How to comply with your landspreading permit

TGN EPR 8.01

Version 5
February 2017

Document Owner: National Services/ Knowledge, Strategy & Planning

Version History:

Document Version	Date Published	Summary of Changes
1.0		
2.0		
3.0	February 2014	
4.0	October 2014	Rebrand to NRW
5.0	February 2017	• Improve formatting • Amendment of references of Environmental Permitting (England and Wales) Regulations 2010 to Environmental Permitting (England and Wales) Regulations 2016 • Amendment of references of Nitrate Pollution Prevention Regulations 2008 to The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules) • Amendment of references Code of Good Agricultural Practice/CoGAP to Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20) • Amendment of references of Forestry Commission to Natural Resources Wales • Amendment of references of WM2 to WM3

Published by:
Natural Resources Wales
Cambria House
29 Newport Road
Cardiff
CF24 0TP
0300 065 3000 (Mon-Fri, 8am - 6pm)

enquiries@naturalresourceswales.gov.uk

www.naturalresourceswales.gov.uk

Contents

Introduction 7
Operations and facilities covered by this guidance 7
Your Environmental Permit 8
Section 1: How to comply with your landspreading permit 9
1 Management 9
1.1 General Management 9
2 Operations 13
2.1 Permitted Activities 13
2.2 Waste Acceptance 27
2.3 Operating techniques 27
3 Emissions and Monitoring 27
3.1 Emissions to air, water or land 27
3.2 Emissions of Substances not controlled by emissions limits 28
3.3 Odour 29
3.4 Noise and vibration 30
4 Information 31
4.1 Reporting 31
4.2 Notifications 31
5 Directly Applicable Legislation 32
5.1 Duty of Care 32
5.2 Hazardous Waste Regulations (2005) 32
5.3 The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules) 33
5.4 Animal By-product Regulations (2011) 33
Section 2: Guidance and technical standards for deployment applications 34
1. Application to deploy 34
1.1 General Principles 34
2. Risk Assessments 35
2.1 Generic Risk Assessments 35
2.2 Site specific risk assessments 35
3. Location Plan 36
4. Waste and waste analysis 37
4.1 General Principles 37
4.2 Waste analysis 38
4.3 MCERTS for Waste soils 40
5. Soil and soil analysis 40
6. Demonstrating Waste Recovery without harm: The Benefit Statement 41
6.1 Appropriate Technical Expertise 42

6.2 Waste Recovery or Waste Disposal: General Principles 42
6.3 Agricultural Benefit 43
6.4 Ecological Improvement 44
6.5 Negative impacts of the application 45
6.6 Soil Substitutes and Soil Conditioners 46
6.7 Application rates 46
6.8 Mixed wastes streams and application rates 47
6.9 Levelling land 47
6.10 Method and timing of application 48
6.11 Multiple deployments 49
6.12 Repeat deployments 49
7. Making changes to deployments 49
8. Model Statement of agricultural benefit 49
Appendix A - Information on wastes for use in land spreading activities 59
Section 1: Wastes listed under SR2010 No. 4 only 59
02 Waste from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing 59
Wastes excluded from the revised Waste Framework Directive 63
Oil and Fat trap Wastes 70
Soils from the cleaning and washing of fruit and vegetables from agriculture and food preparation and processing 72
Sludges from onsite effluent treatment plants of food and drink waste 76
Sludge from biological treatment plants for food waste 77
Soil from cleaning and washing beet 78
03 Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard 86
04 Wastes from the leather and fur and textile industries 87
05 Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal .. 91
10 Waste from thermal processes 91
19 Wastes from the aerobic treatment of waste 96
20 Municipal wastes 96
Plant Tissue Waste only 97
Section 2: Wastes listed under SR2010 No4 and SR2010 No5 105
03 Waste from pulp, paper and cardboard production and processing 105
10 Waste from thermal processes 108
Waste gypsum 108
17 Construction and Demolitions wastes 114
19 Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use 120

19 05 Wastes from the aerobic treatment of waste 121
Section 3: Wastes listed under SR2010 No.5 only 133
19 Wastes from waste management facilities, offsite waste water treatment plants and the preparation of water intended for human consumption and water for industrial use 133
Section 4: Wastes listed under SR2010 No.6 139
Appendix B – Soils and Land treatment activities 142
1. Physical and chemical analysis 142
2. Soil descriptions 142
3. Sampling the soil, methods and frequency 144
3.1 Sampling the soil 144
4. Crop and plant requirements 146
4.1 Limiting plant nutrient levels 146
4.2 Adjusting the soil's chemical properties 147
4.2.1 Adjusting metals levels including PTE'S 147
4.2.2 Other metals not in the soils metals and PTE guidance 148
4.3 Adjusting soil pH 149
4.3.1 Effects of adjusting pH 149
4.3.2 Adding Liming materials to the soil 150
4.3.3 Comparing liming materials 150
4.3.4 Applications that use a liming material 151
4.3.5 Disease control using pH adjustment 152
5. Adjusting soil nutrients using soil indices as a guide 152
5.1 Nitrogen 152
5.1.2 Ammonia and nitrogen volatilisation 153
5.2 Phosphate adjustment 154
5.3 Potash adjustment 156
5.3.2 Building up and running down phosphorus and potash reserves in the soil 157
5.4 Magnesium adjustment 157
5.5 Sulphur adjustment 158
6. Adjusting the soils physical properties 159
6.1 Adjusting the soil's organic content 159
6.2 Improving the soil structure with gypsum 161
6.3 Adjusting the soil's carbon: nitrogen ratio 161
7. Adjusting the soil's water content 162
8. Metal additions to soils 163
8.1 Permissible levels 163
8.2 Typical top soil concentrations 166
8.3 The effects of metals in soils 166

Appendix C - Benefit statement template.....171
Appendix D – Glossary and further information 175
Glossary 175
Sources of additional information.....178

Introduction

Section 1: How to comply with your landspreading permit

Section 2: Guidance and technical standards for deployment applications

Appendix A: Information on waste for use in land treatment activities

Appendix B: Soils and Land Treatment activities

Appendix C: Benefit statement template

Appendix D: Glossary and further information

You must also follow the guidance on **How to comply with your environmental permit EPR 1.00**

How to Comply describes what you must do to control the risk of harm to health and pollution to the environment from most activities in the waste management industries.

This guidance is for businesses involved in spreading waste materials on land including:

- permit holders and their contractors
- waste producers
- land managers
- farmers on whose land waste is spread.

Landspreading can beneficially add organic matter to soil and reduce your reliance on manufactured fertilisers and quarried soil conditioners. This document will explain whether a landspreading operation is considered as recovery or disposal. It will tell you what you must do to ensure that the activity does not harm human health or the environment including soils, rivers, groundwater, animals and habitats.

A reference list of all documents and guidance specifically referred to in this technical guidance note is provided in **appendix D**.

Operations and facilities covered by this guidance

This technical guidance applies to waste to land operations which operate under a standard rules permit, a bespoke permit or U10 and U11 exemptions.

The table below sets out the standard rules permits to which this guidance applies.

Standard rule	Agricultural land	Non-agricultural land	Waste quantity limits
SR2010No4 (landspreading)	Yes	Yes	No more than 250t/ha. Exceptions are: Dredgings 5000t/ha soil from cleaning and washing of sugar beat 1500t/ha
SR2010No5 (reclamation/ restoration)	No – but some waste can be used to restore land back into agricultural production	Yes	No more than 5000t/ha.

SR2010No6 (sewage sludge)	Yes (used for production of non-food crops)	Yes	No more than 250t/ha.
The operations described in the standard rules permits above can be carried out using mobile plant. A mobile plant operation is defined in Regulation 2 of the Environmental Permitting (England and Wales) Regulations 2016			

Your Environmental Permit

Modern environmental permits describe the objectives and outcomes that must be achieved. They do not normally tell you how to achieve them. This gives you a degree of flexibility.

Where a permit condition requires you to take appropriate measures to secure a particular objective, we will expect you to use, as a minimum, the relevant measures described in this guidance. The measures set out in this guidance may not all be appropriate for a particular circumstance and you may implement equivalent measures that achieve the same objective. You may have to take additional measures to those set out in this guidance to ensure the objective is achieved. To see how we determine the requirements for a particular activity read our guidance on **setting the standards for environmental protection (RGN4)**

This guidance also explains what you have to do if you change your operating techniques.

Bespoke Permits

Your operation may not be able to meet the requirements of the standard rules, for example because you want to spread a waste types not listed in the standard permit. If this is the case then you may need to apply for a bespoke permit. For further advice contact your local Natural Resources Wales office or call 0300 065 3000.

Section 1: How to comply with your landspreading permit

This section provides further information on the permit conditions and minimum standards we would expect operators to adopt in order to demonstrate compliance with these permit conditions. This section is laid out in the same way as your environmental permit. If at any time you have concerns regarding compliance with your environmental permit you should contact your local Natural Resources Wales office.

1 Management

1.1 General Management

Who is the 'Operator'?

The operator is the person who holds the permit and has control over the landspreading operation. It is important that the operator/operators are correctly identified when applying for an environmental permit. In deciding whether someone is the operator of a regulated facility they must be able to exercise control over its operation. Please read **Regulatory guidance series EPR1 - Understanding the meaning of operator**.

A permit holder and operator for landspreading could be:

- a consultant
- land agent
- farmer
- waste contractor or waste broker.

The operator may contract out parts of the landspreading operation. For example using local agricultural contractors for field operations or using independent Fertiliser advisers certification and training scheme (FACTS) qualified agronomists for submission of deployment applications. The operator retains control of the operation and must be able to demonstrate this to us as part of their application.

The operator has the responsibility to ensure that the sub-contractor is familiar and can comply with the conditions in the permit and associated management plans (e.g. odour management plans, accident management plans) and any site specific documents in relation to the operation such as:

- the deployment application and benefit statement they are operating under
- record keeping
- any site specific risk assessment

Ultimately it is the operator's responsibility to comply with the conditions of any Environmental Permit. If at any time you are concerned that you cannot comply with the conditions of your permit or exemption please contact your local Natural Resources Wales office.

Environmental Management System (EMS)

Condition 1.1.1 requires the operator shall manage and operate the activity in accordance with a written management system. This means you must identify the risks that your activities pose to the environment and take all reasonable actions to prevent or minimise those risks. You will also need to be able to demonstrate that you are implementing your Environmental Management

System (EMS), that is, your control of your operations must be auditable. That means that your plans must be written down and you must keep good records.

General guidance of contents of an EMS can be found in the **How to comply** guidance

In the case of waste to land, your EMS needs to demonstrate the activity is a genuine recovery activity will not cause harm to human health or the environment. A landspreading operation can consist of several different activities and your EMS will need to consider the risks posed by all activities. These activities will commonly include but are not limited to: – management and training of contractors/subcontractors

- consideration of the source and nature of waste to be spread to land
- designing and constructing of waste storage facilities
- handling and discharging of waste into storage facilities
- selecting the receiving land
- spreading controls
- the method of application and selection
- handling and managing odorous wastes
- machinery calibration records to demonstrate accurate application.

Your management system will document and demonstrate how you plan to retain control over these activities. Box 1.1.1 details the basic general management measures that should be included in an EMS.

Box 1.1.1 General management measures

- Ensure that management and operational staff are aware of the causes and effects of pollution.
- Ensure that contractors and staff are aware of and understand the requirements of the key environmental legislation affecting waste to land operations e.g. the need for a permit for a groundwater activity (regulation 35(2) and schedule 22 of the Environmental Permitting (England and Wales) Regulations 2016). This will also include the circumstances under which a spreading operation may relate to a disposal rather than a recovery operation (For example spreading in unsuitable conditions such as waterlogged ground).
- Ensure that contractors and staff engaged in waste to land operations follow good practice e.g. **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and site safety procedures to minimise the risk of pollution to the environment or harm to human health.
- Undertake regular environmental and human health risk assessments of procedures and sites.
- Undertake regular inspection and maintenance of all mobile plant and equipment.
- Ensure that contractors and staff have and follow a documented emergency procedure for dealing with spillages of waste.
- Ensure that contractors and staff follow good practice and undertake routine plant inspection and maintenance of mobile plant used for waste to land operations to prevent spillage or leakage of oils, hydraulic fluids and fuels.

- Ensure contractors and staff know the critical points in waste to land operations where pollutants or potential nuisances could escape to the external environment so that protective measures may be put in place as soon as possible.
- Ensure all contractors and staff know where the particularly sensitive receptors are located, these should be mentioned in the benefit statement in the deployment application with location plans. They must be aware of what buffer zones there are for protection of watercourses and habitats or species.
- Ensure all contractors are aware of contingency arrangements available to them when conditions are unsuitable for spreading or land is not available. Spreading of wastes in unsuitable conditions may constitute a disposal activity.

Contingency planning

Your EMS should include contingency plans to take into account effects of adverse weather and operational disruptions that may prevent spreading from taking place (e.g. notifiable disease outbreaks). Short term disruptions may also have a detrimental effect on field operations and the potential to cause pollution, see box 1.1.3 for some examples of this.

During prolonged periods of adverse weather Natural Resources Wales may offer advice on the options available for land spreading of wastes. More details of whether 'extreme weather conditions' have been declared can be found on our website

Box 1.1.3 Contingency planning

Planning for short term interruptions to field operations can include:

Interruptions to field operations may result from:

- machinery breakdown
- accidents that may result in pollution to the environment – delivery problems
- adverse weather conditions
- staff shortages.

Interruptions are temporary setbacks that may have a relatively minor impact on the operation, never the less contingencies should be in place such as:

- repair or servicing contracts for machinery to enable repairs to be carried out quickly
- more than one machine available or machinery hired in
- extra storage either at the site of production, a suitably permitted site or in the field stack providing there is no risk of pollution and permitted quantities are not exceeded – available staff to cover sickness etc.

This list of examples is not exhaustive and other interruptions to field operations are possible.

To keep your management system up to date you should review its content regularly and in particular after any incidents or non-compliances. Once the root cause of any incident or non-compliance has been found the management system should be amended accordingly. We too will be looking to identify the management system failure in these cases.

Registration to a formally certified scheme such as ISO 14001 or EMAS, while valuable to identify continuous improvement, do not guarantee permit compliance. A basic management system, such as the **EMS Toolkit** may be sufficient for a landspreading operation, rather than an independently certified environmental management system (EMS).

Technically Competent Manager (TCM) and Nominated Competent Person (NCP)

Your EMS requires you to demonstrate that sufficient competent persons and resources are being used to maintain control over your activities. Where mobile plant is used the activity may take place some distance from the main office of the permit holder. Nominated Competent Person's (NCP) are only required where it would be physically impossible to supervise all of the deployments because of numbers and / or distance from the base of the TCM. Where deployment applications are countrywide the operator must be able to demonstrate that they have control of day to day operations through their management procedures and any written/contractual arrangements. This may require several NCPs. The management system should also show how the Technically Competent manager (TCM) has overall management of any nominated competent persons. If things go wrong it is the operator who holds the permit and who is ultimately liable.

The roles and responsibilities of the NCP are listed in box 1.1.2 below.

Box 1.1.2

Nominated Competent Person (NCP) requirements

As a minimum the NCP should have a direct line of contact to the TCM. The NCP should also have a copy of, and be familiar with:

- the relevant permit rules or conditions
- the operators management system
- the approved deployment form for all spreading operations they are supervising
- '**How to comply with your Environmental Permit'**
- 'Technical Guidance Note, No. EPR 8.01 – additional guidance for spreading waste to land operations'.

The NCP should also:

- ensure all storage and spreading is carried out in accordance with the above
- have sufficient authority to give or withdraw approval for spreading to go ahead at a particular time using dynamic risk assessment (for example taking into account prevailing weather conditions)
- be able to be on site within 2hrs when spreading is occurring and 4 hrs at any other time
- make sure that persons operating the equipment delivering the waste to the site have been briefed on where and how the waste must be stored prior to spreading
- make sure that persons operating the equipment to spread the waste are aware of any no spread or buffer zones and any measures that need to be taken to ensure that sensitive sites are protected
- raise any issues with the TCM to prevent permit breaches
- be the first responder to any incidents including noise, dust or odour issues if the TCM is unavailable

- report any incidents or non-conformances to the TCM.

Who can be the Nominated Competent Person?

This may be a direct employee of the company or may be a contractor or consultant provided there is a formal written contract in place stating the role and responsibilities of the Nominated Competent Person.

In a small business the Technically Competent Manager may also be the Nominated Competent Person.

What qualifications do they need?

They will need to demonstrate that they have had sufficient training in:

- waste management legislation and its requirements
- environmental Risk Assessment
- environmental protection measures
- the operator's management procedures.

This can be achieved through formal qualifications and / or through a documented in-house training programme. Evidence of qualifications should be documented as part of the management system.

