a reduction in the farmer's SPS/SFPS payments.

Water companies and their contractors supplying biosolids to farms operate under the regulations, the codes of practice and The Safe Sludge Matrix thus assisting farmers to meet the requirements of Cross Compliance.

Further information on Cross Compliance can be accessed at:
www.crosscompliance.org.uk

Safety

Scientific background

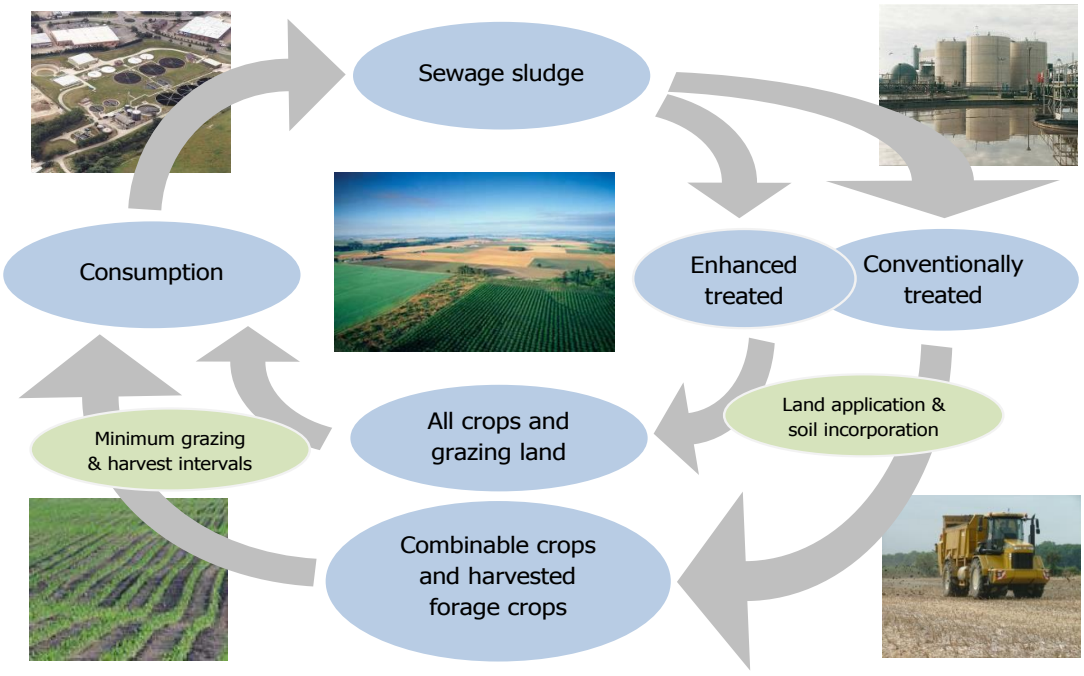
There has been extensive and continuing research into the use of sludge on agricultural land over the last forty five years. In particular considerable additional research has been conducted in order to underpin the provisions of The Safe Sludge Matrix and the proposed standards in the revised regulations.

The work confirms that any risk to the food chain or the environment from recycling treated sludge to land is exceedingly small provided it is carried out in accordance with The Sludge (Use in Agriculture) Regulations, The Code of Practice and The Safe Sludge Matrix. All research reports are in the public domain and are available if required. The results from on-going research will also be published.

Health considerations

Treatment of sewage sludge eliminates the vast majority of pathogens before application to land. Application to land within the regulations and codes of practice and conformance with The Safe Sludge Matrix guidelines, which may soon be mandatory, ensures that the risk of transfer of pathogens to harvested produce is exceedingly small as illustrated on the figure below.

Multiple barriers to pathogen survival



Health risks from pharmaceutical products

There is no evidence to suggest that any pharmaceutical products or their derivatives that may be found in biosolids are linked to any adverse environmental or public health impacts. In addition most pharmaceutical products are inherently biodegradable and thus would not be expected to remain intact during wastewater/sludge treatment or after the application of sludge to land.

