Sewage sludge and biosolids

Briefing and position statement

CIWEM Chartered Institution of Water and Environmental Management

This Policy Position Statement (PPS) sets out the position of the Chartered Institution of Water and Environmental Management (CIWEM) on wastewater (sewage) sludge treatment and biosolids utilisation.

Contents

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Note: CIWEM Policy Position Statements (PPS) represent the Institution's views on issues at a point in time. It is accepted that situations change as research provides new evidence. It should be understood, therefore, that CIWEM PPSs are under constant review and that previously held views may alter and lead to revised PPSs. PPSs are produced as a consensus report and do not represent the view of individual members of CIWEM.

CIWEM
106-109 Saffron Hill
London EC1N8QS
Charity registration No 1043409 (England and Wales)
SC038212 Scotland

www.ciwem.org

CIWEM is the leading independent Chartered professional body for water and environmental professionals, promoting excellence within the sector.

CIWEM recommends

The following measures are recommended to ensure biosolids are managed in a sustainable way in future:

- **Develop evidence-based regulation** – new regulatory controls are needed. These should be designed to meet the challenges arising from nutrients and chemical substances in biosolids used in agriculture and must be based on the best available, UK aligned evidence, such as that being gathered through the Chemical Investigations Programme (CIP). While it is recognised that the current round of CIP is set to run until at least 2027, efforts to accelerate evidence gathering and its outputs should be explored and enacted wherever possible.

- **Take a systems-wide view** – any new regulatory limits should be set using a systems-wide approach that understand and appropriately apportions the risk presented by biosolids in the context of the other organic and inorganic materials that are commonly recovered to agriculture. This will support a proportionate regulatory response around biosolids that balances actions on any environmental and human health risk against costs that are likely to be passed on to water customers.

  This big picture approach should also consider other UK policy priorities that offer environmental benefits, including the production of renewable energy and the circular economy. The Circular Economy Taskforce should consider the risks that chemical substances in wastes pose to the viability of circular products and investigate possible actions, such as source control opportunities.

- **Engage openly with policy makers** – the water sector must engage policy makers to help join the regulatory dots needed to plan and invest, advance circular economy opportunities and empower source control initiatives that will enable the most cost-efficient outcomes for water customers. This must be done in parallel to evidence gathering efforts such that there is more immediate clarity around possible ways forward once the outcomes of evidence gathering exercises, such as CIP, are provided.

  Regular engagement with government and policy makers will also support a 'no surprises' approach to the regulatory landscape that helps to provide certainty for planning and investment. This should come not only from the perspective of chemical substances but also from the use of nutrients in agriculture, such as the development of guidance around the Farming Rules for Water, in England.

- **Develop greater resilience for sewage sludge treatments and biosolids outlets** – the water industry should continue to research innovative treatments for sewage sludge and alternative circular outlets for biosolids or other sewage sludge-derived materials. This must be proactive with respect to evidence gathering but also responsive to abrupt regulatory and market changes.

This should include not only technological innovations for the management of chemical substances in sewage sludge but also a robust risk assessment of commercial and industrial inputs. This should enable the prioritisation of opportunities for source control, e.g. by the water sector working with businesses to better manage their wastes, to reduce or maintain chemical concentrations to acceptable levels (whatever the evidence gathered deems these to be).

Context

What is sewage sludge and how is it treated in the UK?

Sewage sludge is the solid part of sewage that settles out and is treated separately from the wastewater. Most UK sewage sludge is treated by Anaerobic Digestion (AD) or *Advanced* AD (AAD). Treated sewage sludge is often termed *biosolids*. Treating sewage sludge by AD or AAD:

- Kills pathogens (AAD can kill 99.9999 per cent of E. coli and result in no detectable salmonella)
- Reduces its biological activity (i.e. its potential to ferment) in a controlled manner
- Reduces its volume by biological conversion into biogas, a mix of methane and CO_2 gas
- Recovers energy by capturing and combusting the methane component of biogas

AD (and particularly AAD) produces biosolids that can be readily transported and stockpiled, with a relatively low odour profile. This has played a role in the rise of agriculture as the primary outlet for UK biosolids. Other outlets, such as incineration or landfilling generally have higher costs.