Further guidance can be found in **RGN No.5 Operator Competence**

2 Operations

2.1 Permitted Activities

Your landspreading permits and exemptions must only be used for recovery activities only – not disposal.

2.1.1 R13: Storage of waste pending recovery to land

Waste can only be brought onto site and stored once the deployment application has been approved by Natural Resources Wales.

Place of storage

Permits for landspreading of waste allow the secure storage of waste at the place where it is to be used for land treatment only. The place of spreading is considered to be the place identified in any approved deployment form. Storage at an intermediate site not at the place of spreading is not authorised under these permits and will require a site based permit.

Duration of storage

Storage under these mobile plant permits allow the temporary storage of waste pending the appropriate timing or conditions for spreading during the 12 month deployment period only. Storage on farms should not be used as permanent stores to account for lack of storage at producer sites – storage is for the deployed waste types and amounts pending spreading only. At

the end of a deployment period any store should be empty as all waste should have been spread in this deployment period. Where all waste has not been spread (for example where conditions did not allow) the operator should contact their local Natural Resources Wales officer for advice.

If the storage facility used permanently stores waste a site based permit will be required for storage. Where a storage facility is being used to temporarily store a succession of waste it is, in effect, a permanent storage facility. Further information on what is meant by mobile plant can be found in **RGN2 – understanding the scope of mobile plant**

Purpose of storage

The waste must be suitable for direct use and must not undergo any significant biological, physical or chemical changes whilst being stored. Therefore the composition of waste to be spread must reflect the sample results submitted in the deployment application.

A landspreading permit cannot be used to further treat waste prior to spreading, this includes during the storage phase. Should further treatment of waste be required prior to the waste being spread to land the operator should discuss their requirements with their local Natural Resources Wales office. Alternatively the waste should be taken to a suitably licensed facility for treatment prior to spreading.

Storage of Mixed Wastes

Wastes can only be mixed to ease handling and spreading of the waste under the same deployment. If wastes are mixed and stored before use this must not be for treatment purposes. There should be no change in composition to the waste, for example significant changes in pH and metals availability. Any mixing should not cause wastes to react and must not pose a risk to human health or the environment. The stored wastes must remain appropriately mixed for the duration of the spreading operation to ensure even application to the receiving land, for example: the avoidance of striping across crops.

Multiple deployments at the same site

Where a single operator has multiple deployments at the same site with identical wastes these may be stored in the same container. Where a single operator has multiple deployments at the same site with different wastes these may be stored in separate containers.

Where multiple operators hold deployments at the same site operators must store their wastes in separate containers regardless of whether these wastes are the same.

Storage Requirements

All waste must be stored securely. All reasonable precautions should be taken to ensure waste cannot escape (e.g. leak from a container) and members of the public are unable to gain access to the waste.

The way the waste is stored must be suitable for its containment for example, a container, vessel, lagoon, impermeable base (with containment for effluent), in a roofed building, field heap or slurry store. All containers, tanks and lagoons should have secondary containment or alternative appropriate measures are in place to prevent any leaks or spills. Box 2.1.1 lists some appropriate storage measures however operators should be able to demonstrate that the method of

containment is appropriate for the waste being stored and that it is continually maintained. Table 2.1.1 also lists some of the benefits and risks associated with some common storage methods.

Box 2.1.1

Appropriate measures for storage of waste

Temporary field heaps/stockpiles:

Solid wastes (including stackable cakes) can be stockpiled however the operator must consider whether the stockpile/ heaps are open to the weather. In these cases:

- locate temporary stockpiles in areas of low permeability if at all practicable
- grade temporary stockpiles to promote rainwater run-off rather than infiltration into and through the stockpile
- manage all run-off or leachate which may be produced by the waste
- be aware that the heaps or stockpiles may slump and
- consider location of any residential property or workplace in relation to stockpiles that might be affected by loss of amenity or dust and odour

The following is best practice when wastes are stored in temporary stockpiles or field heaps:

- not on land likely to become waterlogged, frozen or snow covered
- no odorous waste within 250m of a residential property or workplace – not on land likely to flood
- not on steeply sloping ground where there is a risk of run off
- not in any single position, on bare soil, for more than 12 successive months or
- not over land drains or land drained in the last 12 months.

Further guidance on storage in field heaps can be found in Booklet 4 **'Storage of Organic Manure'** of the NVZ guidance booklets) and the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)**

Lagoons and Containers

All liquid waste with the potential to cause pollution should be stored in a secure impermeable lagoon/ container with secondary containment. Where secondary containment is not provided appropriate measures should be used to prevent and minimise leaks and spills.

Appropriate measures for fixed facilities

Appropriate measures for the storage of liquid wastes in fixed facilities are considered to be those detailed in the Water resources (control of pollution, silage, slurry and agricultural fuel oil) regulations 2010 (SSAFO). Operators should refer to the design and standards set out in the **Natural Resources Wales guidance for farmers factsheets** for details of the appropriate measures expected from liquid storage facilities used under landspreading permits and exemptions.

The storage capacity of the container/ lagoon must also be sufficient to ensure that the waste will not overflow and there is additional capacity to allow any rainfall or runoff inputs whilst providing adequate freeboard:

- an open topped storage container must have a freeboard of 0.3m.
- an earth banked lagoon must have a free board of 0.75m.

Table 2.1.1

Benefits and risks associated with storage techniques

Storage technique	Benefits	Risks
Field stock pile (solid wastes only	– Simple to use – easy to set up – close to spreading area – can be kept small with top up deliveries during spreading.	– Leachate pollution via land drains and surface run-off, odour and dust – pests and scavengers – mud and debris on the road from use or deliveries – may damage the soil through nutrient enrichment and by compaction and rutting from machinery – may be unsightly.
Purpose built lagoon or permanent tank (liquids and slurries)	– permanent engineered structure – constructed access.	– Potentially storing large volumes site security – rain water collection – may be remote to the parcel of land being spread – may not be well maintained – may not maintain adequate freeboard.
Mobile tanker (liquids and slurries)	– Flexible can be moved to prevent damage to the land – secure container – sealed tanks reduce odour.	– Site security – may damage the soil through nutrient enrichment at filling and draw off points and by compaction and rutting from machinery – mud and debris on the road from use or deliveries.
On field concrete pad/hard standing (solid wastes)	– Ease of handling for loading and unloading – less damaging to soil/land by compaction and rutting from machinery and delivery vehicles.	– Leachate containment and run-off if there is no effluent tank – odour – pests, scavengers, may be unsightly, – dust – mud and debris on the road from use or deliveries

		– may be remote from the spreading area.
Farm building or yard area/silage clamp/slurry store (Solid, liquids or slurries)	– contained leachate collection – accessible for loading and unloading – secure site.	– poor farm infrastructure may lead to pollution – the farm may be closer to sensitive receptors than the land to be spread – may be remote from the spreading area – odour, dust, pests and scavengers.

2.1.2 R10 Land Treatment resulting in benefit to agriculture or ecological improvement

Landspreading permits make a distinction between agricultural and non-agricultural land. This definition can be important when determining what permit to use and the acceptable waste types to be used. The glossary in **Appendix D** contains a detailed definition of agricultural land for the purposes of these permits.

SR2010 No.4: Landspreading for agricultural benefit/ecological improvement of agricultural and non-agricultural land

This permit should be used for the improvement of agricultural or non-agricultural land only – not the restoration of land.

SR2010 No.5: Landspreading for reclamation, restoration and improvement of land subject to industrial or other man-made development

This permit can only be used for landspreading on previously industrial or developed land. Deployments under this permit should intend and be designed to achieve restoration, reclamation or improvement of land to be used for agricultural or non-agricultural purposes. Once land has been successfully restored for either agricultural or non-agricultural purposes the land would be considered fully restored and would no longer require further restoration or reclamation activities. Therefore following successful deployment for the restoration, reclamation or improvement of land under this permit, any subsequent waste applications for ecological improvement or agricultural benefit should be deployed under SR2010 No.4.

Operations using wastes from table 2.3 of this permit must only be applying wastes to land not intended to be returned to agricultural use. Where necessary the operator must be able to supply confirmation of the intended future land use of sites wishing to benefit from this permit.

The **SNIFFER Code of Practice** for using recycled organic materials in land reclamation provides information on the uses of CLO, compost, biosolids, digestate and other organic wastes in land reclamation.

Agricultural Land

SR2010 No.5 differentiates between agricultural and non-agricultural end uses of land for certain wastes. Where crops or grassland are or could directly or indirectly link to the food chain this is considered to be an agricultural activity. This includes energy crops that may be used for anaerobic digestion where the digestate will be used for agricultural benefit on land. Similarly where energy crops or other non-food crops can fit onto an agricultural rotation this land is considered to be agricultural land. Under circumstances where energy crops are grown and there

is a significant investment of time and longevity to the activity this may be considered to be non-agricultural land, for example short rotation coppice grown as a fuel for 15 years or more. Please refer to **Appendix D** and contact your local environment officer if you require clarification or more information on whether land you are considering is agricultural or non-agricultural land.

SR2010 No.6: Landspreading of sewage sludge

The Sludge (Use in Agriculture) Regulations control the use of sludge on land used for agriculture. Agriculture is interpreted by these regulations as meaning the growing of all types of commercial food crops, including for stock-rearing purposes.

SR2010No6 is used to control the use of sludge on non-agricultural land or agricultural land where the land is used to grow non-food crops grown outside of an agricultural rotation.

2.1.2 Submitting a Deployment Application

Section 2 provides details on the guidance and technical standards for deployment applications and also details the requirements that must be fulfilled in order to demonstrate that the activity relates to waste recovery without causing harm.

Appendix A provides further information on specific waste streams listed on the permit and the potential benefits and negatives of these waste streams. Any potential negatives of proposed waste streams should be addressed in the deployment application form.

Form LPD1 and the associated guidance provide details on how to apply for a deployment.

2.1.3 Agricultural Benefit Statement and Appropriate Technical Expertise

Each deployment application must be accompanied with a benefit statement detailing how the activity relates to waste recovery by providing either agricultural benefit or ecological improvement. This statement should also address any risks posed by the activity and how these will be controlled. Operators should refer to **Section 2** for further information on the requirements of benefit statements.

2.1.4 – 2.1.6 Compliance with an approved deployment form
2.1.4 Starting your activities

The activities shall not begin at any site until Natural Resources Wales has agreed a deployment form in writing for that particular site. Where a deployment has expired and the operator intends to apply for a new deployment waste must not be taken to the site until the new deployment has been approved.

2.1.5 Complying with your approved deployment form

The activities shall only be carried out in accordance with the requirements of the agreed deployment form unless otherwise agreed in writing by Natural Resources Wales. If you have concerns over your ability to comply with your approved deployment form please contact your local Natural Resources Wales Office.

2.1.6 Records demonstrating compliance with rules 2.1.3, 2.1.4 and 2.1.5 shall be maintained.

Operators should be able to provide records demonstrating compliance with the approved deployment form. Where compliance cannot be demonstrated it may be concluded that you are not complying with your permit and agreed deployment form.

2.1.7 Carrying out the Spreading Activity

The amount and timing of waste applications is vital when ensuring that the spreading activity does not cause harm to human health or the environment. The measures in Box 2.1.7a below should be adopted when applying waste to land to minimise the loss of nutrients and potential pollutants to, inland fresh water, coastal and relevant territorial waters and groundwater.

Box 2.1.7a

Appropriate measures for the application of waste to land

- Spread the waste at a time when the soil or crop will need it and will provide optimal benefit to the soil or crop.
- Spread the waste when the weather and ground conditions are suitable to allow the waste to be incorporated into the soil and/or used by the crop. Wastes should not be spread on land that has been frozen for 12 hours or more, in the preceding 24 hours. Wastes should also not be spread on land which is waterlogged, frozen or snow covered.
- Spread the waste at the rates approved in the deployment farm to ensure that the minimum amount of waste is used to confer the intended benefit.
- Wastes must be spread in as accurate a manner as possible to achieve the deployment application rate.
- Machinery used to spread wastes must be appropriate for the physical state of the waste and the receiving land (e.g. to allow for slope, soil type and land use).
- Liquid and odorous wastes should not be spread using high trajectory splash plate equipment. Splash plates should be adjusted to produce a low trajectory spread pattern not exceeding 4 metres from ground level in accordance with leaflet 8 of the NVZ guidance
- do not apply on steep slopes where run-off is a high risk and
- where any liquid waste has been used on bare soil or stubble without being injected into the soil, it should be worked into the soil as soon as reasonably practicable and at the latest within 24 hours.

For additional information on best practices please refer to the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)**

Dynamic Risk Assessment

The dynamic management of risk is the continuous process of identifying hazards, assessing risks, taking action to eliminate or reduce risk, monitoring and reviewing, in the changing circumstances of an operation.

Whilst operations are being carried out you should use a dynamic risk assessment to ensure that the operations will not cause harm to the environment as circumstances change, for example:

- when spreading begins it might be dry but forecast rain may be heavier than anticipated and may lead you to suspend the operation to avoid the waste running off the fields into land drains or directly into a nearby watercourse

- if the waste has been stockpiled for a long period (several months) and you identify a potential for odour when you start to open the pile, you amend operations to reduce any impact on nearby human receptors.

Appropriate methods for applying waste to land

The method of spreading the waste(s) is an important factor in managing the potential for pollution and odour from the spreading activity. The box below shows common spreading techniques that can be used to apply waste to land, the method chosen should apply the waste accurately to the soil while minimising the potential for pollution caused by over application, poor spreading, run-off, odour, noise and dust.

Box 2.1.7b

Appropriate methods for the application of waste to land

The following methods are appropriate when spreading waste to land:

- surface application by manure spreader or liquid tanker and mobile irrigation unit
- surface application using band spreading methods, for example dribble bar, trailing shoe or trailing hose
- injection using deep or shallow injection with open or closed slot.

It is important to note that liquid and odorous wastes should not be spread using high trajectory splash plate equipment. Splash plates should be adjusted to produce a low trajectory spread pattern not exceeding 4 metres from ground level - see NVZ guidance booklet 8

For additional information on best practices please refer to the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)**

Further guidance can be found in Table 2.1.7 below regarding the benefits and risks of techniques for spreading waste to land.

Table 2.1.7 : Benefits and Risks of Spreading Techniques		
Spreading techniques	**Benefits**	**Risks**
Surface application – solids & semi-solids e.g. rota spreader, rear discharge spreader & dual purpose spreader	– Good spreading pattern can be achieved with a rear discharge spreader, less so with other methods. – Ammonia loss (NH3) – very low to moderate relative to %DM,% of total ammoniacal N (total ammonia N or TAN, ammonium-N + ammonia-N) in the material, and time of incorporation after spreading.	– Direct discharge into a surface water if spread too close. – Soil structural damage (e.g. rutting, compaction, etc.) if spread in inappropriate soil conditions. – Crop damage (e.g. smothering). – Odour. – Dust. – Pest and scavengers.
Surface application – low rate/low trajectory irrigators, and pulse jet irrigators.	– Can be used on established grassland. – Allows low application rates (<50 m3). – Spreading accuracy acceptable, subject to good management and supervision – Ammonia loss – low to moderate relative to % DM, % of total ammoniacal N in the effluent, droplet size and soil infiltration rate.	– Direct discharge into surface water if spread too close. – Run-off (including land drains where present) through poor supervision, use in inappropriate soil / weather conditions and through over-application. – Run-off due to a failure (e.g. where anti-pollution pressure and flow switches are not used or are broken). – Drainage to, and pollution of, groundwater and or groundwater-dependant surface water when spread in unsuitable soil/weather conditions or through over-application for conditions. – Nitrate leaching to groundwater during winter months. Amount relative in particular to: readily available N content, amount and date spread,

		%DM, soil type and effective rainfall after application (to end of soil drainage). – Pulse jet irrigator: potential wind drift (moderate breeze and above).
Surface application – high rate irrigators (rain guns)	– May increase risk of run off, drift and ammonia loss. – Reduced spreading accuracy and ponding of effluent.	– Ammonia loss – moderate to high relative to % DM, % of total ammoniacal N in the effluent/soil infiltration rate. – Direct discharge to surface water or through run-off where the application rate is greater than soil infiltration. – Run-off through land drains, where present and spread in inappropriate soil / weather conditions. – Pollution to groundwater and / or groundwater dependent surface water where application rate exceeds field capacity or the soil is cracked. – Nitrate leaching to groundwater during winter months. Amount relative in particular to: readily available N content, amount and date spread, % DM, soil type and effective rainfall after application (to end of soil drainage). – Aerosol spray.
Surface application – broadcast (non-precision) i.e. vacuum and pumped tanker fitted with a splash plate or nozzle	– Pumped tanker achieves improved spreading accuracy when fitted with a positive displacement pump.	– Major source of ammonia loss, particularly if the effluent is not incorporated immediately after application. – Crop damage.