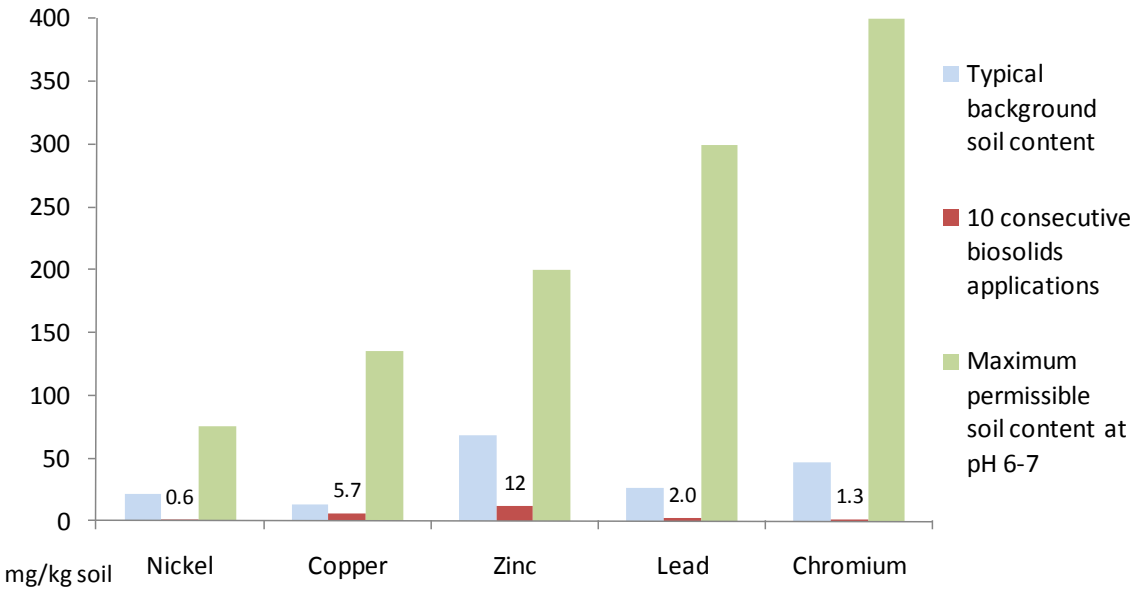
Heavy metals

The control of heavy metals was the principal focus of the 1986 EU Sludge Directive (86/27/EEC) and The Sludge (Use in Agriculture) Regulations. Heavy metals are deemed to be the main potentially toxic elements (PTEs) of concern when sludge is being applied to land; hence the regulatory controls require consideration of both the immediate application and the cumulative effects of sludge addition. The process is tightly regulated, with the water industry obliged to take extensive sludge samples to demonstrate that the metals levels are safe. This is enforced by the regulators under the existing statutory regime.

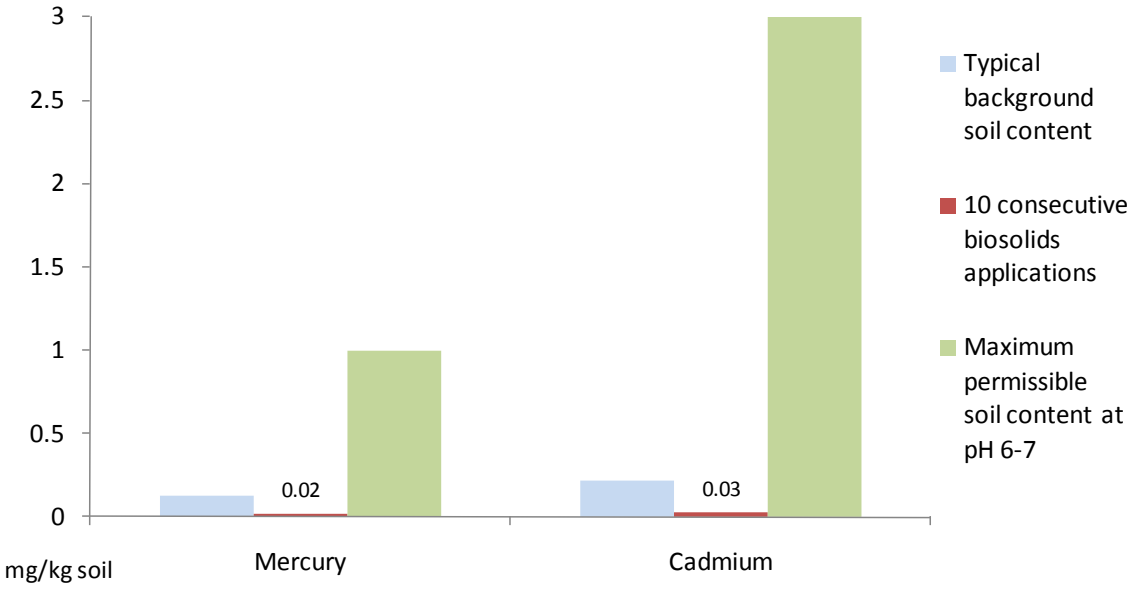
Sludges from different sewage treatment works differ in character and composition according to the origin of the sewage and the type of treatment processes employed. The occurrence of heavy metals in sewage sludge arises principally through domestic, road run-off and industrial inputs to the sewerage system in the UK. Industrial effluents are strictly controlled through trade effluent consents and these inputs now represent a relatively small proportion of total metal discharges to sewers. The main inputs now come from diffuse sources such as road run-off and household use (e.g. copper pipes).