Biosolids in the UK context

Around 3.5 million tonnes of biosolids are produced in the UK each year, with 87 per cent spread on agricultural land[1]. Although this amounts to a significant logistical operation for water companies, biosolids make up just under 4 per cent of the organic materials used in British agriculture[2], with the majority made up by cattle slurry and farmyard manure.

Just 1.6 per cent of agricultural land area receives biosolids each year, on average[3]. This provides important perspective on the prevalence of biosolids use in agriculture compared to other waste materials, but this does not negate the importance of understanding and mitigating any associated risks from biosolids.

Most biosolids (89 per cent) are applied to 'winter' or 'spring' sown combinable crops, such as winter wheat, spring wheat or oilseed rape. About 11 per cent are applied to grass.

[1] Assured Biosolids Limited. About Biosolids. 2025.

[2] Defra. Accredited official statistics - Latest British survey of fertiliser practice report. 18 July 2024.

[3] Defra. Accredited official statistics - Latest British survey of fertiliser practice report. 18 July 2024.

Key issues

What are the current circular economy benefits?

In November 2024, the government formed a Circular Economy Taskforce to co-design the first strategy to begin the transition to a circular economy in England[4]. This signals government's desire to maintain and advance circular economy opportunities at the policy level.

In 2023/24, in England and Wales, biogas from sewage sludge was used to generate c.900 GWh of renewable electricity, enough to power the homes of a city the size of Leeds. About 800 GWh of usable heat and c.600 GWh of biomethane (a renewable substitute for natural gas) were also produced.

This Annual Performance Reporting (APR) data is captured by Ofwat via a common template[5], and published on each water company's website. Energy is also recovered from sewage sludge as biogas in Scotland[6] and by incineration of sewage sludge in Northern Ireland[7].

Energy recovery is enabled by the availability of agriculture as a viable outlet for the biosolids that AD and AAD treatments produce (except in Northern Ireland). But the biosolids themselves also contain valuable nutrients, e.g. nitrogen (N) and phosphate (P_2O_5), that can replace fossil fuel intensive manufactured fertilisers when the biosolids are used in agriculture.

Approximately 40,000 tonnes of phosphate and 6000 tonnes of available nitrogen are supplied to agriculture each year in biosolids, based on the nutrient specification of biosolids in agricultural industry guidance[8]. Assuming average market prices for these nutrients delivered to farm as manufactured fertiliser in 2025[9], c.£350/tonne for ammonium nitrate (34.5 per cent N) and c.£475/tonne of triple superphosphate (45 per cent P_2O_5), the nutrients in biosolids contribute a combined value of around £45m per year. Biosolids are also a source of organic matter that helps to improve soil structure.

What are the risks and challenges?

Chemicals enter sewage treatment works via sewers from domestic sources or commercial and industrial sources (as trade effluent). These can include microplastics and per/poly fluoroalkyl substances (PFAS). Industrial and commercial waste can also be imported by road tanker at specific, permitted sites. However, it is likely that most tanker imports contain cess pit or septic tank waste.

Significant media attention has focussed on the prominence of industrial sources for chemicals in biosolids. However, evidence shows that sewers serving only domestic sources

[4] Defra. Circular Economy Taskforce.

[5] Ofwat. 2023-24 annual performance report tables. 10th April 2024.

[6] Scottish Water. Anaerobic Digestion. [Online] 2025.

[7] Northern Ireland Water. Belfast Sludge Incinerators. [Online] 2025.

[8] AHDB. RB209 Section 2 Organic materials.

[9] AHDB. GB fertiliser prices.

also contain appreciable chemical concentrations (including PFAS) and in some instances can show higher concentrations than catchments that include trade effluent sources[10].

Ofwat's APR data indicates that trade effluent makes up between 1-3 per cent of total flows receiving treatment at wastewater treatment works. This suggests a complex picture around the sources of chemicals in biosolids and points towards a wider, and more challenging, societal-level chemical problem. The UK water sector is currently undertaking a research project to risk assess the impact of trade effluent and tankered waste on biosolids[11].

Substances such as microplastics and PFAS can end up in sewage sludge but are not well-degraded by treatment. As a result, using biosolids in agriculture has the potential to release the substances they contain into the environment. There are concerns that substances could then be taken up by crops or livestock and enter the food chain.