		– Run-off (including through land drains where present) and soil structural damage where spread in inappropriate soil/weather conditions. – Nitrate leaching to groundwater during winter months. Amount relative in particular to: readily available N content, amount and date spread, % DM, soil type and effective rainfall after application (to end of soil drainage). – Aerosol spray (high trajectory). – Vacuum tanker may reduce spreading accuracy. – High trajectory (>4m above ground level) are considered higher risk relative to other spreading methods (e.g. due to drift, ammonia loss, lower accuracy, ponding, etc.).
Surface application – Precision i.e. band spreader & trailing shoe spreader	– Considered lower risk. – Ammonia loss – low, subject to good soil infiltration. – Allows low application rates (<50 m3). – Can be used in standing crops, such as arable and root using tramlines or rows, and on established grassland. – Low risk of crop damage. – Advanced band spreaders and trailing shoe spreaders achieve improved spreading accuracy, maximising nutrient use and minimising nutrient loss	– Run-off and soil structural damage where spread in inappropriate soil/weather conditions. – Tramlines and rows between crops may form a preferential pathway for runoff by acting as shallow ditches, made worse if planted down slope. – Nitrate leaching to groundwater during winter months. A mount relative in particular to: readily available N content, amount and date spread, % DM, soil type and effective rainfall after application (to end of soil drainage) Simple band spreaders provide reduced accuracy across spread width, relative to other spreading methods.

Sub-surface application – shallow injection (5-10 cm) Liquids and slurries only.	– Improved spreading accuracy in favourable soil conditions, maximising nutrient use and minimising nutrient loss. – Ammonia loss – low (open slot) to very low (closed slot), except when injected in very dry or stony soil where effluent is likely to break the surface. – Allows low application rates (<50 m3).	– Some crop damage. – High risk of run-off (in particular if injected down slope) and or drainage to land drains if applied in clay soils at or near to field capacity, even at low application rates. – Nitrate leaching to groundwater during winter months. Amount relative in particular to: readily available N content, amount and date spread, % DM, soil type and effective rainfall after application (to end of soil drainage). – Release of potent greenhouse gas emissions, such as nitrous oxide (N2O) and methane (CH4), where injected effluent concentrates in and around the injection slit and where anaerobic conditions develop – Spreading accuracy reduced in wet clay soils, where horizontal movement between injection slots is restricted by smearing and sealing of the clay by the disc.
Sub-surface application – deep injection (>15 cm) Liquids and slurries only **Caution: Deep injection is designed for soil that is sufficiently dry to enable the soil to loosen and fracture as the wing cuts through the soil. This**	– Recognised risk management technique when applying Animal By-products to land. – Reduction in odour potential.	– Significant crop damage (grassland). – Soil structural damage in wet soils – Light soils at or near field capacity: high risk of effluent draining beyond crop use and polluting groundwater/groundwater-dependant surface water. – Heavy soils at or close to field capacity: very high risk of polluting surface waters (via run-off, land

allows under high pressure (5-7 bar) injected effluent (in excess of 100 m3/ha) to move horizontally and achieve an acceptable spread pattern. As a result the method is unlikely to be suitable during the winter in all soils until the end of soil drainage and until the soil has sufficiently dried.		drains, smear channels, etc.). Also where soil is very dry and or cracked. – High risk of nitrate leaching to groundwater during winter months due to poor spread pattern and very high application rate. Amount relative in particular to: – readily available N content, amount and date spread, % DM, soil type and effective rainfall after application (to end of soil drainage). – Release of potent greenhouse gas emissions, nitrous oxide (N2O) and methane (CH4), where injected effluent concentrates in and around the injection slit and where anaerobic conditions develop. – Unacceptable loss through drainage and leaching, soil damage, etc., during the field capacity period and until the soil has sufficiently dried, likely to negate benefit. – Considered higher risk, due to reduced spreading accuracy and a very high application rate (>100 m3/ha). – Must not be used on soil that is shallow, overly stony or cracked (e.g. clay). – Wet soils at or near field capacity restrict horizontal movement, in particular clay soil, and have limited capacity to hold effluent against drainage. Risk of drainage is increased in such conditions as restricted horizontal movement causes an already very high application of

		effluent to concentrate around the wing, in particular in clay soils which smear and seal as the wing passes through the soil.

2.2 Waste Acceptance

Characterising your waste – knowing what you are dealing with

Operators of landspreading permits have a legal duty of care to know about the waste they are handling as identified by the EWC code and description on a waste transfer note.

Operators of landspreading permits are also required to identify all potentially beneficial and harmful properties of a waste in their deployment applications (see **Section 2**). This will often require obtaining additional information beyond that found on a waste transfer note. This information will help the operator to identify any potential problems that may arise from the storage, transport and spreading of the waste.

Physical state of the waste

You may need to consider whether a waste is liquid, sludge or solid. In these circumstances operators should refer to definitions of liquid, solid and sludge provided in the **guidance for waste acceptance at landfills**

Describing the waste using the List of Wastes Codes

'The List of Waste (England) Regulations 2005' and 'The List of Waste (Wales) Regulations 2005' transpose the European Waste Catalogue into law in England and Wales.

The standard rules permits contain lists of permitted wastes in table 2.2 and table 2.3 including the list of waste codes and descriptions. The waste descriptions are more prescriptive than those in the "List of Waste" catalogue to clarify what wastes are acceptable for spreading to land.

Note: It is the duty of the waste producer to describe and code the waste correctly. Codes should not be amended following removal from the site of production.

You must ensure that any waste received has the appropriate waste code and description as detailed in the permit and in the approved deployment form. Reliance on the waste code only is not sufficient.

Waste producers and operators should refer to **Appendix A** of this guidance for further clarification and definitions of waste descriptions included in these standard rules permits.

2.3 Operating techniques

This condition provides additional conditions for the storage of liquid wastes. For further guidance on the storage of liquid waste under these permits please refer to section 2.1 of this section - Permitted Activities.

3 Emissions and Monitoring

3.1 Emissions to air, water or land

Landspreading permits and exemptions do not allow the point source emissions to air or water courses. The only emissions to land permitted under these authorisations are the waste types and amounts listed in any exemption or agreed deployment form.

3.2 Emissions of Substances not controlled by emissions limits

Emissions from waste to land operations can include pollution of surface and groundwater, dust, aerosols from the delivery, storage and application of waste. Potential emissions from the waste should be controlled by implementing appropriate treatment measures on the site of production. All potential emissions from a deployment site should be addressed within your Environmental Management System and any risk assessment. You must consider the sources, pathways and receptors from each site, for example, land drains leading to watercourses.

Dust

Dust generated from the actual application of waste or the ancillary operations associated with the deployment may also impact sensitive environmental receptors and cause nuisance to humans. Further guidance on minimising dust and pests can be found in boxes 3.2a and 3.2b below.

Box 3.2a

Appropriate measures for reducing dust

The following measures should be taken into account when spreading wastes on land where dust has been identified as a potential issue:

- reduce the potential for dust generation by undertaking operations within suitable weather windows where possible
- manage loading operations from stockpiles to spreaders and unloading operations from delivery vehicles to stockpile to minimise dust generation
- keep stockpiles which have the potential to give rise to dust as small as possible
- locate potentially dusty material in sheltered areas if possible and consider covering with a suitable material or cover
- spread on stubbles or established grass, not on land undergoing cultivation with a broken surface
- implement speed limits for machinery haul routes
- avoid using headlands close to sensitive receptors when running on stubble or bare land
- traffic speeds should be minimised to reduce the generation of dust
- avoid spreading dusty wastes in close proximity of residential properties where dust may cause nuisance and other sensitive receptors were dust may deposit nutrients on sensitive habitats.

Scavengers, vermin and flies

Box 3.2b

Appropriate measures for reducing nuisance from scavengers, vermin and flies

The following measures should be taken into account when storing and spreading wastes on land where a potential for nuisance from scavengers, vermin or flies could occur:

- reduce the potential for scavenging, attracting vermin and fly breeding in stock piles by identifying wastes likely to attract flies, such as food wastes, wastes containing animal by-products and minimise the quantity stored, deliver and clear stockpiles daily
- locate loading operations, stockpiles/nurse tanks as far from human and environmental receptors as possible
- incorporate wastes with a potential to attract scavengers, vermin and flies within 24 hours of spreading on land for cultivation
- inject wastes with a potential to attract scavengers, vermin and flies into grassland and if applying this type of waste to established crops
- keep machinery clean
- conclude operations as quickly as possible treatments for flies including sprays can be applied to stock-piles.

The appropriate measures above are not an exhaustive list of measures and you may employ other management systems and measures to achieve the same outcomes of protecting environmental and human receptors.

3.3 Odour

There is a potential risk that spreading or storage of wastes may cause odour pollution beyond your “site”. When spreading waste to land it is important to take into consideration the type of waste and whether any odours associated with this waste is likely to cause pollution. All operators must have a written odour management plan in place available for inspection. In cases where the wastes being used are likely to be odorous, operators are required to have a site specific odour management plan that is specific to the deployment.

This written odour management plan must outline the receptors, risk to those receptors and what steps you will take to prevent pollution from odour. There are a number of appropriate measures available to control odour from the storage and spreading of wastes.

Box 3.3.a

Appropriate measures to control odour

In addition to the requirements in **How to comply with your environmental permit**, if waste is likely to cause an odour please take into consideration the following when storing or spreading wastes:

- direction of the wind when spreading and any sensitive receptors downwind including residential property and workplaces
- check the predominant wind direction to help determine the location of stockpiles
- avoid high trajectory spreading methods
- timing of application of waste to land
- avoiding spreading during bank holidays and weekends when odour may become a nuisance.

If odour has been identified as an issue, the first option should always be pre-treatment to reduce odour prior to field delivery. Other appropriate measures may include:

- covering any odorous waste stockpiles
- storing minimal quantities of waste at any one time (regular deliveries during the working day)
- incorporate odorous waste into the soil as soon as possible (within 24 hours) and/ or,
- undertake olfactory monitoring for odour throughout the working day.

Aerosols can also be odour vectors and are often associated with the techniques used in the spreading of liquid waste. Aerosol drift from waste applications should be avoided by adopting appropriate measures as detailed in Box 3.3b below. Where this cannot be achieved your odour management plan should describe the measures you intend to use to prevent nuisance to sensitive receptors from odour.

Box 3.3b

Appropriate measures for reducing aerosols

The following measures should be taken into account when spreading wastes on land where aerosols has been identified as a potential issue:

- reduce the potential for aerosol generation and drift by undertaking operations within suitable weather windows where possible
- manage the discharge from spreading machinery to minimise aerosol production such as reducing discharge pressures when operating splash plate spreading machines
- avoid spreading wastes which may produce aerosols in close proximity of residential properties where drifting aerosols may cause nuisance and other sensitive receptors were drifting aerosols may deposit nutrients on sensitive habitats.

Further guidance on spreading wastes can be found in Booklet 8 '**Field application of organic manures**' of the NVZ guidance booklets and the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)**

Further guidance on writing and implementing an odour management plan can be found in our **"Horizontal Guidance Series", H4 Odour Management Guidance**

3.4 Noise and vibration

Noise and vibration when spreading should not be above that of normal agricultural activities.

Your environmental risk assessment, undertaken in accordance with your Environmental Management System (see section 1.1.1), should have identified any sensitive receptors to the potential risk from noise and vibration from your waste operations and your proposed risk reduction measures.

"Horizontal Guidance Series", H3-Noise assessment and control provides more guidance on noise assessment, control and how to write a noise management plan.

4 Information

All records demonstrating compliance with the Environmental Management System (e.g. diary, TCM attendance, incidents etc.) shall be made available for inspection when requested.

Your environmental permit also requires you to keep records specifically relating to spreading activities and demonstrating compliance with your benefit statement. These records should also be available to an inspecting officer on request.

Box 4.1

Record keeping

In relation to each approved deployment application the following is a list of records which should be made available upon request:

- wastes applied
- records of quantity and application rates applied to notified land
- records to demonstrate compliance with storage limits (3000 tonnes)
- date(s) of application to land
- plan of locations
- benefit statement (Agricultural Benefit/ Ecological Improvement)
- soil analysis and waste analysis
- “Duty of Care” records.

4.1 Reporting

All waste returns, for waste spread, must be submitted to Natural Resources Wales using the relevant form no later than one month after the end of each quarter. Each quarter refers to January to March April to June July to September and October to December.

If no waste is spread in a quarter a nil return is still required to be submitted to Natural Resources Wales.

Waste return forms and guidance can be found on our website:

For technical help with the waste return submission form or to find out other ways to make your submission please contact our Customer Care Centre

4.2 Notifications

The phrase “without delay” means that you must notify us as a priority, as soon as is practicable.

If, during operations or associated monitoring, you discover any breakdowns or failures of equipment or techniques which have the potential to or are causing breaches of the limits or conditions specified in your permit, we expect you to notify us as soon as it is possible to do so.

Any results of samples taken or tests made that are submitted following such notifications must have passed any relevant laboratory quality assurance checks.

Significant adverse environmental effects include harm to any sensitive receptors and significant impacts on properties.

During normal working hours, you may be able to contact the site officer or the local Natural Resources Wales office by telephone, fax or email. You can also use Natural Resources Wales's pollution incident hotline, 0800 807060. Calls are free and the hotline operates 24 hours a day, seven days a week.

5 Directly Applicable Legislation

5.1 Duty of Care

Records shall be maintained to demonstrate that waste acceptance procedures are being followed correctly. These records should be available for inspection on request and need to show:

- the origins of the wastes accepted, including quantities, characteristics, delivery dates and the identity of the waste producer
- details of any rejected loads and the reasoning behind the rejection

All Duty of Care requirements must be met – further information on Duty of Care can be obtained via our website.

Box 5.1

Duty of Care - What you must do

Anyone who manages waste has a role to play under the Duty of Care, ensuring all other parties comply with the requirements.

To comply with the Duty of Care you must take reasonable steps to:

- prevent the escape of waste whilst you hold it, and while it is being held by others after being transferred
- provide the correct LoW code and written information which describes the waste when you transfer it to another person, sufficiently well to allow them to comply with their duties
- ensure that you only transfer waste to a person authorised to receive it
- prevent waste causing pollution or harm, both when it is under your control and subsequently under the control of those to whom the waste is transferred.

Failure to comply with 'Duty of Care' may lead to enforcement action under the Environmental Protection Act 1990 and the Environmental Permitting (England and Wales) Regulations 2016.

5.2 Hazardous Waste Regulations (2005)

If you transport or receive Hazardous Waste you will have to comply with the Hazardous Waste Regulations 2005. Mixing of hazardous waste can only be carried out if you hold an appropriate permit allowing you to do this and the activity must comply with Best Available Techniques (BAT). More information on the requirements under the Hazardous Waste Regulations 2005 can be found on the **Hazardous waste pages** of our website.

5.3 The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules)

All landspreading activities will have to comply, where applicable, with the requirements set out under Nitrate Vulnerable Zone (NVZ) Rules. More information on these rules can be obtained from the NVZ section of our website and the government website

5.4 Animal By-product Regulations (2011)

Animal By-products legislation controls the risks to human and animal health from the handling, treatment, storage and disposal of Animal By-products (ABP). If your landspreading operation includes the recovery to land of ABP, then Animal By-Product Regulations ABP controls may also apply to your activity. For example, the feeding of farmed animals with herbage, either directly by grazing or by feeding with cut herbage, from land to which ABP or ABP derived products has been applied can only take place after the expiry of a waiting period.

Please refer to the government website and the Defra website for more information on the Animal By-product Regulations.

Section 2: Guidance and technical standards for deployment applications

This section provides additional guidance about the information we require and the principles you should consider when making an application to deploy your mobile plant. This should be read in conjunction with the deployment application form LPD1 and the associated LPD1 Form Guidance.

1. Application to deploy

The deployment application is where you provide us with the information and justification regarding your land spreading activity. Before you commence any activity we must assess your deployment application and authorise you to deploy your mobile plant. Deployment applications must be submitted and completed with all the relevant information and correct fee attached. Once the application is accepted as being complete we then have 25 working days to assess the information contained in the application.

To enable us to process your application promptly the information should be provided in a format which enables us to process your application quickly and effectively. To help you do this we have provided a benefit template which we recommend you use, particularly for deployments made under SR2010No4, in appendix C.

1.1 General Principles

Box 1.1 sets out some of the general conditions and principles that should be considered when making a deployment application.