Heavy metal additions to land are strictly controlled and biosolids may not be applied in circumstances where the addition would lead to the advisory soil limits being exceeded. The advisory limits are based on extensive research and plant uptake studies and already incorporate a safety threshold. All applications are audited by the relevant environment agency. The following two tables indicate the relatively low levels of metal additions to soil through biosolids applications compared with typical background soil contents and maximum permissible concentrations in soil.

The effect of ten consecutive biosolid applications in relation to typical background soil content and maximum permissible concentrations for Nickel, Copper, Zinc, Lead and Chromium



The effect of ten consecutive biosolid applications in relation to typical background soil content and maximum permissible concentrations for Mercury and Cadmium



Sustainable solutions

Recycling and disposal options

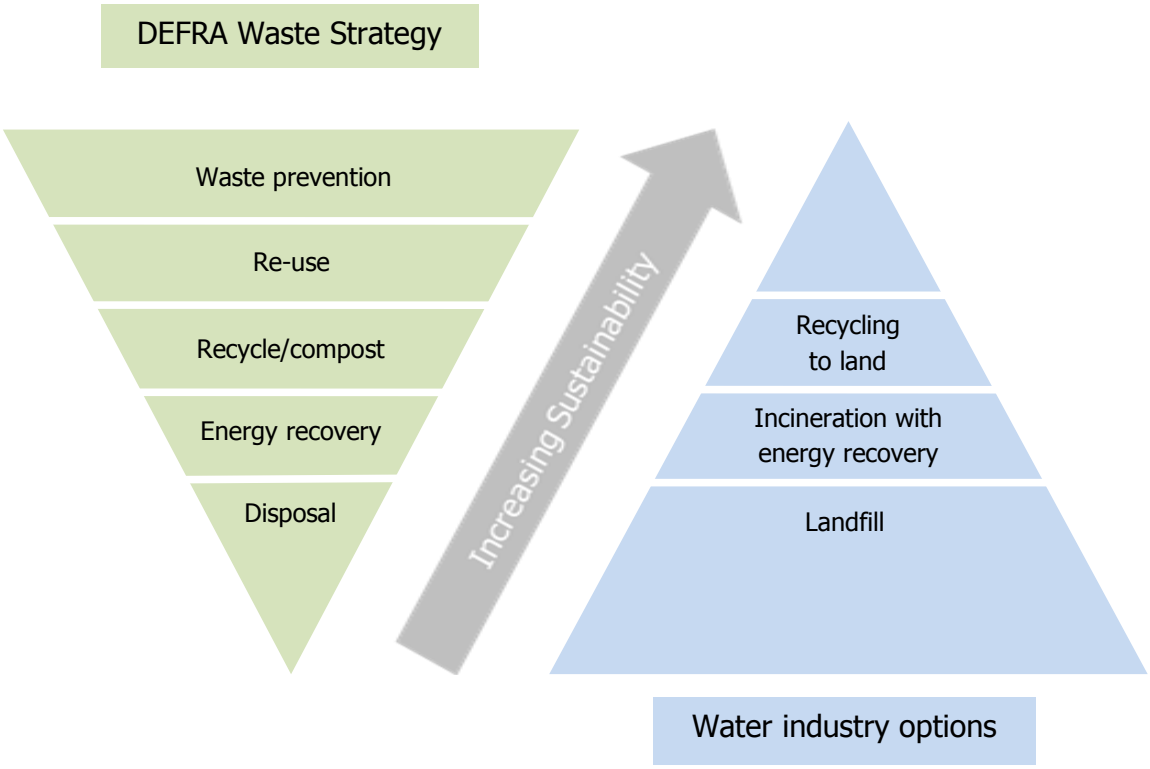
Prior to 1998, sewage sludge was disposed of at sea, in landfill, incinerated or recycled to land. Disposal to sea was banned from 1998 resulting in only three realistic options for disposal or recycling with particular merits and drawbacks as the following table indicates.