However, taking PFAS as an example, the significance of this human health risk in the context of wider possible exposure routes is not yet well-understood. For example, while a maximum test result of 135 parts per billion (ppb) of one particular PFAS compound (known as PFOS) was highlighted in one sample of UK biosolids[12], the global literature indicates that the sum of all PFAS in everyday household items can exceed this concentration by many times[13]. Another study has shown detectable levels of PFOS and other PFAS compounds in the air of UK homes and offices, albeit at significantly lower concentrations[14].

Microplastics and PFAS are also found in livestock manures, albeit typically at much lower concentrations than found in biosolids[15, 16]. However, there is also a much greater prevalence of livestock manure use than biosolids in UK agriculture.

The significance of the relative risk posed by the load of these substances into the environment from these different sources does not appear to be well-understood and there is a pressing need to improve this understanding.

A 2025 DEFRA report[17] highlighted how microplastics intentionally added to cosmetics, detergents and other consumer products can end up in biosolids that are then spread on land. It was estimated that, on average across 20 years, source control of these microplastics

[10] UK Water Industry Research. The National Chemical Investigations Programme 2015-2020. Volume 4 Catchment Investigations.
[11] UK Water Industry Research. Live Projects.
[12] ENDS Report. Water companies selling sludge fertiliser containing banned 'forever chemical' to farmers. 20 Sep 2024
[13] Dewapriya, P et al. Per- and polyfluoroalkyl substances (PFAS) in consumer products: Current knowledge and research gaps. Journal of Hazardous Materials Letters, vol 4, 2023, 100086
[14] Goosey, E and Harrad, S. Perfluoroalkyl substances in UK indoor and outdoor air: Spatial and seasonal variation, and implications for human exposure. Environment International. Vol 45, 15 September 2012 pp 86-90.
[15] Sheriff, I et al. Microplastics in manure: Sources, analytical methods, toxicodynamic, and toxicokinetic endpoints in livestock and poultry. Environmental Advances. Vol 12, July 2023, 100372
[16] Munoz, G., et al. Target and Nontarget Screening of PFAS in Biosolids, Composts, and Other Organic Waste Products for Land Application in France. Environmental Science & Technology. Vol 56/Issue 10. October 20, 2021
[17] Defra. Option Appraisal for Intentionally Added Microplastics - CB04121. 2025

(i.e. actions that stop or reduce microplastics before they can enter biosolids) could result in 54 per cent to 78 per cent reduction in microplastics emissions to the environment.

Meanwhile, for modelled scenarios considering the diversion of 50 per cent or 95 per cent of biosolids currently used in UK agriculture to incineration outlets, it was estimated that 17 per cent and 32 per cent reduction in microplastics emissions could be achieved, respectively. However, it was estimated that biosolids incineration could be more cost effective than the source control measures considered.

Further work would be needed to assess the feasibility of diverting biosolids to existing incineration outlets in the waste sector, as was assumed in the DEFRA work. This would need to include an assessment of the ability of the particular incineration technologies typically used in the waste sector (i.e. moving grates) to accept sewage sludge or biosolids feedstocks. For example, the Best Available Techniques (BAT) Reference Document[18] for Waste Incineration indicates that moving grates can experience operational issues if sewage sludge makes up more than 10 per cent of the total incinerator feedstock.

[18] European Commission. JRC Science for Policy Report. Best Available Techniques (BAT) Reference Document for Waste Incineration. 2019

At present, regulatory limits on biosolids are limited to a small list of heavy metals. In 2020, the Environment Agency (EA) reviewed the existing regulations and accepted that biosolids use in agriculture should be brought under Environmental Permitting Regulations (EPR). This will include a review of risks presented by chemical substances beyond those currently regulated, such as microplastics, with the UK water industry's Chemical Investigations Programme (CIP) cited as the primary route for evidence gathering[19].

However, as of summer 2025, the regulation of biosolids use in agriculture has not been brought under EPR. A case against the EA was resultingly taken to the high court to compel the EA to implement EPR[20]. However, the case was dismissed, in part, because of a recognition of a lack of drive in government to make changes to biosolids regulation obligatory. The transition of biosolids use in agriculture to more risk-based regulation under EPR was recently recommended by the Independent Water Commission[21].