Box 1.1

General principles of deployment applications

- The application must demonstrate that the activity meets the principles of waste recovery as set out in RGN13
- The application must demonstrate that the activity will not cause harm to the environment or human health and for agricultural operations be carried out in line with the Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)
- A maximum of 10 waste streams may be notified per deployment
- Each individual waste stream must be notified with the List of Waste code and full description of the waste
- Each waste must be suitable for direct use without further treatment
- Mixing of waste should be for operational reasons only and not to treat, buffer, or ameliorate properties of a waste
- Analysis must be provided for each waste prior to any mixing
- Application rates must be established and justified in line with relevant standards, e.g. RB209
- Fields to be treated must be within a 10mile radius of a central address

- Soil analysis must be provided for each field or area of land to be treated
- a maximum area of 50 hectares may be treated per deployment
- the 50 hectares does not include buffer zones or areas of land which will not be spread to for a reason e.g. wooded area/ steeply sloping
- Previous waste applications and nutrient management in the previous 12 months must be identified and referenced
- Any environmentally sensitive sites within 500 metres must be identified.

2. Risk Assessments

The impact of storage and spreading of waste on a site must be considered for all sensitive receptors including harm to humans, soil, surface watercourses, groundwater, animals and habitats. In particular the activity must not:

- pose a risk to water, air, soil, plants or animals
- cause nuisance through noise or odours
- adversely affecting the countryside or sites of special interest which may include subsurface features such as karst limestone and cave systems.

A risk assessment must therefore be carried out for each deployment application. Further guidance on risk assessments can be found at **H1 Technical Guidance Note - Environmental risk assessments**

The type of risk assessment will depend on whether the activity takes place in a higher risk or lower risk location (this depends on the proximity to sensitive receptors - see Guidance for LPD1 for more information)

2.1 Generic Risk Assessments

Deployment applications in lower risk locations may be able to use the generic risk assessment to support their application and then undertake a dynamic risk assessment whilst operating:

The generic risk assessments do not need to be submitted to us but they may be useful in helping you decide if a site specific risk assessment is required and as the basis of your dynamic risk assessment during operations. Applications for spreading in higher risk locations, as set out in the LPD1 guidance must submit a Site Specific Risk Assessment with the deployment application.

Bespoke permits do not have generic risk assessments therefore you will have to submit a site specific risk assessment in all cases.

2.2 Site specific risk assessments

If any operation is within a Groundwater Source Protection Zone (SPZ) 2 and/or 500m of a European site (see section 2.6.4) or SSSI a site specific risk assessment must be submitted with your deployment application. We may also ask for a site specific risk assessment if we consider there to be other potential sensitive receptors. This risk assessment must describe the risks and the steps you will take to prevent any risk to these receptors

Box 2.2

Appropriate controls

The operational controls before, during (and in some cases after) applying waste greatly affects the potential impact of the waste-to-land activity. These controls may include:

- method of surface spreading
- buffer zones
- spreading at optimum time of the year for nutrient recovery
- shallow or deep injecting and,
- timeliness of incorporation into the soil following surface spreading.

See section 1 of this document for more information

Further guidance on environmental risk assessments can be found at **H1 Environmental risk assessments.**

3. Location Plan

A location plan must be submitted in the format described in the LPD1 Form Guidance. It should include the following, set out in box 3.1

Box 3.1

Deployment application requirements – additional information

The map must include the following details in relation to both storage and spreading:

- location of all storage sites for the waste to be spread
- any spring, well or borehole not used to supply water for domestic or food production purposes within 50m
- any spring, well or borehole used to supply water for domestic or food production purposes within 250m
- identify any European designated sites or SSSI which are within 500m of the location where the waste is to be stored or spread (please see section on designated environmentally sensitive sites for more information)
- the location of any other designated environmentally sensitive sites within 500m of the location where the waste is to be stored or spread (see section on designated environmentally sensitive sites for more information)
- the location of any public rights of way
- any groundwater source protection zones – surface water courses and
- any buildings or houses within 250m.

4. Waste and waste analysis

4.1 General Principles

The wastes listed in the standard rules sets for landspreading are very specifically described. This is to ensure that only wastes where we have satisfactory evidence showing that they can be suitably recovered to land are permitted to be spread. If you wish to spread a waste which is not listed on the standard rules you will need to apply for a bespoke permit and demonstrate that the waste can be suitably recovered to land.

What is a waste stream?

A maximum of 10 waste streams are permitted per deployment where a "waste stream" is defined as a single waste, for example 02-02-01 (untreated wash waters and sludges from washing and cleaning from abattoirs, poultry preparation plants, rendering plants or fish preparation plants), generated from a single site. Single waste streams that have been mixed together (for ease of storage or spreading) must be individually described and must be listed in the tables as separate “waste streams”. For example 02-02-01 (as above) and 02-01-01 (sludges from washing and cleaning produced food during food preparation and processing only) could be stored and spread together but must be described separately

When making an application to deploy there are some general principles regarding the wastes you intend to spread that you need to consider, as set out in box 4.1 below.

Box 4.1

Basic principles of waste to be spread

When an operator submits a waste to be spread under a deployment, the operator must ensure that the waste:

- is listed under the rules
- its description matches those listed in the permit
- is not hazardous - except in the case where the permit specifically lists a waste code that is hazardous because of its liming potential
- its benefits and potential negative impacts are known and have been described
- can provide a benefit to the soil or plants
- is suitable for direct use when brought to site and requires no further treatment prior to spreading
- can provide benefit in isolation to the soil or plants
- is analysed for parameters which are relevant to the waste types.
- analysis is done prior to mixing with any other waste.

It is important to remember that each waste must provide a benefit in its own right. Under no circumstances should other wastes or the soil be used to buffer or ameliorate the properties of a waste stream to make it suitable for use, e.g. using one waste to buffer or neutralise the acidic properties of another wastes. This may constitutes waste treatment. Wastes should only be mixed together for operational purposes.

4.2 Waste analysis

Without a recent analysis of the waste it is not possible to assess what nutrients and potential contaminants could be applied to land and what the benefits or potential negative impacts could be. The analysis of the waste must have been completed within 12 months of the deployment application date and should have been analysed in a laboratory with accredited methods. Analysis should be representative of the waste that is proposed to be spread and where there may be significant changes in the process or inputs producing the waste, analysis should be more recent.

In essence the waste that has been tested for should be the same waste that arrives on the site. The analysis should be supplied on laboratory data sheets.

The operator must:

- identify substances that are or may be reasonably expected to be present in that waste. This includes justification of the substances tested for and where appropriate, where substance have not been tested for
- provide evidence of the nutrients or properties that the waste contains that will confer agricultural benefit or ecological improvement to the land to which it is being applied
- provide evidence of the potential contaminants that the waste contains that may cause potential disbenefit to a crop or to the land to which it is being applied
- provide evidence that the application of the waste will not cause the concentration of potentially toxic elements (PTE's) to build up to significant levels and
- include a description of the type of sampling and analysis undertaken to quantify the concentrations of substances present in the waste.

In identifying what materials may be present and what to test for then you should gather as much information as possible in to the relevant processes and inputs that went in to producing the waste. The best source of this information is the waste producer themselves and you should consider visiting the producer site to fully understand all risks associated with the waste as a result of the inputs and processes. **Appendix A** of this guidance document and other relevant reference sources will also help you.

Once you have identified all the constituents of the waste, you should assess the potential for benefit or harm against recommendation manuals e.g. RB209**,** published thresholds e.g. PAS 100**,** Code of practice for agricultural use of sewage sludge**,** published literature, and professional judgement.

The decision on what to test for and against what criteria is the responsibility of the applicant. However, we may require further analysis if we consider that the testing does not provide enough information or an accurate characterisation of the waste.

We will make an assessment based on the information provided, on our own professional knowledge, and against established standards. When approving a deployment application this is not a guarantee that the use of this material is safe. A new or previously unidentified issue with the waste may arise such as a new hazard or property which was not disclosed in the application. Therefore it is vital that a thorough assessment of the waste is made, particularly when considering that some materials may be taken up by plants and bioaccumulate in the food chain.

Box 4.2 sets out some of the typical analysis suites and parameters that we would expect to see:

Box 4.2 **Typical analysis suite and parameters**	
Suite	**Potential Parameters**
Nutrients	Nitrogen Phosphate Potassium Magnesium Sulphur
Physical properties	%dry matter % organic matter
Chemical properties	Neutralising value Conductivity pH
Metals (PTE's)	all those set out in **Code of practice for agricultural use of sewage sludge**
Organics	dioxins PAH's
Pathogens - to demonstrate biologically active waste is sanitised	E. coli Salmonella
Physical contaminants – particularly important in compost to demonstrate material is fit for use	Metal Glass Plastic
Other contaminants	Notifiable disease Noxious weeds
Waste specific analysis	C:N ratio in composts Sodium levels in salty wastes Demonstration of waste stability, e.g. for compost

The list above is not a prescriptive, exhaustive, or a minimum requirement list of what to test for. Analysis requirements depend on the processes and inputs that went into forming the waste.

For all deployment applications the analysis must include:

- the date when sampled
- the sampling methodology and,
- details of the laboratory that carried out the analysis.

If waste streams are being mixed prior to spreading for operational or logistical purposes, individual waste analysis must be provided to identify the contents and characteristics of the waste in its own right.

You should always consider the analysis yourself prior to submission on your deployment application, especially where you are not the waste producer. The analysis may show high levels of certain substances or contamination with unsuitable waste types. For example in compost analysis

Peaks in the sulphur content can indicate the inclusion of plasterboard or gypsum,

Peaks in PTE levels such as copper, nickel, arsenic can indicate treated timber products have been included

Peaks in organic compounds can indicate liquid wastes have been included.

4.3 MCERTS for Waste soils

When submitting data on waste soils, Natural Resources Wales only accepts data from methods that have been approved under Natural Resources Wales Monitoring and Certification Scheme (MCERTS). The performance standard is applicable to all laboratories and procurers of analytical services where results generated for the chemical testing of soil are submitted to the Agency for regulatory purposes.

The **MCERTS Performance Standard for Laboratories Undertaking the Chemical Testing of Soil (Version 4)** has been published, and provides an application of the European and International standard BS EN ISO/IEC 17025:2000 (accredited by United Kingdom Accreditation Service (UKAS)) specifically for the chemical testing of soil.

It is good practice, but not a requirement, to also apply this approach to the testing of receiving soils.

5. Soil and soil analysis

An accurate and representative soil analysis is an integral part of the determination process. This enables the benefits provided by the waste to be quantified in terms of nutrients or soil properties which require amendment.

Where a soil has been subject to a previous deployment or similar operation, i.e. through the addition of sewage sludge, then analysis supplied for any new or subsequent deployment application should be representative of the soil. For example, if previous analysis showed PTE's to be approaching threshold values, then new analysis of this parameter would be required.

The analysis of the soil also helps in understanding the influence applied materials will have on the nutrient reserves and availability as well as the behaviour of any trace minerals and PTE's. Box 5.1 sets out some of the typical analysis suites we would expect.

Box 5.1

Typical analysis suite and parameters

Suite	Potential Parameters
Soil Type	Where appropriate the type should be consistent with those set out in **RB209**
Soil Indices	Phosphate Potassium

	Magnesium
Physical Properties	% organic matter
Chemical Properties	pH
Metals (PTE's)	all those set out in the **Code of practice for agricultural use of sewage sludge**

Again, as with waste analysis, the list above is not a prescriptive, exhaustive, or minimum requirement list of what to test for and is dependent on what is in the waste and the benefit being claimed.

In most cases it is important not to exceed the specified limits of concentration of PTE's in soil as set out in the **Code of practice for agricultural use of sewage sludge** following treatment of the soil with a waste and you should consider this when deciding whether to test for them. Box 5.2 sets out some of the factors to consider regarding testing soils for PTE levels. In most cases it is likely that analysis for PTE's will be required.

Box 5.2

Factors affecting the requirement to test receiving soils for PTE's

Soil testing for PTE's will be influenced by the:

- presence and concentration of PTE's in the waste
- the application rate of the waste (total PTE addition to the land) and,
- the previous and current land use is there a history of waste, sewage sludge or slurry applications to the land?

The soil analysis for PTE's must be representative of the area.

The type and extent of any analysis should always be justified. You should seek advice on type and extent of analysis from a person with the appropriate technical expertise, as outlined in the **section 1** of this document. **Appendix B** - soils and land treatment activities provides more information on Soil descriptions, adjusting the soils properties and guidance on the effects of metals in soils.

6. Demonstrating Waste Recovery without harm: The Benefit Statement

A deployment application must contain an assessment that shows that benefit will be conferred by spreading of the waste. The assessment shall be made by a person with appropriate technical expertise and contain evidence demonstrating the reasons for their opinion.

The benefit statement uses the soil analysis, waste analysis and intended end-use of the land (e.g. cropping regimes) to describe the benefits and improvements that the spreading of waste provides. The statement should describe any potential negative impacts the activity may impart to the receiving soil and surrounding environment and include the operator's management and operational procedures to manage and prevent such impacts before, during and after the activity.

We must make a thorough assessment of the benefit statement and extract the relevant information from it to enable us to assess the deployment application. To allow us to assess this information in a timely manner we provide a template of a benefit statement in **appendix C** which we recommend you to use when making your application.

6.1 Appropriate Technical Expertise

An individual writing a benefit statement for the deployment application must have the appropriate technical expertise which may include qualifications, professional experience or vocational qualifications to be deemed qualified. Details of the relevant qualification and experience must be included in the statement.

The preferred qualification for operations resulting in agricultural benefit is training and certification on the BASIS Fertiliser Advisers Certification and Training Scheme (FACTS), though we will consider statements prepared by people with relevant academic qualifications, vocational experience, or relevant professional membership. For operations resulting in ecological benefit there is no preferred qualification but we would expect those people preparing statements to hold relevant qualifications, experience, or professional membership.

6.2 Waste Recovery or Waste Disposal: General Principles

The spreading of waste to land for agricultural or ecological benefit is a waste recovery activity. The benefit statement must demonstrate that the activity is a waste recovery and not a waste disposal operation. We use the criteria outlined below in box 6.1 to determine if the activity is a genuine waste recovery operation rather than waste disposal

Box 6.2

Waste Recovery vs. Waste Disposal

Waste recovery is about using waste to replace other non-waste materials to achieve a beneficial outcome in an environmentally sound manner. In other words, a material that would be otherwise disposed of is put to a beneficial use, which saves the use of non-waste materials. Justification for a recovery activity must include positive responses to all the following questions:

Is there a clear benefit from the activity?

You will need to consider the scale of the operation in relation to the level of benefit achieved. If an activity involves the deposit of large quantities of waste on land where the derived benefit was too small to measure, this may indicate the activity is disposal.

Is the recovered material suitable for its intended use?

The waste must be suitable for the intended purpose – this is demonstrated in this case by a person with the appropriate technical expertise detailing why the waste is suitable for conferring benefit to the land. Note that it is unlikely that materials will be suitable for recovery where, once deposited, they pose a risk to human health, animal health or the environment.

Is the minimum amount of waste being used to achieve the intended benefit?

You must demonstrate that the application rates or the volume of waste used is no more than needed to confer the intended benefit or improvement (for example meeting crop need). If waste is applied in excess of what is required then this may be viewed as disposal unless sufficient justification can be given. Where volumes of waste are referred to for land restoration, plans showing the scale of the project with the intended final levels must be provided.

Is the waste being used as a substitute for a non-waste material?

It is common in the landspreading industry for large industrial processes and waste management processes to rely on landspreading as a major outlet for their waste streams. These processes will not respect the timing in which the landspreading industry requires waste for use. It is important that the operator is able to demonstrate that the waste is substituting a non-waste material and that the waste equivalent is being used in the same way. For example, artificial fertiliser is applied at a time when the crop can use it and in amounts that the crop can take up. A waste recovery operation would be expected to operate in the same manner, with the waste being applied when the crop can take up the material, at periods of crop growth and in amounts that can be taken up. Application of waste in inappropriate times and conditions or at excessive rates is likely to fail the recovery test

Where industrial processes are operating and producing wastes all year round the operator should identify suitable storage arrangements that will allow wastes to be stored until the wastes can be used at the appropriate time and rate.

Will the proposal be completed to an appropriate standard?

Ultimately for landspreading the agreed standard is the deployment application that has been assessed and issued. Any deviation from this which has not been agreed is likely to be viewed as disposal.

More information on the definition of waste recovery and disposal can be found in **RGN 13: Defining waste recovery**

6.3 Agricultural Benefit

The statement must show how the spreading of the waste will result in agricultural benefit to the land if this is the benefit claimed. We use the criteria set out in boxes 6.2 in assessing whether the proposed waste application will provide this benefit.

Box 6.3

Agricultural benefit

Agricultural benefit is the application of waste for the physical, chemical and biological improvement of the soil to support growth. It must be for the purpose of providing,

maintaining or improving the soil's ability to provide a suitable growing medium. Agricultural benefit also extends to the benefit for other plants e.g. commercial timber crops for biomass.