OUTLET	COST TO CUSTOMER	ENVIRONMENTAL SUSTAINABILITY	PUBLIC PERCEPTION
LANDFILL	High	Low	Low
INCINERATION WITH ENERGY RECOVERY	High	Medium	Medium
RECYCLING TO LAND	Medium	High	High (desired goal)

Application to agricultural land is the most sustainable, environmentally beneficial and economically viable option for biosolids. Disposal to landfill does not have a long term future and incineration with energy recovery although preferable to landfill is a relatively expensive option, which can attract adverse public reaction. Whilst under some circumstances landfill and incineration are appropriate neither of these routes are normally the best environmental option; nor are they fully sustainable solutions.

The UK Government acknowledges that biosolids recycling to land is the best option as follows:
"The Government considers that recycling of treated sewage sludge to agricultural land is the Best Practicable Environmental Option (BPEO) in most circumstances" – DEFRA.

Recycling biosolids to land also aligns with the principles of the DEFRA Waste Strategy of waste prevention, re-use, recycling/composting, energy recovery or disposal to maximise sustainability of resources as illustrated in the figure below.



Investment for a sustainable future

The UK is a world leader in the recycling of biosolids to land. It is an environmentally sustainable recycling solution surpassing the merits of other disposal options. The water industry has invested £1.06 billion over the last 5 years (England and Wales) to improve treatment and management practices so that stakeholders can have confidence in biosolids recycling.

The way forward

With the continuing support of Government, regulatory bodies, farmers, processors, manufacturers, retailers, consumers and environmental groups' biosolids recycling will help contribute to national recycling targets and continue to set the standards for recycling organic material to agricultural land. It is a safe, sustainable solution that benefits us all and will benefit generations to come.

Anaerobic Digestion

Anaerobic digestion can be described as a natural biological process involving a complex microbial environment that converts waste organic matter into a mixture of methane and carbon dioxide (biogas) in the absence of oxygen.

The water industry currently accounts for over 90% of all biogas produced in the UK (Andrews, 2008) generated from digestion of 60% of the 1.4 million tonnes dry solids sewage sludge produced annually (2008). The majority of the biogas is utilised to produce electricity by combustion in combined heat and power units (CHP). Currently the industry produces some 800 GWhr/year with a planned increase of 30% over the next few years. The energy produced assists the Government in meetings its renewable energy targets.

DEFRA have identified (*Anaerobic Digestion – Shared Goals,* February 2009) the importance of the water industry as a key stakeholder in the implementation of its vision statement on anaerobic digestion:

"The water industry will be an important part of a national anaerobic digestion infrastructure. Anaerobic digestion will remain one of the most important methods for treating sewage sludge."

DEFRA identifies (*Developing an Implementation Plan for Anaerobic Digestion,* July 2009) a number of recommendations which will enable the water industry to meet its expectations. The recommendations (paragraph 31) focus on a top priority of ensuring there is a clear and robust environmental and economic regulatory framework in place to facilitate the co-digestion of sewage sludge and other feedstocks and enable appropriate management of the resulting digestate:

"An important area for the growth of anaerobic digestion is in the co-digestion of other feedstocks with sewage sludge. The water industry has a well established infrastructure of anaerobic digestion plants and extensive experience of the technology."
"Recommendation 15: Amend the Sludge Use in Agriculture Regulations to ensure the maintenance of confidence levels in this vital route for the recovery of sewage sludges and maximise the efficient use of existing infrastructure in the water industry."