In Scotland, the use of biosolids in agriculture is now regulated under The Environmental Authorisations (Scotland) Amendment Regulations 2025[22], which replaces The Sludge (Use in Agriculture) Regulations 1989. This stipulates that only conventionally or enhanced treated biosolids can be used in agriculture and brings an equivalent of the Safe Sludge Matrix into regulation. While there are some adjustments to how the concentrations of specified heavy metals in soils are regulated, there does not appear to be an expanded list of regulated substances at this time.

There are also more general concerns around the overapplication of nutrients in agriculture, particularly in certain sensitive river catchments. If this is allowed to happen, damage to aquatic ecosystems is likely.

In England, this has led to a regulatory desire to restrict the spreading of organic materials, including biosolids, in autumn when the risk of nitrogen leaching into waterways is greatest. Instead, spreading in spring, when many crops uptake nitrogen, may be preferred.

Several expert reviews have indicated that the leaching risk profile of biosolids is such that a move towards increased spring spreading could be counterproductive. Subject to soil type and conditions, the increased travel of heavy spreading equipment across typically moist spring-time soils could risk increased soil damage and with this an increased risk of phosphorus release into waterways[23, 24].

A 2024 Defra Report of the Nutrient Management Expert Group states that autumn spreading of biosolids is generally most appropriate[25]. How regulations on this topic should

[19] Environment Agency. Policy paper: Environment Agency strategy for safe and sustainable sludge use. August 2023

[20] Fighting Dirty. Toxic sewage sludge case thrown out, as judge rules that the EA were hamstrung by Ministerial delays. Now Labour must step up. 21 August 2024

[21] Independent Water Commission: review of the water sector. July 2025

[22] The Environmental Authorisations (Scotland) Amendment Regulations 2025

[23] AHDB. An assessment of the impact of Farming Rules for Water. [Online] 10th February 2021.

[24] House of Commons Environment, Food and Rural Affairs Committee. Farming Rules for Water Non-inquiry session.

[25] Defra. Report of the Nutrient Management Expert Group (NMEG). May 2024.

be enforced remains under consideration by Defra[26], investigation by the Office for Environmental Protection[27] and has been the subject of legal challenge in the High Court[28].

What controls are in place?

The Sludge (Use in Agriculture) Regulations 1989 (SUiAR) are the primary regulations controlling the use of biosolids in agriculture. It has been highlighted that these regulations are becoming outdated and cover only a limited scope of chemical substances.

However, there are other controls that also provide layers of protection. A selection of key controls is provided below. As well as direct controls on biosolids use in agriculture, this includes controls pertaining to trade effluent and commercial waste imported by road tanker upstream of sewage sludge production and treatment.

Control	Key impact
SUiAR (12)	Regulates the level of specified chemical elements in biosolids that can be applied to agricultural land in England and Wales. This will fall under the Environmental Authorisation regulations[29] in Scotland, from November 2025
Nitrate Vulnerable Zones (13) (14) (15)	Limits the application rate of biosolids based on their nitrogen content. Most agricultural land area in the UK falls within an NVZ.
Farming Rules for Water (16)	Regulates the timing of biosolids applications and their suitability based on the level of phosphate in the soil (England only).
Source Protection Zones (17) (18) (19)	Protects groundwater (springs, boreholes and wells for human consumption) by placing exclusion zones where biosolids cannot be stockpiled or spread.
Biosolids Assurance Scheme (BAS) (20)	Provides independently assured standards and tests for sewage sludge treatment and biosolids use based on regulation and national/industry guidance (e.g. Code Of Good Agricultural Practice, Safe Sludge Matrix).
Water Industry Act[30]	Provide regulatory basis for controls underpinning trade effluent arriving at wastewater treatment works by sewer. Covered under the Sewerage Act[31] in Scotland.
Trade Effluents Regulations[32]	Defines special category effluents and enables particular consent conditions for hazardous waste effluents. Consent conditions related to priority and hazardous substances fall in the Sewerage Act in Scotland.
Environmental Permitting Regulations (EPR)[33]	Defines whether sites can accept commercial waste by road tanker and stipulate quantities that can be imported and monitoring requirements. This is managed through Pollution Prevention Control (PPC)[34] and Waste Management Licencing (WML) regulations[35] in Scotland.