Benefit should be assessed against the following criteria:

- plant nutrient requirements (e.g. nitrogen, phosphorus, potassium, magnesium),
- timing and amount to be applied
- soil chemical properties (e.g. liming and pH)
- soil physical properties (e.g. organic matter and soil structure)
- soil water content and/or,
- levelling the land.

DEFRA fertiliser manual RB209 recommends setting nutrient levels at the economic optimum for crop production.

If an applicant wants to set plant nutrient levels above the levels recommended by RB209, they should:

- justify the nutrient level with appropriate technical expertise
- include the nutrient level in their environmental risk assessment and,
- state the source of information that they used to set the nutrient level.

6.4 Ecological Improvement

The statement must show how the spreading of the waste will result in benefit or ecological improvement to the land if this is the relevant benefit being claimed. We use the criteria set out in box 6.4 in assessing whether the proposed waste application will provide this benefit.

Box 6.4

Ecological improvement

Ecological improvement must be for the purposes of providing, maintaining or improving the soils ability to provide a growing medium.

Benefit should be assessed using the following criteria:

- maintenance and improvement of existing habitats and their bio-diversity – provision of new habitats
- prevent deterioration of habitats
- development or restoration of existing habitats to give greater biodiversity and sustainability
- development and maintenance of landscaped, amenity and recreation sites.

Reclamation of derelict or degraded land

Restoration of mineral extraction or waste management facilities, provided that the land has no existing conservation value and the land is not a specialised habitat The above improvements for habitats may also include assessment against the same criteria outlined above for agricultural benefit i.e. the physical, chemical and biological enhancement of the soil to create or support a habitat.

Existing habitats must not be damaged in the process

When a waste-to-land activity seeks to create a habitat, the operator is advised to consult with the appropriate conservation agency.

When another criterion is used to justify benefit to agricultural or non-agricultural land this must be based on sound scientific evidence and the operator must justify this benefit with appropriate technical expertise.

6.5 Negative impacts of the application

The statement must also describe any potential negative impacts and how these will be managed. Box 6.5 outlines some of the negative impacts that may occur. This list is not exhaustive and there are other potential impacts that you may need to consider.

Box 6.5

Potential negative impacts

The operator should address any potential negative impacts of the waste-to-land activity in the benefit statement. Operators may be asked to provide more information if the benefit statement does not adequately address a particular hazard identified during the assessment process.

Negative impacts may occur if the waste analysis indicates a substance's presence has the potential to:

- adversely affect soil health or plant growth,
- cause contamination or pollution to the wider environment
- impact on human receptors.

Some negative impacts from waste-to-land activities are:

- excessive nutrients that are not required by the current crop and could leach into watercourses or groundwater and cause pollution or eutrophication. For example phosphorus additions at above recommended index levels and in excess of any rotational crop off-take
- excessive metals accumulation that could result in plant or animal toxicity
- a pH change that decreases crop yields or causes an undesired change to plant communities
- excessive application rates of waste that may smother plants or cause run-off
- compounds, pests and pathogens at levels that stunt or kill plants
- odours from spreading the waste

- soil compaction or rutting by the machinery that applies the waste, which could hinder farm operations and result in increased risk of runoff and soil erosion
- physical contaminants such as plastics and,
- organic materials or other materials with high biochemical oxygen demand entering surface watercourses.

6.6 Soil Substitutes and Soil Conditioners

There are also some principles to consider when using soil substitutes and soil conditioners for ecological benefit under a SR2010 No5 or similar bespoke mobile plant for land reclamation, restoration or improvement as outlined in Box 6.6

Box 6.6

Soil Substitutes and soil conditioners for ecological benefit under SR2010 No5 or bespoke mobile plant for land reclamation, restoration, or improvement.

When proposing to use a soil substitute or soil conditioner it is important to know the difference between them.

- A soil substitute is used to create a soil where there is no existing soil profile.
- A soil conditioner is used to improve an existing soil profile. Further advice on this can be found in **appendix A**.

When using a soil substitute in isolation or with other wastes to create a new soil profile, the resultant soil profile should meet the standards set out in the **Code of practice for agricultural use of sewage sludge** and the **British Standard for topsoil** which includes carrying out a site specific risk assessment of the source of the soil.

When using a waste as a soil conditioner to treat an existing soil there must be an improvement to that soil. For example the addition of a waste to enrich a soil should not cause resultant PTE's levels to exceed threshold values. Where PTE levels in a soil are already in excess there should be no further increase in levels.

6.7 Application rates

The statement should describe the proposed application rate for each proposed waste stream. For applications under SR2010 No4 and relevant bespoke permits we use RB209 to identify the need of the receiving soil or crop.

The principles regarding application rates under SR2010 No4 are set out in Box 6.5

Box 6.7

Application rates under SR2010 No4

Total application rates should not exceed:

- 250 Kg Total N /ha

- 250 tonnes/ha (In the case of soil from washing and cleaning sugar beet (02 04 01) 1,500 tonnes per hectare; and In the case of dredging spoil from inland waters, (17 05 06) 5000 tonnes per hectare)
- Where a waste contains metals, specifically those classed as potentially toxic elements (PTE's) under the Code of practice for agricultural use of sewage sludge, the waste application rates must not allow the maximum concentrations referred to in the regulations to be exceeded.
- crop nutrient requirement as identified in RB209.

Wastes should not be applied in excess of crop or soil need as this may not meet the principles of waste recovery. (Box 6.2) However, in some circumstances certain nutrients can be applied in excess of need to build up soil indices as described in RB209. There must be an agronomic justification for this and it would be expected that this would form part of a whole farm nutrient management plan. Where applications rates are excessively high or if the land has been subject to an over application of nutrients in a previous deployment or through addition of other materials, for example sewage sludge, it is unlikely that further over applications can be justified. This is particularly relevant to additions of phosphate and further guidance on this can be found in **appendix B** - soils and land treatment activities.

6.8 Mixed wastes streams and application rates

We allow up to ten waste streams in a single deployment application. Each waste (notified in the relevant section of a deployment application) must confer benefit to the receiving land at the proposed spreading rate, without risk of breaching the rules and objectives in your permit which should be detailed in the benefit statement. Mixing can only be for operational purposes and any risks associated with the use and incidental mixing of the wastes should also be covered. This includes the risks of mixing with other wastes listed on a different deployment application for the same piece of land. Where an operator has submitted more than one deployment application for the same parcel of land, he should clearly state this in the benefit statement.

For multiple waste streams each waste must be able to convey a benefit in its own right and application rates must be established for each waste. The actual application rates for mixtures of waste must be based on the ratio of each individual waste stream. If this is not known then the waste stream with the highest nutrient, Potentially Toxic Element (PTE) or other limiting parameter must be used as the maximum application rate allowed to be spread, i.e. the waste will be spread at the lowest application rate.

6.9 Levelling land

Levelling land can be of benefit to agricultural operations by bringing unusable areas of a field into production e.g. by replacing areas of eroded soil. A landspreading permit cannot be used to solely raise the level of the land without any resulting agricultural benefits or ecological improvement.

For an operation to be a recovery operation, the limiting factor for land-levelling is typically the proposed depth of the applied waste.

Landspreading for agricultural benefit or ecological improvement typically refers to any method of applying waste to the surface of the soil or directly within the body of the soil (rooting zone). This should normally involve even spreading of waste to confer an

agricultural benefit across the area identified in the deployment application. Waste should typically be spread in a shallow layer so that normal agricultural operations can incorporate the material into the agricultural soil profile (such as by ploughing and subsoil operations).

For wastes on landspreading permits limited to 250t/ha this equates to depths of approximately 0.025m of soil. Some wastes allow greater volumes of waste to be spread allowing maximum depths of up to approximately 0.5m.

Levelling land **Spreading volumes and depths**
– 1 hectare = 10,000m2 – at 250t/ha spread depth is 0.025m e.g. soil – at 1500t/ha spread depth is 0.15m e.g. sugar beet soil – at 5000t/ha spread depth is 0.5m e.g. dredgings – The depths achieved using other wastes will depend on waste type and the bulk density of the waste (kg/m3). – 'Spreading' means any method of applying waste to the surface of the soil or directly within the body of the soil (rooting zone).

Spot Treatment

These depths are based on the maximum spreading rates under landspreading permits. They are guidelines and in some circumstances it may be possible to spread waste at greater depths over a smaller area and the work should be completed within the life of the deployment. For example spot treatments for small eroded areas of fields where the depth of soil required may exceed these guidelines. It is important to consider that these permits are for landspreading and not for landfilling.

Operations under SR2010 No.5 allow the spreading of waste to previously developed land and can include both improvement of land and creation of a soil profile where there is no existing soil profile on the site.

6.10 Method and timing of application

The principles of waste recovery should be considered when outlining the method and timing of waste applications.

The method of application should be appropriate for the waste type and crop to ensure a benefit is bestowed and to meet the principles of waste recovery. Spreading wastes in a manner that is operationally unsound would go against the principles of recovery, for example:

- spreading solid wastes that smother crops
- spreading liquid wastes that cause scorch and
- spreading oily wastes that coat the crop or soil particles.

The timing of the application must also be appropriate. Under the principles of waste recovery the waste is substituting for a non waste product so there is a presumption that

waste will be only be spread at a time when a non waste would be, for example during the crop growing season. Spreading a waste in inappropriate conditions or out of a crop growing season may constitute disposal. You should clarify in your deployment application when and how often you intend to spread the waste. Stating that waste will be spread over a 365 day window according to crop requirement is not acceptable.

6.11 Multiple deployments

Where an operator is submitting 2 or more deployments for the same area of land due to the number of waste streams available, each benefit statement must draw reference to the other.

6.12 Repeat deployments

If the deployment application is a repeat of the previous year's application, for the same land, this should be referenced in the benefit statement. If the deployment is claiming a nutrient benefit you should ensure that the crop need is still present for that nutrient.

7. Making changes to deployments

Deployment applications assessed by Natural Resources Wales are approved in writing once they have been assessed. Once a deployment is approved in writing it is not possible to, for example add new wastes to an existing deployment.

Any deviation from the activity described in the deployment will need to be risk assessed. Deviations from an agreed deployment which change the risk or charge band already agreed will require a new deployment application to be submitted.

Changes to the following will require a new deployment application:

- addition of approved wastes
- increases to the application rate of an approved waste
- changes to the ratios of mixtures of approved wastes
- adding extra land to the agreed area notified.

Operational changes which may be allowed provided adequate written risk assessments are provided include:

- change in application method, for example change from injection to surface spreading with following incorporation
- re-location of stockpiles for operational reasons.

Such operational changes would have to be agreed with the local area office.

8. Model Statement of agricultural benefit

We have set out a model statement of agricultural benefit using our template below along with accompanying information. A blank template is available in **appendix C** should you wish to supply information to us in a similar format

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

1.1 Person with appropriate technical expertise and permit details

Mr A N Other (ABC Recycling Ltd).

BSc Agriculture, FACTS (registration number `).

I have worked in the agricultural industry for the past 15 years providing agronomy advice on arable cropping and soil management, and the recycling of materials to land as a consultant with ABC Recycling Ltd for the last 5 years.

This deployment application is being made under Natural Resources Wales permit number XXXXX.

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

1.2 Where the waste is to be spread

Farm address: XYZ Farm, Little Spreading, AB3 4DC.

Stock pile grid reference: NY123456, 654321 – Area of the receiving land: 10 Hectares.

Quantity to be stored at any one time: 100 cubic metres, this is restricted by the size of the mobile field storage tank.

Total quantity to be spread: 2000 tonnes.

Location maps showing the field and receptors, temporary tank position and spreading control measures: Map 1.

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

1.3 What is the waste to be spread

Waste producer: Sludge from washing and cleaning at ABC Abattoir, Anytown, Countyshire, AB1 2CD.

EWC code: 02-02-01.

Waste description: Untreated wash water sludge from the cleaning down of ABC's slaughter house buildings containing animal excrement wastes. – Additional information:

Manure and slurry from abattoirs is the only category 2 ABPR material exempt from the requirement to be stored on a designated category 2 plant and can be handled and stored without approval.

The waste is the sludge collected from the settlement of wash water in the site effluent tank.

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

1.4 Operational details

The current crop is winter barley with an expected yield of 7.5t/ha to be followed by winter oilseed rape, the barley straw is to be removed from the field for sale as feed/bedding straw.

Spreading is to take place following harvest and straw removal, running machinery on the stubble to reduce surface damage and compaction caused by the field operations.

The sealed storage tank is to be situated at the top of the field adjacent to the farms access track to allow vehicular access without causing undue compaction or rutting to the land (see map).

Spreading is by umbilical supplied shallow injection, placing the material in the top 100mm of the soil, reducing volatilisation, nutrient loss and odour, spread width is approximately 6 metres.

Minimal cultivation techniques are to be employed to sow the OSR crop, targeted sub-soiling on the headlands and heavily trafficked areas will be accompanied by direct drilling into the stubble.

The stubble is to be left to protect the emerging seedlings from both adverse weather and pigeons.

No spreading will be undertaken in the areas identified for sub-soiling (headlands and heavily trafficked areas) to prevent run-off.

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

1.5 Compliance with NVZ requirements

The site falls within a designated Nitrate Vulnerable Zone, compliance with the requirement for incorporation of slurry on bare land or stubble will be achieved with shallow injection (section 8 in NVZ Guidance Leaflet 8).

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

1.6 Benefits and nutrients supplied to the soil or crop from this application

Wash water from the clean down process at ABC Abattoir contains moderate levels of nitrogen and small quantities of phosphate, potash, magnesium and sulphur. The table below shows the total nutrients supplied based on the waste analysis supplied (see Waste Analysis document supplied with the application).

Nutrients supplied by the waste (kg/Ha)					
Application Rate (t/Ha)	Nitrogen (kg/ha)	Phosphate (kg/ha)	Potash (kg/ha)	Magnesium (kg/ha)	Sulphur (kg/ha)
200	166 20% available	9	21	3	15

The application provides 200 kg/ha of nitrogen of which only 20% is readily available to the crop, this provides 33.2 kg/Ha of available nitrogen in the seed bed for the following OSR crop.

The next crop in the farms rotation is winter oilseed rape, the table below shows the nutrient requirement for winter oilseed rape on a silt clay loam soil with an SNS of 1.

Crop requirements for winter OSR based on RB209: soil indices & SNS in kg/Ha					
Crop	Nitrogen	Phosphate	Potash	Magnesium	Sulphur
Winter OSR	SNS 1 Seed bed	Index 1	Index 2-	Index 3	RB209 deficiency map
Nutrient Requirement	30	75	40	0	25

The waste has a total solids analysis of 2.5% this will supply 6t/Ha of solid material to the soil, this acts in a similar way to farm manures applied to land and will contribute to the soil as an organic conditioner and to the soil nutrient reservoir. Nutrients held in the solid fraction will become available to following crops as they are released. The magnesium index is 3 which indicate the crop has no requirement for magnesium. The waste contains minimal quantities of magnesium supplying 3kg/ha in this application. The projected average crop yield on this farm is 3.2t/ha and average crop off-take is 2.4kgMg/t. The magnesium supplied in the waste will provide approximately 34% of the crop off-take.

The waste contains only traces of the potentially toxic elements as described in the 'sludge use in agriculture regulations' the table below shows the wastes contribution of PTE's and micro nutrients in Kg/Ha at the proposed application rate of 200 tonnes per hectare.

Copper	Zinc	Calcium	Molybdenum	Lead	Cadmium	Mercury	Nickle	Chromium	Sodium	Fluoride	Arsenic	Selenium
0.03	0.02	0.1	0.003	0	1.16	<0.01	0.02	0.04	6	2.6	<0.01	0.011

The field is on a south facing slope and prone to drying, the liquid contained in the waste will help provide moisture in the soil; the direct drilling will also help preserve soil moisture by minimising soil disturbance providing the seeds with ideal germination conditions. Additional fertilisers, notably phosphate and potash fertiliser are to be placed in bands at the time of drilling to address the shortfall from the waste application.

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

1.7 Potential negative impacts to the soil or crop from this application

The site slopes at approximately 5° toward the bottom of the valley where a well-established hedge separates the site from the field through which the river flows, run-off may pose a risk if not addressed see below

The waste pH is 7.2, no detrimental effects are anticipated from this property, the receiving soil pH is 6.5 and as such the addition of a near neutral pH waste will have no detrimental effect conductivity is low and the level of fats and oils are negligible in the waste

The waste is a slurry and run-off may be an issue during spreading due to the slope of the site see below

Machinery will be running on stubble, tyres and tyre pressures will be adjusted to match the soil conditions, spreading direction and load

Odours from spreading the waste may be an issue, on field storage uses a sealed tank with lockable valves, and other odour controls are discussed in the following sections.