The *Anaerobic Digestion – Shared Goals* (February 2009) can be accessed at:
http://www.defra.gov.uk/environment/waste/ad/documents/ad-sharedgoals-090217.pdf

The Task Group report, covering recommendations, *Developing an Implementation Plan for Anaerobic Digestion* (July 2009) can be accessed at:
http://www.defra.gov.uk/environment/waste/ad/documents/implementation-plan.pdf

Agriculture & the environment

Benefits to soil and the environment

Recycling biosolids to agricultural land increases the organic matter in the soil with the following benefits:

- The organic matter increases water retention within the soil providing more resistance to drought and reducing the likelihood of erosion after heavy rainfall. It also improves drainage characteristics within the soil.
- The improved soil structure increases workability of the soil, helps better plant root development with the benefit of increased crop yields.
- Higher levels of organic matter increase life within the soil from microbial activity to earthworms.
- Organic matter also increases carbon sequestration in the soil.
- Biosolids replace soil nutrients essential for plant growth. It principally contributes Nitrogen and Phosphate as well as sulphur, magnesium, potassium and other trace elements, which are not found in manufactured fertilisers.
- Recycling biosolids is an opportunity to recover nutrients, which would otherwise be lost. As Phosphate is a global finite resource it is of environmental importance that it should be recovered and reused.
- Nitrogen and Phosphate within biosolids tends to be less water soluble than farm yard manures or manufactured fertilisers. Therefore its application to soil has a lasting effect that is less prone to eutrophication and associated pollution of water courses.

Value to agriculture

- The estimated 1.0 million tonnes (dry solids) of biosolids recycled to agricultural land contain significant amounts of Nitrogen (*c.* 4.2%) and Phosphate (*c.* 3.2%).
- The total value of nutrients in biosolids recycled to agricultural land is estimated at £40 – £50 million per annum (based on 2008 manufactured fertiliser prices).
- The water industry and its contractors provide biosolids and a service to agriculture at minimal cost.
- Biosolids can and do replace the need for alternative manufactured fertilisers.
- Around 165,000 hectares (less than 2% of agricultural land) in the UK benefit from biosolids treatment annually.

Water industry research

Biosolids and sewage sludge have been recycled to land throughout the UK, Europe and the US for many years and extensive international research has been carried out over the last 45 years. As a result, we understand more about the potential risks associated with biosolids recycling than any other organic material going to agricultural land.

UK Water Industry Research (UKWIR) provides a framework for the procurement of a common research programme for UK water industry on 'one voice' issues including sludge.

Activities

- UKWIR sludge research has helped to underpin scientifically *The Safe Sludge Matrix* agreement.
- Long-term collaborative research with DEFRA and the Environment Agency means the findings are thorough and acceptable to all parties, ensuring consistent regulation based on sound science.
- The fertiliser value of biosolids can now be quantified, enabling the farmer to assess additional fertiliser needs more accurately.
- Pro-active research on emerging issues is enabling the industry to develop better methods of detecting such chemicals as organic contaminants in sewage and treated sludge and the environment as a whole.
- UKWIR investment in sludge research has amounted to around £9 million over the last 15 years.

This research has enabled the UK water industry to:

- Develop a thorough understanding of risks associated with recycling biosolids (treated sewage sludge) to agricultural land.
- Establish a *HACCP* based risk assessment throughout the industry.
- Identify environmental benefits and financial benefits to agriculture.
- Understand the impact on soil fertility and control application methods accordingly.
- Provide information and re-assurance to stakeholders.
- Demonstrate recycling of biosolids to agricultural land is the Best Practicable Environmental Option (BPEO) in most circumstances.

Statements of support

DEFRA

"The Government considers that recycling of treated sewage sludge to agricultural land is the Best Practicable Environmental Option (BPEO) in most circumstances. The practice aligns with the principles of the waste hierarchy of reduction, re-use, recovery and then disposal. Recycling to agricultural land also brings considerable benefits including positive effects for the fertility, workability, structure and the water holding capacity of the soil."

"The Sludge (Use in Agriculture) Regulations 1989 (SI 1263) as amended in 1990 (SI 880) impose controls on the application of sludge to agricultural land to prevent the accumulation of heavy metals in the soil and to prevent bacteriological contamination of crops. These controls are supplemented by a non-statutory Code of Practice and the 'Safe Sludge Matrix' drawn up by Water UK and the British Retail Consortium. On the basis of advice from the independent expert Advisory Committee on the Microbiological Safety of Food, the Food Standards Agency has indicated that it considers the application of sewage sludge to agricultural land should not present unacceptable risks to food safety, provided that it has been carried out in accordance with the requirements currently set out in the regulations, the code and the matrix."