[26] Defra. Statutory guidance - Applying the farming rules for water. 16th June 2022.
[27] Office for Environmental Protection. OEP launches investigation into lawfulness of government guidance on water pollution from agriculture. 19th November 2024.
[28] River Action. Farming practices will have to change, rules judge following River Action legal action over state of River Wye. 24th May 2024.
[29] The Environmental Authorisations (Scotland) Amendment Regulations 2025
[30] Water Industry Act 1991
[31] Sewerage (Scotland) Act 1968
[32] The Trade Effluents (Prescribed Processes and Substances) Regulations 1989
[33] The Environmental Permitting (England and Wales) Regulations 2016
[34] The Pollution Prevention and Control (Scotland) Regulations 2012
[35] The Waste Management Licensing (Scotland) Regulations 2011

Technical guidance WM3[36]	Framework for classifying commercial waste imported by road tanker as hazardous or non-hazardous and assigning European Waste Category (EWC) codes.
Duty of Care regulations[37, 38]	Require pre-acceptance and acceptance procedures to be implemented for commercial waste imported by road tanker. Includes waste characterisation and exchange of waste transfer notes.

What can be done to address concerns around biosolids?

Research – For biosolids, research is underway to understand what chemical substances are present, their significance when biosolids are used in agriculture, and what new treatments may remove them:

- **Chemical Investigations Programme (CIP)** – CIP is an ongoing, multi-phase body of open-access research[39]. It is funded by UKWIR, the research body for the water sector in the UK and Ireland. CIP's most recent drivers around sewage sludge have come out of the Water Industry National Environment Programme (WINEP)[40], a regulatory framework outlining the environmental obligations for water companies.

  WINEP is developed by the EA, Defra, Natural England (NE) and Ofwat and the EA are key stakeholders on the most recent 'Sludge Investigations' and 'Advanced Thermal Conversion (ATC) and Microplastics' CIP projects. These projects include sampling sewage sludge at different sites over 12 months and lab analysis for a list of substances, including microplastics and PFAS. Up to 7 innovative ATC treatments will also be tested to understand their ability to destroy microplastics and other substances found in sewage sludge.

- **Ofwat Innovation Fund**[41] – several projects are studying the potential of gasification and pyrolysis technologies as possible ATC technologies to treat sewage sludge and remove chemical substances that are not well-addressed through established treatment methods, such as microplastics and PFAS. There is also an aim to understand how the outputs of these advanced treatments, such as biochar, can be used to maintain circular economy benefits.

- **Other work** – several water companies are examining Hydrothermal Liquefaction (HTL) technology to convert sewage sludge into Sustainable Aviation Fuel (SAF).

[36] Environment Agency. Waste classification technical guidance. 2021
[37] The Environmental Protection (Duty of Care) Regulations 1991
[38] The Environmental Protection (Duty of Care) (Scotland) Regulations 2014
[39] UK Water Industry Research. Chemical Investigations Programme Data Access Portal.
[40] Environment Agency. Water Industry National Environment Programme (WINEP)
[41] Challengeworks. Ofwat Innovation Fund

Source control - There are also non-technological options such as source control which aim to stop chemical substances from entering sewage sludge in the first place. Substances arise from commercial and industrial sources as 'trade effluent', but domestic sources are also big contributors. Water companies must manage trade effluent within the limits of existing regulatory frameworks and have little direct influence over the domestic realm. Engagement with regulators and policy makers is therefore needed to support and advance source control opportunities.

In the EU, the updated Urban Wastewater Treatment Directive (UWWTD) has introduced strong Extended Producer Responsibility (ExPR) measures as a mechanism to drive source control and more equitable outcomes for water customers by better proportioning the costs of treating chemical substances in wastewater (which can end up in biosolids) to those industries that produce them[42].

Water companies in England, Wales and Scotland will not benefit from the reallocation of costs away from water customers that these regulatory updates seek to provide, post-Brexit. At the time of writing, ExPR is undergoing legal challenge by the European pharmaceutical and cosmetics industries likely to be most impacted by the recast UWWTD, illustrating the challenges associated with the apportioning of responsibility and costs associated with treating commercial and industrial wastes[43].

[42] European Union. Directive (EU) 2024/3019 of the European Parliament and of the Council of 27 November 2024 concerning urban wastewater treatment (recast)

[43] European Federation of Pharmaceutical Industries and Associations. EFPIA begins legal proceedings in European court, to seek clarity on Urban Wastewater Treatment Directive. 10 March 2025


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