Measures to be put in place to remove or reduce the potential risks or minimize the potential impacts from the operation are listed below.

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

1.8 Sensitive human and environmental receptors

Sensitive human receptors:

- There are two dwellings within 400 metres of the receiving land, but no other buildings such as schools or work places. The occupants of these buildings may be exposed to odours from spreading operations
- A public right of way runs east to west along the river bank at the south of the site. People using this path may be exposed to odour from spreading operations, aerosol drift and proximity of spreading operations
- The dwellings and right of way are shown on the overview map.
- There are no boreholes, wells springs or private water supplies within 250 metres of the site.

Sensitive environmental receptors:

- The river that runs through the adjacent field to the south of the site is designated a SSSI
- The river banks are also designated by the local authority as local nature reserves
- The established hedge line also falls within the local nature reserve designation.

These habitats and designations are shown on the overview map.

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

1.9 Practices to reduce the impacts of the operation on identified sensitive receptors

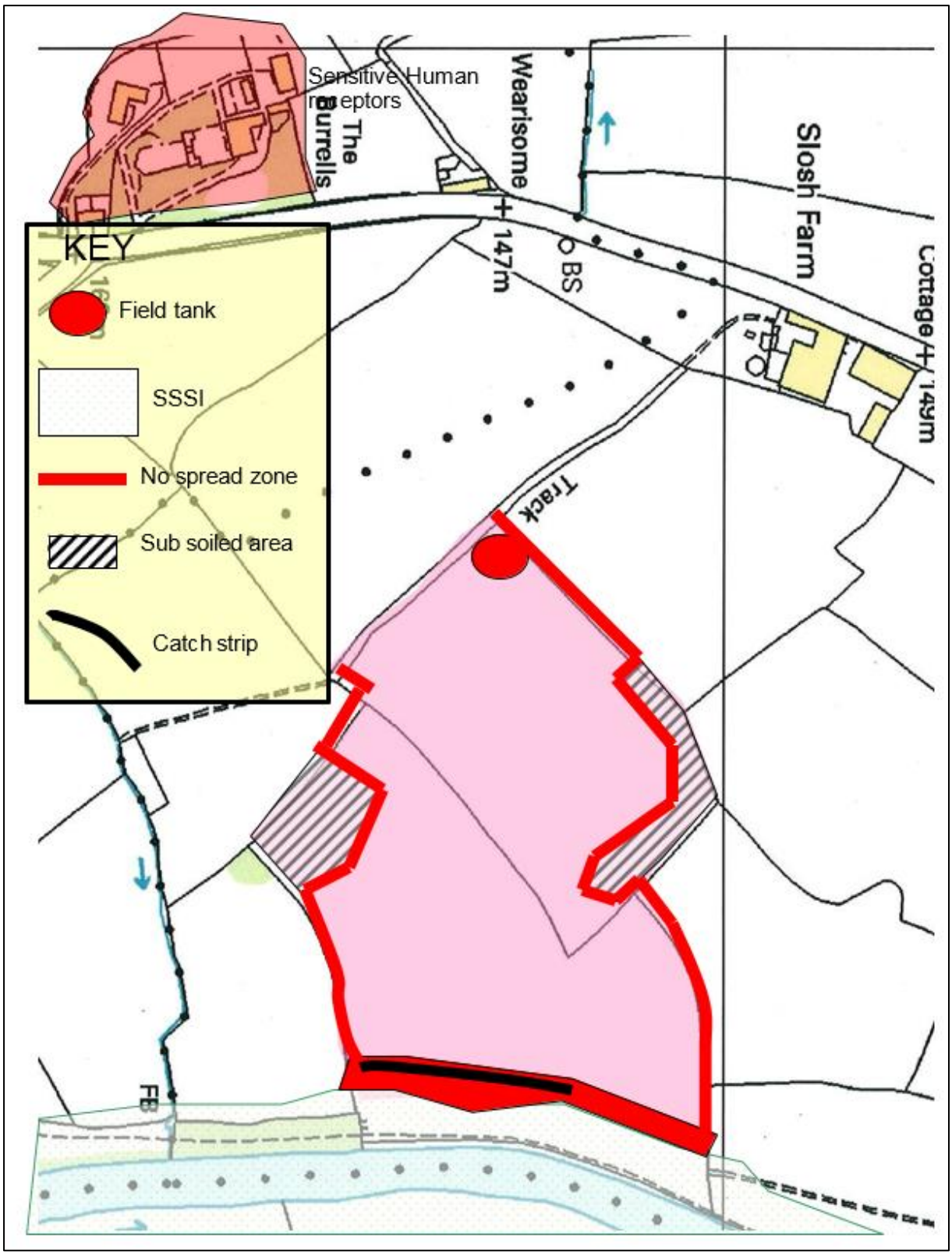
In this section we have set out the measures we will take to reduce the impact of the operation on the receptors identified.

- The injection of the material will reduce the potential for odour from the spreading operation
- The predominant wind direction puts the dwellings up wind of the operation this should reduce the risk of odour at the dwellings

- Spreading will only be undertaken when weather conditions are suitable to prevent aerosol drift and odour problems. The weather assessment and decision will be recorded by the machinery operator in his operation day book.
- A public right of way crosses below the bottom of the field along the river bank. Spreading will only take place during the week when use of this right of way is low and in accordance with the required buffer strips keeping any operations more than 10 metres from the pathway.
- The machinery operator is to be instructed to avoid spreading close to the bottom buffer strip if people are on the adjacent path.
- Machinery operations will run up and down the slope as there are suitable areas at the top and bottom to allow turning, the injection equipment will be lifted out of work prior to turning at the end of each run
- The umbilical feed pipe will be checked for damage daily. This check and any repairs will be recorded by the machinery operator
- Machinery turns will be gentle to avoid rutting and wheel slip the turns will not be executed in the buffer strips
- Waste deliveries to field will be made daily or twice daily as required, the aim is to empty the storage tank before the end of each working day
- Filling of the tanker will be via a dedicated pipe with a lockable valve, there is a facility available to drain the transfer pipe prior to disconnection to prevent spillage
- The field slopes down toward the river, the boundary is marked with an established hedge and sheep netting fence. This slope has been identified as a major risk and a catch strip is to be placed at the bottom of the field within the10 metre no spread zone. This will be provided by breaking the surface of the stubble with a spring tine cultivator to provide a catch for any run-off that may occur and allow it to percolate into the soil. The injection equipment will be lifted out of work before the machinery reaches the catch strip
- The field is not under drained spreading will not be carried out in the areas of the field that have been identified as requiring targeted sub-soiling
- Soil depth is in excess of 400mm over clay subsoil, infiltration to ground water is not identified as a high risk, and the wash water slurry behaves in a similar way to agricultural slurry
- Emissions to air post spreading are not anticipated to cause issue, spreading will be even and at an application rate designed to allow infiltration without run-off or ponding.
- Spreading restrictions within the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** will be adhered to
- The catch strip is shown on the risk map included with this application.
- All machinery is regularly serviced and spreading equipment is calibrated on an annual basis, full maintenance record and calibration reports for all equipment are available.

Mr I Farm, XYZ Farm, Little Spreading, AB3 4DC.

2.0 Contingency planning
Machinery breakdown: – replacement field machinery is available – machinery is fully serviced on a regular basis – hire vehicles will be used in the event of transport vehicle breakdown. Staffing : – There are sufficient trained staff to maintain general sickness cover. Weather. Operations will not carried out in – heavy rain – when heavy rain is imminent – high winds – frozen or snow covered ground as defined in the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** – when weather conditions are assessed to be likely to interfere with the operations. Transfer and umbilical pipe failures: – the injector supply pump has a pressure activated switch that cuts off if pressure drops below or rises above optimum operating pressures – pipes and clamps are visually inspected daily – the temporary field tank is equipped with a non return valve on the input system – unloading is fully supervised and the tanker can be isolated in the event of the transfer pipe breaking.


Cottage
149m
Slosh Farm
Track
BS
Wearisome
147m
Sensitive Human receptors
The Burrells
FB
KEY
Field tank
SSSI
No spread zone
Sub soiled area
Catch strip

Waste Analysis

Waste Analysis Results Wash water from ABC Abattoir, Anytown, Countyshire, AB1 2CD. EWC code 02-02-01 Analysis results on - Sample As Received Date taken: 01/02/2009		
Determinant	Value	Unit
Total solids	2.5	%
Conductivity	401	uS/cm
pH	7.2	-
B.O.D	190	mg/l
Total Nitrogen	0.083	% w/w
Total Carbon	0.065	% w/w
C:N Ratio	0.8:1	-
Ammonium Nitrogen	199	mg/kg
Total Phosphorus	16.3	mg/kg
Total Potassium	71.0	mg/kg
Total Magnesium	6.33	mg/kg
Total Copper	<0.01	mg/kg
Total Zinc	0.078	mg/kg
Total Sulphur	12.0	mg/kg
Total Calcium	48.7	mg/kg
Total Molybdenum	0.014	mg/kg
Total Lead	0.011	mg/kg
Total Cadmium	0.012	mg/kg
Total Mercury	0.05	mg/kg
Total Nickel	0.067	mg/kg
Total Chromium	0.173	mg/kg
Total Sodium	22.2	mg/kg
Total Arsenic	<0.01	mg/kg
Total Selenium	0.011	mg/kg
Fluoride	2.70	mg/kg

Soil analysis

Soil Analysis Report		
Material – Agricultural soil		
Reference – XYZ001		
Date taken: 03/04/2008		
Soil pH	6.5	-
Soil Lime requirement	0.00	tonnes/Ha
Available Phosphorus (Index)	14.2 (index 1)	mg/l
Available Potassium (Index)	148 (index 2-)	mg/l
Available magnesium (Index)	154 (index 3)	mg/l
Total Copper	14.2	mg/kg
Total Zinc	86.1	mg/kg
Total Lead	43.9	mg/kg
Total Cadmium	0.52	mg/kg
Total Nickel	16.4	mg/kg
Total Chromium	23.1	mg/kg
Total Mercury	0.03	mg/kg
Soil Type	Silt Clay Loam	-

Appendix A - Information on wastes for use in land spreading activities

This appendix provides additional guidance for operators of waste to land operations. The most commonly encountered benefits and potential negative impacts of various waste types are provided, together with information on likely properties which may restrict application rates. The appendix will be updated as new information on waste types becomes available.

Wastes are listed in standard rules permits according to their waste code and therefore the source of the waste. Where specific information is known about a waste type this is listed in this appendix. Omission of a benefit or potential negative impact from this appendix for an individual waste should not be taken to mean it does not exist.

It is important that waste is described correctly please see **section 1** of this Technical Guidance Note that accompanies this appendix for further guidance about describing waste.

Section 1: Wastes listed under SR2010 No. 4 only

The wastes in this section have been identified for the treatment of land for agricultural benefit and ecological improvement. These wastes are not intended for the restoration, reclamation and improvement of land that has been subject to industrial use/man-made development and are therefore only included in SR2010 No.4.

02 Waste from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing

02 01 wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing

02	WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING
02 01	**wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing**
02 01 01	soils from washing and cleaning fruit and vegetables only sludges from washing and cleaning produced during food preparation and processing only
02 01 03	plant-tissue waste
02 01 06	farmyard manure and slurry, horse manure and soiled bedding made from plant tissue only
02 01 99	milk from agricultural premises only slurry and manure and soiled bedding from any premises except abattoirs, soiled biodegradable bedding not made from plant tissue, soiled bedding desiccants only spent mushroom compost

Soils from the washing and cleaning of other fruit and vegetables

See **02 03: soils from the washing and cleaning of fruit and vegetables only**

Soils from the washing and cleaning of sugar beet

See **02 04: soils from cleaning and washing beet**

Plant tissue waste

See **20 02: plant tissue wastes**

Farmyard manure and slurry, horse manure and soiled bedding made from plant tissue only and milk from agricultural premises only

See **wastes excluded from the Waste Framework Directive**

Soiled animal bedding containing waste materials

Farm yard manure consists of livestock excreta mixed with bedding material, generally plant tissue based crop residue materials. It is produced where animals are kept in deep bedded pens or yards. The key properties of farm yard manure are

- it can be stacked in a freestanding heap without slumping
- it does not give rise to free drainage from within the stacked material
- it can be spread on land or incorporated into soil as a fertiliser.

Traditional farm yard manure containing plant tissue based crop residue material and animal excreta is described in **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules)** as low nitrogen content manure. Much of the nitrogen (N), phosphorus (P) and potassium (K) in livestock diets is excreted in the manure. Manures contain useful amounts of these plant available nutrients, as well as the other major nutrients sulphur (S) and magnesium (Mg), and trace elements.

Manure and slurry mixed with non-waste bedding materials (e.g. straw) are category 2 animal by-products and are excluded from the Waste Framework Directive and regulation under these permits – see **wastes exclude from the Waste Framework Directive** for more information.

Manures may contain wastes used for bedding such as dried paper crumble, wood chips and bark, shredded paper and cardboard and oversized chips from compost production.

These wastes are very often used in conjunction with straw on bedded yards or pens to reduce straw use but may also be used as bedding in systems such as cattle cubicles and stalls or corrals.

Animal bedding systems may also use desiccants including ‘product’ materials such as lime. In the past waste materials such as paper sludge ash (PSA) have also been used as desiccants in animal bedding. Please note that PSA and gypsum are not acceptable waste streams for use in animal bedding. For more information on Gypsum please see our position statement **Restriction on the use of gypsum and plasterboard in animal bedding.**

Landspreading of soiled bedding containing waste bedding materials such as those mentioned above are subject to environmental controls under the Environmental Permitting Regulations.

Larger wood chips from cattle corrals and outdoor pens should be stacked and allowed to compost prior to spreading to avoid surface contamination on grassland and possible

incorporation into silage/hay crops. Paper crumble, shredded paper/cardboard, and small wood chips/bark once soiled and incorporated into manure can also benefit from being composted prior to spreading. The application of these materials must also comply with any relevant regulations such as The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).

Nutrient and nitrogen availability values can be found in leaflet 3 of the **NVZ guidance** found on the government website).

Further information on the storage and spreading of this material is available at the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

Spent Mushroom Compost

Spent mushroom compost (SMC) is the residual compost waste generated by the mushroom production industry. The compost is initially produced from materials including chopped straw, poultry and other farm manures including horse manure and ground chalk, composted together.

Some mushroom composts may also contain added gypsum.

Discarded mushroom compost can also contain the casing material used to enhance the retention of water in the growing beds, and promote mushroom fruiting body formation. The casing typically consists of peat soil or alternative material amended with calcium carbonate (to neutralize pH) and water (about 80 percent moisture).

Base materials used in the production of mushroom casing can include:

- peat
- commercial composts including PAS 100 compost
- coconut fibre/coconut coir
- de-inked paper fibre pellets (does not require pH amendment)
- rock wool.

Spent mushroom compost may contain both the casing and the lower layers of compost from the growing beds.

Spent Mushroom Compost Benefits and potential negative impacts of application to land
Much of the nitrogen content of the compost is used up by the composting process and the growing of mushrooms. **Potential benefits:** – the compost is a good source of general nutrients (typically in a range 0.7% N, – 0.3% P, 0.3% K plus a full range of trace elements) – soil conditioner adding organic matter – increasing soil organic carbon – improves water holding capacity

- improving soil structure.

Potential negative impacts:

- mushroom compost may also contain chemical residues, used in the control of pests and as sterilants in the growing sheds
- chemicals may also have been used to treat the straw, and to sterilise the compost. The concentrations of these chemicals can be reduced by stacking and turning following removal from the growing sheds to allow aerobic decomposition
- the level of physical contamination in the compost will depend on the screening process during compost formation. There is the potential for poultry carcasses and feathers to be present from poultry manure used in the compost formation. Physical contamination can also include materials discarded during handling and harvest such as damaged punnets and gloves.
- The application rate for SMC is most likely to be restricted by crop nutrient requirement. Any spreading activity should comply with the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and must comply with **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

Further information on mushroom composts containing gypsum can be found in: **WRAP report: Using waste plasterboard in mushroom compost**

02 02 Wastes from the preparation and processing of meat, fish and other foods of animal origin

02	WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING
02 02	**wastes from the preparation and processing of meat, fish and other foods of animal origin**
02 02 01	untreated wash waters and sludges from washing and cleaning from abattoirs, poultry preparation plants, rendering plants or fish preparation plants only
02 02 02	blood and gut contents from abattoirs, poultry preparation plants, rendering plant or fish preparation plants only shellfish shells from which the soft tissue or flesh has been removed only
02 02 04	sludges from on-site effluent treatment plant from abattoirs, poultry preparation plants, rendering plants or fish preparation plants only
02 02 99	slurry and manure and soiled bedding from abattoirs including soiled biodegradable bedding not made from plant tissue and soiled bedding desiccants only
02 02 99	wash waters and sludges from secondary food processing or the cook chill sector

Wastes excluded from the revised Waste Framework Directive

Paragraph 2(1)(f) and 2(2)(b) of the revised Waste Framework Directive (rWFD) (2011) excluded Animal by-products including processed products covered by Regulation (EC) No 1069/2009, except those which are destined for incineration, landfilling or use in a biogas or composting plant. Therefore animal by-products in line with this definition are not currently regulated under the Environmental Permitting Regulations 2016.