The Environment Agency

"The Environment Agency believes that in most cases recycling to agricultural land represents the Best Practicable Environmental Option for managing treated sewage sludge (biosolids) arising from sewage treatment. The addition of sludge biosolids to agricultural land benefits the soil in the form of nutrients and organic matter that would otherwise have to be supplied through alternative fertilisers and soil conditioners."

Stavros Dimas, Member of the European Commission

"Our aim in the revision of the Sewage Sludge Directive will be, on the one hand, to encourage the sustainable use of properly treated sludge and, on the other hand, to enhance the controls applied to sludge in order to guarantee that both its professional users and the larger public increase their confidence in the environmental protection guaranteed by the Directive."

ADAS

"We believe that the recycling of biosolids (treated sewage sludge) to agricultural land is the best practicable environmental option in most circumstances, working within the bounds of the "Sludge Use in Agriculture Regulations" and the "Safe Sludge Matrix". Recycling to agricultural land completes natural nutrient cycles and enables farmers to improve the economics of crop production, and to improve soil quality and fertility through the addition of valuable organic matter. Also, recycling to land can make a contribution in reducing greenhouse gas emissions, compared with land filling, and will therefore make a contribution to UK climate change policies."

"We do recognise that the recycling of biosolids (and other organic materials) to land may give rise to public concern. However, we believe that the "Safe Sludge Matrix" agreement has gone a long way towards addressing any concerns. Biosolids products are valuable organic fertilisers for beneficial use by farmers."

The Royal Society for the Protection of Birds (RSPB)

"The RSPB believes that biosolids have a small but important part to play in solving the problem of nutrient over-supply within the UK as a whole. At present, nutrients contained in the waste organic materials from agriculture and human activity are not adequately recycled back to plants which need these for their growth. Instead, too great a proportion of these nutrients find their way into watercourses causing pollution, poor water quality and negative impacts on wildlife. Chemical fertilisers are then used to replace these lost nutrients further adding to the nutrient over-supply problem."

"The RSPB recognises the beneficial properties that biosolids have in returning nutrients, needed for plant growth, and organic matter to soils for the growth of crops and for gardens."

The Soil Association

"The Soil Association believes that recycling treated sewage sludge (biosolids) to the land is an important component of sustainable farming. It would enable the closure of the nutrient cycle, an important principle in organic agriculture."

Surfers Against Sewage (SAS)

"Surfers Against Sewage (SAS) believe that, when carried out in accordance with the relevant legislation and guidelines that protect the food chain and the environment, the application of sewage sludge to land is an acceptable and beneficial practice. The natural cycling of nutrients and organic matter contained in the sludge represents a sustainable management route, avoiding the need for chemical fertilisers in the areas where sludge is used. SAS thus fully support the use of treated sludge on agricultural land, when used in accordance with the relevant legislation and the guidelines that are in place."

The Sustainable Organic Resources Partnership (SORP)

The Sustainable Organic Resources Partnership (SORP) has been established to support and promote the safe use of all recycled organic matter in sustainable ways. SORP is very pleased to endorse the recycling of biosolids to land and applauds the work of Water UK to maintain this practice.

Green Alliance, Jiggy Lloyd

Extract from *The nutrient cycle: closing the loop.*

"At its simplest level, the concept of closing the loop, as applied to waste and resources, expresses a desire to move away from a linear process of resource extraction, manufacture, consumption and disposal, towards a cyclical system where resources remain in use almost indefinitely. In global terms, and particularly in 'developed' countries, a relatively small proportion of resources are cycled, or go round in loops, and a large proportion are in productive use for a very short time."

"This is unsustainable because it means: depletion of non-renewable resources (minerals and metals); degradation of habitats, landscapes and biodiversity; dangerous over-use of what should be renewable resources and over-use of the environmental 'sinks' needed to absorb the pollution we generate as we produce and consume. Circulating resources around the economy, rather than just passing them through once, reduces the environmental impacts associated with extraction of resources and disposal of waste."