Operators should be aware that whilst the application of this material to land is not regulated by the Environmental Permitting Regulations (2016), the pollution of watercourses or controlled waters from spreading of ABPR remains an offence under the Environmental Permitting Regulations 2016. Operators spreading any animal by-product to land as a fertiliser (regardless of waste status) should adopt the following general measures when dealing with wastes from this industry sector.

Waste from the preparation and processing of meat, fish and other foods of animal origin
Application to land – general measures
The management of onsite storage should minimise odour from the storage, this can be achieved by ensuring that volumes stored on site are kept to a minimum for example, daily use. Storage tanks should be fitted with lockable valves and secondary containment unless other measures are in place to prevent leakage or spillage. Daily deliveries and ensuring the tank is empty at the end of each working day would be seen as best practice for the storage of this material. In most circumstances, operators should inject these liquid wastes where possible or immediately incorporate as soon as practicable, liquid and solid waste into the receiving soils. Grass leys, forage crops and permanent pasture: – only inject the waste into the soil; do not surface spread on grassland. Arable land, including forage maize: – inject waste into the soil where possible – surface spread followed by cultivation to incorporate the waste into the soil on stubble or bare land within 24 hours – apply to the bottom of the rows in standing crops with dribble bar or other suitable spreading machinery. – Injecting into the soil reduces odour and increases nutrient availability and uptake. Due to the odorous nature of these wastes it is likely that a site specific odour management plan will be required for deployments of this waste. After injecting on grassland, wait a minimum three weeks before using the land for grazing or cutting.

The following wastes are currently excluded from the Waste Framework Directive, however operators are advised to use this information to inform nutrient planning and reduce the risk of harm to human health and the environment. Operators should also refer to controls under

the **Animal By-products regulations** which may apply restrictions on the handling, treatment and grazing access in relation to the spreading of these materials.

Excluded wastes: Soiled animal bedding not from abattoirs

Poultry litter containing carcasses

Best available technique for poultry shed management should include daily checks and a walk through to remove any carcasses and birds requiring culling on health grounds, see technical guidance note **'How to comply with your environmental permit for intensive farming'**

Poultry farmers and/or suppliers of poultry litter should ensure that this material is free of animal by-products such as poultry carcases.

Poultry litter containing carcasses **Benefits and potential negative impacts of application to land**
Best practice for the spreading of poultry litter: – Manure should not be spread on land whilst other livestock have access to it. Where possible litter should be stacked and allowed to rot for at least four weeks before spreading. – Where facilities exist, the incineration of used litter from flocks infected with Salmonella is preferred. Animals should not be grazed on land on which poultry litter has been spread for at least five weeks. Further information can be found at **DEFRA Animal Health and Welfare.** Any spreading activity should comply with the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and must comply with **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).** Nutrient and nitrogen availability values can be found in **Leaflet 3** of 'Guidance for Farmers in Nitrate Vulnerable Zones' **Potential benefits** – plant nutrients, N, P & K – organic matter **Potential negative impacts** – the stacking in a field or on the farm yard and spreading of poultry manure may cause nuisance with odour and flies if the operation is carried out close to sensitive receptors such as domestic properties – Disease transfer to receiving land e.g. Botulism outbreaks in cattle.

Excluded waste: Blood and gut contents from abattoirs, poultry preparation plants, rendering plant or fish preparation plants only

Blood

Abattoirs and poultry preparation plants produce waste blood in large quantities. Operators apply blood to land as a source of nutrients, especially nitrogen. The ABPR state that blood must be treated in accordance with the ABPR before operators can apply it to land. Whilst these applications are not covered in the environmental permitting regime, blood should be

applied in accordance with the spreading controls described in box 02 02 on page 10 to reduce the risk of pollution. The box below details the potential negatives and benefits of this material to agricultural land for consideration in nutrient management planning.

The application of blood to land

Benefits and potential negative impacts of applying blood to land

Potential benefits

- The high fertiliser value of waste blood has been known for a long time, and it is one of the more traditional materials applied to land.
- nitrogen content is extremely high — typically in excess of 15 kg m-3 total nitrogen and 2 kg m-3 of ammonium nitrogen
- with potassium and phosphorus contents of 1-2 kg m-3, blood is a good source of plant nutrients that is more readily available than most organic wastes.

Potential negative impacts

- blood may have high concentrations of salt, nitrogen and potassium, each of these may increase the soil's electrical conductivity, which may inhibit the soil's uptake of water
- applying too much blood which is readily degradable by soil micro-organisms can rapidly cause anaerobic soil conditions, because of the waste's high BOD
- blood wastes can be visually offensive and typically have an offensive odour; operators must take precautions to minimise this nuisance.
- ABPR require that blood is treated to prevent risk to animal or public health through the transmission of disease it from being reintroduced into the food chain via animal feed. This treatment can involve the use of chemicals such as Iodine. Operators wishing to spread treated blood should provide information on the chemicals used to treat blood to allow the operator to test for this in the waste analysis.

Gut contents

The slaughter industry produces waste gut contents. This consists predominantly of partially digested feed or vegetable matter. All boluses found in gut contents should be removed at the abattoir before spreading.

The best place for the storage of this material is at the site of production. The management of storage of gut content prior to spreading if storage at the site of production cannot be arranged should take into account the prevention of the potential for odour nuisance and the potential of this waste to create leachate especially following rain. The volume of gut content stored on site should be kept to a minimum.

Daily site deliveries from the site of production and the clearing of any residual gut content waste by the end of each working day would be seen as best practice for the storage of this material.

The application of gut content to land

Benefits and potential negative impacts of applying gut content to land
Potential benefits Contains high levels of nitrogen, potassium and phosphorus, typically in the order of: – nitrogen: typically 5 kg m-3 and contains a moderately high ammonium nitrogen content – potassium: typically 1 kg m-3 – phosphorous: typically 1 kg m-3. **Potential negative impacts** – stomach and gut contents can cause odour, depending on the storage period; the material requires incorporation within 24 hours or sooner. After application on grassland, wait a minimum three weeks before using the land for grazing or cutting.

Gut content may also contain small pieces of the digestive tract the material has the potential to cause odour and nuisance with scavengers. The waste should be incorporated as soon as possible following spreading in accordance with **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20**) and **Animal By-product regulation** requirements. A site specific odour management plan will also be required for this waste type.

Processed animal protein (PAP)

The production and use of processed animal protein as a fertiliser must be in accordance with the Animal By-Products Regulations (ABPR) and the Transmissible Spongiform Encephalopathies Regulations (TSE Regulations).

Processed animal protein contains useful amounts of total nitrogen, phosphorus, calcium and other trace elements and also contributes organic matter to the soil. There is evidence from research[1] that the nitrogen in PAP is mineralisable but slow release with 12 – 15% availability in the first year with approximately 25% of the phosphorus is available in the first year[2]. Nutrient availability is linked to the fineness of the material. Finer ground materials are quicker releasing and have higher availabilities.

The application of PAP to land Benefits and potential negative impacts of applying PAP to land
Potential benefits Contains useful levels of nitrogen, potassium and phosphorus in the order of: – nitrogen: typically 8% (12 – 15% available) – potassium: typically 1%

[1] Meat and bone meal as nitrogen and phosphorus fertilizer to cereals and rye grass - Alhaji S. Jeng Trond Knapp Haraldsen, Arne Grønlund and Per Anker Pedersen (2008)
[2] Prof. Dr. Dr. Ewald Schnug, Federal Agricultural Research Centre (FAL), Institute for Plant Nutrition and Soil Science, Germany (August 2005).

- phosphorous: typically 6% (25% available) and,
- calcium: typically 10 - 15%
- may also contain traces of magnesium, sulphur, boron and selenium[3]
- typically 50% organic matter[1].

Potential negative impacts

- can cause odour, during delivery, handling, storage and spreading
- stockpiles should be covered to prevent scavenging, leachate generation, flies and dust nuisance
- stockpiles should be sited away from land drainage, surface water, boreholes, source protection zones and sensitive human receptors
- the material should be incorporated within 24 hours or sooner and should not be spread on grassland where stock may ingest surface material or grassland prior to cutting for silage or hay
- may adversely affect soil micro-organism ecology[4].

Storage and spreading should be carried out in accordance with the Animal By Products Regulations (ABPR), Transmissible Spongiform Encephalopathies Regulations (TSE Regulations) and also regulation (EC) 1774/2002 of the European Parliament and of the Council, laying down the health rules concerning animal by-products not intended for human consumption.

Excluded waste: Lairage waste

Lairage is generally considered to be the area of an abattoir where livestock are kept prior to slaughter. The term also applies to the facilities at auction markets and includes loading ramps, passageways, holding pens, drafting races, covered housing, feeding and watering points. Lairage waste should not contain anything other than livestock excreta and bedding materials, it is essentially farm yard manure.

Lairage waste is classified as a 'Category 2 Animal by-product' under the **Animal By-products regulations.**

Lairage waste **Benefits and potential negative impacts of application to land**
Potential benefits – source of organic matter, lairage waste will contribute to the soil organic content in the same way as FYM

[3] Meat and bone meal as nitrogen and phosphorus fertilizer to cereals and rye grass - Alhaji S. Jeng Trond Knapp Haraldsen, Arne Grønlund and Per Anker Pedersen (2008)
[4] Prof. Dr. Dr. Ewald Schnug, Federal Agricultural Research Centre (FAL), Institute for Plant Nutrition and Soil Science, Germany (August 2005).

- lairage waste will contribute plant nutrients to the soil in the same proportions as farm yard manure. The waste can be in both solid (stackable) and liquid (pumpable) forms depending on the premises and management techniques.

Potential negative impacts

- no ABPR material such as gut content should be mixed with the waste
- over application may result in leaching and surface run off which may cause water pollution lairage wastes may contain desiccants and disinfectants.

The application rate of Lairage waste is subject to the nutrient requirements of the crops to which it is applied. Nutrient and nitrogen availability values can be found in **Leaflet 3** of 'Guidance for Farmers in Nitrate Vulnerable Zones'

Any spreading activity should comply with the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and must comply with **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

Consideration should be given to the application of lairage waste during notifiable animal disease outbreaks to prevent disease transmission.

Wastes regulated under the Environmental Permitting Regulations 2016

The following wastes are controlled by the Environmental Permitting Regulations and must be spread under an approved deployment.

ABP Wash waters and Sludges from washing and cleaning

The wash waters often contain small amounts of blood but typically do not require treatment.

Wash waters may also contain treatment chemicals to comply with ABP controls such as Iodine.

These wash waters from plants handling ABP are subject to controls under the Environmental Permitting Regulations (2016). To ensure the relevant objectives of the Waste Framework Directive are met and risks to animal and human health are minimised, wash waters from abattoirs and other premises handling, storing and processing ABP's should be applied to land in one of the following ways:

- Subsurface injection to a depth of at least 15cms.
- Shallower injection/surface application can be used provided the wash waters are worked into the soil of the land as soon as is reasonably practical & before allowing access to grazing animals.

Wash waters from intermediate sites

Standard rules permit SR2010 No4 does not currently include untreated wash waters from intermediate ABP plants (short-term storage facility where ABP's are bulked up and stored prior to being taken to a rendering plant) handling ABP categories 1, 2 and 3. However we are aware that these wash waters are also being spread on land for agricultural benefit. Analysis has shown that wash waters from these premises are essentially the same composition as untreated wash waters from rendering plants and poultry preparation plants.

The wash water contains small amounts of blood and gut contents and can provide land with a nutrient benefit and soil moisture benefit.

Whilst the omission of this waste is corrected we will not pursue an application for a bespoke environmental permit for spreading wash waters from an intermediate ABP plant handling category 1, 2 or 3 ABP provided:

- Wash waters are spread in accordance with SR2010No4, the deployment procedure is followed (including the completion of LPD1) and the appropriate fee is paid.
- The deployment application submitted describes the waste as wash waters from intermediate ABP plant and they are coded 161002.
- The wash waters are subsurface injected to a depth of at least 15 cm. Shallower injection/surface application can be used but the wash waters must be worked into the land as soon as practicable and before grazing animals have access to the land.
- You meet the relevant objectives of the Waste Framework Directive:

'… ensuring that waste management is carried out without endangering human health, without harming the environment and in particular:

i without risk to water, air, soil, plants or animals

ii without causing a nuisance through noise or odours; and

iii without adversely affecting the countryside or places of special interest.'

Sludge from biological treatment plants at abattoirs, poultry preparation plants, rendering plants or fish preparation plants only

For sludge from biological treatment plants at meat and fish processing plants, operators should base rates of application on both the plant nutrient content and the fat content of the waste. Fatty waste is generally unsuitable for surface application by splash plate spreader to growing crops but soil placement methods such as trailing shoe or dribble bar spreaders may apply the waste to the soil surface, bare soils and stubbles should be cultivated to prevent problems such as surface capping and anoxia as soon as possible after the waste applied, high application rates of fatty wastes can also cause nitrogen deficiency within the soil as bacteria compete to degrade the waste.

The injection of fatty waste is the preferred method of application to reduce odours, with field operations ensuring any fatty material is thoroughly mixed through the soil profile. There should be an interval of at least three weeks between application to agricultural grassland and using the grass for grazing or cutting.

Sludge from biological treatment plants at abattoirs **Benefits and potential negative impacts of application to land**
Potential benefits – As with blood wastes, these materials are likely to be a beneficial source of readily-available plant nutrients. – the predominance of blood in the waste means nitrogen levels can be very high, usually in excess of 8 kg m-3 with ammonium nitrogen usually present in excess of 1 kg m-3

- potassium, phosphorus and magnesium can all be present in variable amounts and can exceed 1-2 kg m-3.

Potential negative impacts

- different types of abattoir produce different types and percentages of fat, however chicken processing plants are potential sources of high fat materials
- sludges may be highly putrescible with the potential to cause odour problems
- over-application of these types of waste may cause anoxic soil conditions, which may lead to problems with crop growth (stunted growth, yellowing leaves die back and reduced yield)
- over application has the potential to contaminate surface or ground water.
- Deleterious effects on crop growth from adding animal fat are usually observed at relatively low fat percentages compared to wastes containing other fats and oils.

The spreading of oily wastes containing animal fat should be placed on the soil surface to avoid coating growing plants and on bare soils and stubbles be incorporated as soon as possible.

Oil and Fat trap Wastes

Oily wastes result from secondary treatment processes that segregate all or part of the oil or fat content of waste materials. Waste is usually collected with a 'trap', where oils and other matter are skimmed from the surface of the waste. These wastes are typically found in food production where the input materials are likely to contain oil, for example: chocolate manufacture, dairy and meat processing, rendering and oilseed crushers.

Waste mineral oils (compared to animal and vegetable oils) are unlikely to be suitable for applying to land because of their hazardous properties. The **'Guide to hazardous wastes'** provides further guidance on the classification of hazardous waste.

The proposed application rate for an oily waste may require that the waste is spread on the receiving land in several applications to prevent any potentially negative impacts to the soil and/or growing crop. Applications in a growing crop should be placed on the soil surface where possible to avoid coating the plants leaves.

There is little information about the types of fat or oil (vegetable or animal) to quantify their effects on the soil. A simple analysis of the fat or oil content in waste is not sufficient to predict its effects, and suitably qualified advice should be sought.

Oily wastes

Benefits and potential negative impacts of application to land

Benefits are hard to generalise because the solid content of this waste is highly variable depending the source and production processes associated with the wastes.

This means that these wastes may have highly variable plant nutrient content.

Potential benefits

- some oily wastes, such as those produced from fish processing, can have a relatively high protein content and hence high nitrogen content (in excess of 1 kg m-3)

- applications to light soils may be more beneficial than applications to heavier soils
- oily wastes can have a similar effect in soils as wastes with a high salt content; see salty whey waste from the dairy products industry (section 5.1 above).

Potential negative impacts

- wastes with about 4% fat or oil content or more, detrimental effects on plant growth have been demonstrated in bioassays and in the field
- oils and fats applied to standing crops including grass may coat leaves affecting respiration and photosynthesis
- oil or fat at high application rates may coat the soil particles, effectively producing a waterproof barrier. This means plant roots cannot extract water causing stunting or die-back. Adding water does not improve the situation because the water runs over the soil particles and the plants absorb very little
- high applications may cause the formation of a layer of fat in or on the soil causing anoxia in the soil
- oils and fats can cause nitrogen lock up because they have a high C: N ratio.

Operators should measure the oil or fat content to determine an acceptable application rate. They should not apply fatty or oily wastes unless analysis shows that the material does not cause harm. Deleterious effects on crop growth from adding animal fat are usually observed at relatively low fat percentages compared to wastes containing other fats and oils.

The spreading of oily wastes containing animal fat should avoid coating growing plants and on bare soil be incorporated as soon as possible.

Wastes containing fats and oils may need to be applied over several separate applications to prevent coating the soil and other potentially negative effects.

02 03 wastes from fruit, vegetables, cereals, edible oils, cocoa, coffee, tea and tobacco preparation and processing conserve production yeast and yeast extract production, molasses preparation and fermentation

02	**WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING**
02 03	**wastes from fruit, vegetables, cereals, edible oils, cocoa, coffee, tea and tobacco preparation and processing conserve production yeast and yeast extract production, molasses preparation and fermentation**
02 03 01	soils from cleaning and washing fruit and vegetables only sludges from washing, cleaning, peeling, centrifuging and separation
02 03 02	wastes from preserving agents
02 03 03	wastes from solvent extraction
02 03 04	biodegradable materials unsuitable for consumption or processing only

02 03 05	sludges from on-site effluent treatment
02 03 99	wastes not otherwise specified from the processing of such materials including those from secondary food processing or the cook-chill sector

Soils from the cleaning and washing of fruit and vegetables from agriculture and food preparation and processing

This section is also applicable for wastes 02 01 01 soils from the cleaning and washing of fruit and vegetables from agriculture

When using waste soils the operator must consider the transmission of soil borne diseases from the relevant crop. Some of the more common diseases for consideration are listed below. Please contact the **Food and Environment Research Agency** section of Defra for more information.

Soil borne potato diseases

Potato is the most important host for the following potato cyst nematodes (PCN):

- Globodera pallida (the white potato cyst nematode) – G.rostochiensis (the yellow potato cyst nematode).
- Potato cyst nematodes attack other solanaceous plants, such as tomato and aubergine and may attack weeds such as bittersweet (Solanum dulcamara).

Each species of potato cyst nematodes has several pathotypes and each one differs in its ability to multiply on different potato cultivars.

Potato cyst nematodes damage the plants' roots and reduce yield, even when no obvious symptoms in the haulm are visible. With severe infestations, the nematodes damage roots more seriously and may kill the plant. Severe PCN infestations typically occur in patches within the crop where plants are often stunted and chlorotic. Rhizoctonia and other secondary fungal diseases associated with nematode feeding may also contribute to the loss of yield.

PCN

Soil treatment options

Waste which may contain PCN can be treated with either heat or liming. Where the waste has not been treated then the applicant should provide information to demonstrate that there is no risk from the spread of this disease. Temperature treatment:

- where waste is been treated with temperature the lethal temperature is 40°C for 10 days or 50 °C for 5 days.

Liming treatment:

- in limed sewage sludge, with a pH >10 PCN were killed in 14 days.

Management of plant health risks associated with processing of plant-based wastes: A review R. Noble, J.G. Elphinstone, C.E. Sansford, G.E. Budge, C.M. Henry (28/03/2009)

Further information can be found in the Defra fact sheet: **EC listed pests — Potato cyst nematodes**

Soil borne onion diseases

Onion white rot (Sclerotium cepivorum) is the most serious, widespread and destructive disease affecting the onion (Allium) family. It is difficult to control or eradicate once the soil is infected. This fungus is soil and green waste borne, affecting onions, leeks, garlic, chives, shallots and other salad crops.

As the disease progresses, a white, cottony-looking fungal growth is seen around the base and up the side of bulbs the fruiting bodies or sclerotia appear as tiny black globules among the fungus and look like poppy seeds.

Onion white rot is an exceedingly persistent organism. The sclerotia are able to survive for at least 15 years in the soil without a suitable host plant.

Onion white rot
Soil treatment options
S.cepivorum is eradicated by heat over a period of time. If the waste has not been heat treated and there may be a possibility that the waste contains this fungus then the waste should be tested prior to spreading. Temperature treatment: Where waste is been treated with temperature the lethal temperature is > 40°C for 21 days. Management of plant health risks associated with processing of plant-based wastes: A review R. Noble, J.G. Elphinstone, C.E. Sansford, G.E. Budge, C.M. Henry (28/03/2009)

Soil borne brassicae diseases

Club root affects all cruciferous crops including oilseed rape, swede, cauliflower, calabrese and mustard, and related weeds. Early disease development can lead to poor establishment plant roots typically become swollen and distorted. Severe infection can produce large galls on the tap root and plants are stunted or killed. Boron deficiency has been linked with clubroot infection and any deficiency should be corrected.

Treatment with finely-graded lime products can be effective and acts within 1-3 weeks of application if incorporated thoroughly. The fineness of the lime products is essential to the quick release of the calcium ions and a rapid rise in pH which needs to be around pH 7.2.

Soil tests for club root are available based on growing susceptible bait plants (Chinese cabbage) in representative soil samples under controlled conditions. Disease severity is assessed after six weeks and the result can help growers assess potential risk in specific fields and may be appropriate where high value crops are grown.

Clubroot
Treatment options
The options for the treatment of clubroot infection are based on whole field treatments.

- retain soil removed by harvesting on the infected fields
- where club root has been found, check soil pH and incorporate lime to achieve pH
- 7.2 in affected fields
- correct drainage and soil compaction problems
- increase the rotation frequency to at least four years between brassicae crops
- consider resistant varieties where club root has developed in previous cruciferous crops
- test soils in selected un-infected fields scheduled for oilseed rape next season
- check soil pH and boron levels on all fields before planting oilseed rape
- minimise soil movement on farm equipment from affected to unaffected fields
- minimise movement of feed swedes and turnips onto clean land.

Verticillium wilt

Treatment options

Verticillium wilt caused by V. longisporum, is a significant threat to yield in oilseed rape and possibly other Brassicae crops in the UK. It is more damaging in warmer areas of the UK, where higher soil temperatures are more favourable for infection and disease development. The spores are soil-borne and present in crop residues this means any activities that move soil or residues have potential to distribute the disease between fields and farms. Severe Verticillium wilt can occur in oilseed rape even after 8-10 years without oilseed rape cropping. The disease causes premature ripening, significantly effecting crop yield.

There are currently no agro-chemical controls or resistant varieties available and the only treatment options are crop and field hygiene measures and rotation.

Treatment options include:

- retain soil removed by harvesting on the infected fields return to the same field
- increase the rotation frequency to at least four years between brassicae crops
- minimise soil movement on farm equipment from affected to unaffected fields
- avoid extending the growing season by early sowing as this may increase colonisation by V. longisporum in crop residues during late summer or early autumn. Organic amendments such as composts which rely on changing the soil micro-flora so that competition suppresses the pathogen, may offer a control method and is likely to be the subject of independent research work against Verticillium species.

(Relevance of verticillium wilt (Verticillium longisporum) in winter oilseed rape in the UK by P Gladders ADAS, May 2009)

Sludges from washing, cleaning, peeling, centrifuging and separation of waste from vegetable preparation and processing

Wastes from vegetable preparation and processing come from washing and preparing vegetables.

The waste can consist of vegetable matter, soil and wash waters. Nutrient contents are highly variable due to the many potential sources of such waste. Wastes are often dilute, with a solids content of approximately 1%.

Where potatoes are processed the process effluent can be high in starch for example when potatoes are processed in chip manufacture (100 tons of potatoes processed can produce approximately 2-3 tons of starch in solution). Large modern processing plants often recover the starch as a by-product.

Operators should seek appropriate technical expertise if they suspect that applying the waste risks spreading pests and disease. For example operators must not spread diseased or foreign plant waste on agricultural land and should seek advice from the Plant Health Division (PHD)

Spreading vegetable wastes may cause odours, the potential for odour increases if process water is stored in lagoons or tanks and solid vegetable waste is stockpiled prior to spreading. In these cases a site specific odour management plan should be in place.

The spreading of low dry matter wastes such as process waters may also cause run-off or enter land drains if applied at high rates and when soil conditions are not suitable, for example:

- during dry weather when the soil is cracked and fissured and,
- during or after prolonged wet periods when the soil is saturated.

Starch ($C_6H_{10}O_5$) and the high organic content of wash waters may increase the BOD of an effluent to over 1750mg/l.

The application to land of vegetable preparation and processing waste

Benefits and potential negative impacts of application to land

Potential benefits

- vegetable matter contains moderately high proportions of all three major nutrients (nitrogen, phosphate and potash) in non-readily-available, organic forms. The proportions of these nutrients are usually greater than 0.5 kg m-3
- some waste may be stored for a period of time, which allows the nutrients to break down because they are effectively digested and composted. This may slightly increase the availability of the nutrients.

Potential negative impacts

- wastes from the processing of imported and home grown vegetables may contain a range of pests and diseases. The nature and origin of waste plant matter needs to be considered in case diseased material is present that could act as a source of infection for succeeding crops. e.g. haulms of potatoes infected with potato blight fungus Phytophthora infestans (see pathogenic agents in soils and infectious animal diseases in section 2, 17 05 04 soil and stones)
- stored liquid wastes and stockpiled putrescible waste vegetables may become odorous when handled and spread. Operators should consider stabilising this waste to reduce potential odour problems.

– high BOD wastes have the potential to cause serious pollution of the water environment if spread incorrectly.

Wastes from Solvent Extraction

Solvents used in solvent extraction include methylene chloride, acetone, ethyl ether, hexane, heptane and cyclohexane. These solvents exhibit a range of toxicity, flammability and volatility, and present an accident risk and a source of VOC emissions. There are four examples below listed from the production of decaffeinated coffee.

Waste from non-alcoholic drinks
Processes for decaffeinating coffee
Water method - green coffee is immersed in water where the caffeine content is dissolved and removed. The caffeine is removed from the solution using activated carbon or other adsorbents, which retain the caffeine, and the water can then be recycled.
Ethyl - Acetate method: Ethyl - Acetate (EA) occurs in several natural products. In the decaffeination process a combination of water and ethyl-acetate is used. The EA is circulated around the water soaked beans to extract the caffeine. Then the mixture of water, ethyl-acetate and caffeine is drained from the extracting vessel.
Supercritical Carbon Dioxide and Liquid Carbon Dioxide method: Under certain conditions this process allows for selective caffeine extraction leaving most of the other coffee bean constituents unaltered. The use of carbon dioxide in its supercritical state (between its liquid and gaseous state) needs very high pressure (up to 250 atmospheres). Liquid CO2 can also be used for caffeine extraction with lower pressure and lower temperatures.
Methylene Chloride (i.e. Dichloromethane-DCM) method: DCM extracts the caffeine selectively and has a low boiling point. In the extracting vessel, dichloromethane is circulated around the water soaked beans to extract the caffeine. The mixture of DCM and caffeine is then drained from the extracting vessel. The DCM can then be recovered.
It is important to describe these types of waste correctly in your deployment application so that a proper assessment of the proposal can be made.

Wastes from processes that may contain these solvents should be assessed for potential hazardous qualities using chemical analysis and **Technical Guidance WM3** and **Guide to hazardous wastes.**

Sludges from onsite effluent treatment plants of food and drink waste

Please note this section can apply to sludges from onsite effluent treatment plants for all food and drink waste and should be considered for the following sub chapters:02 04, 02 05, 02 06 and 02 07.

The separation of digestate from anaerobic and aerobic digestion into solid and liquid fractions, in same way as cattle slurry can be separated, allows flexibility by reducing the volume of liquid and removing the need to mix prior to spreading. Nitrogen in the liquid fraction is more plant available and separation can therefore increase the efficiency of N uptake, the solid fraction may be higher in phosphorus. Management of the operation may

be improved if liquid is injected and solid composted prior to spreading as this practice may reduce odours.

Mesosphilic and thermophilic digestion processes kill most viruses and pathogens found in livestock manures or ABPR (Bovine Viral Diarrhoea BVD, Aujeskys Disease and Johnes Disease are killed or reduced), these processes also reduce plant pathogen levels and the viability of weed seeds.

Some sludges from industrial treatment processes may contain dangerous and hazardous substance which make them unsuitable for application to land. For further information on dangerous and hazardous substances can be found in: **Technical Guidance WM3** and **Guide to hazardous wastes**

Sludge from biological treatment plants for food waste

Wastes classified under ABPR may require further treatment in accordance with the Animal By-Products Regulations and may not be suitable for land spreading. The wastes generated in effluent treatment plants undergo various degrees of biological treatment depending on the type of system in place. The biological treatment of food waste can result in the partial conversion of plant nutrients from an organic into an inorganic form. Much of the remaining nitrogen occurs in readily degradable bacterial floc.

Sludge from biological treatment plants for food waste **Benefits and potential negative impacts of application to land**
Potential benefits – total nitrogen and ammonium nitrogen are usually present in low to moderate amounts (>0.5 kg m-3) much of the nitrogen is readily available for plants – bio-sludges from the food industry are usually low in contaminants and need only be monitored for their nutrient content in relation to crop requirements – the amount of potassium and phosphorus in the sludge is highly variable – the solids content is usually low, and the material is commonly applied as a liquid sludge – waste that has received biological treatment can be more stable (less odorous) and have a reduced (less potentially polluting) Biochemical Oxygen Demand (BOD).
Potential negative impacts – some wastes can have high nutrient and BOD content if there has been no biological treatment – bio-sludges from other industries may contain inorganic or organic contaminants – sludges are likely to be highly putrescible with the potential to cause odour problems – over-application of these types of waste may cause anoxic soil conditions, which adversely affects crop growth – over application has the potential to contaminate surface or ground water.

02 04 Wastes from sugar processing

02	WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING
02 04	**wastes from sugar processing**
02 04 01	soil from cleaning and washing beet
02 04 02	off-specification calcium carbonate
02 04 03	sludges from on-site effluent treatment
02 04 99	wastes not otherwise specified derived from the processing of sugar

Soil from cleaning and washing beet

This section may also be applicable to waste code 02 01 01 soils from the washing and cleaning of sugar beet.

Operators may apply soils from sugar beet washing at a rate of 1500 tonnes per hectare, however, plant nutrient loading is likely to restrict the application before this maximum rate is reached.

Soil borne sugar beet diseases

Rhizomania is a disease of sugar-beet first identified in the UK in 1987 and named because of its ‘mad root’ symptoms. The disease is caused by a virus (beet necrotic yellow vein virus) transmitted by a soil borne parasitic fungus, Polymyxa betae. Polymyxa species are either members of a small group of zoospore fungi or protozoa. The disease can be spread by untreated leachate, soil and plant matter. Infection is by means of swimming spores which attach themselves to the rootlets and inject their contents (which may or may not contain the virus) into the superficial cells. The spores of Polymyxa betae are particularly long lived in soil and remain viable for many years. Severe symptoms stunt the roots and decrease the sugar concentration of affected plants. Losses in sugar yield of up to 50-80% have been experienced with serious infection. Virus infection also affects crop nitrogen uptake. Sugar beet is grown in intensive arable areas and specialist machinery, often contractor operated, is used in the cultivation and harvesting of the crop. Once harvested, beet may be stored prior to transport to factories for processing and sugar extraction or sent direct off field. All of this activity results in considerable movement of soil at harvest time. Waste soil and water accumulates at factories, from washing the roots prior to processing, has to be disposed of. Rhizomania is not only confined to sugar beet and can also infect fodder beet grown for feeding livestock. Weed beet, which are usually susceptible to rhizomania, can be a serious problem by continuing to spread this disease and so exacerbating the problem further.

Rhizomania **Soil treatment options**
There is no agro-chemical solution to the virus the only option is to grow a rhizomania resistant variety of sugar beet. Crop hygiene:

– physical measures put in place to prevent the transmission of infested soil between fields, including haulage from the farm/beet storage clamp to the factory. Heat treatment: – if the waste has not been heat treated the waste should be tested. Temperatures over 70°C for over 3 days may be sufficient to eradicate. Management of plant health risks associated with processing of plant-based wastes: A review R. Noble, J.G. Elphinstone, C.E. Sansford, G.E. Budge, C.M. Henry (28/03/2009)

Further information on plant disease can be found at the **Food and Environment Research Agency** section of Defra.

Sludges from onsite effluent treatment

See 02 03 sludges from onsite effluent treatment plants

Lime (sugar) sludges

Lime (sugar) sludge waste comes from processing sugar cane and sugar beet. It usually contains large quantities of lime and is, therefore, highly beneficial to acidic soils. The sludge may contain other nutrients (N, P & K), but usually in small amounts. The pH is generally around 7.5. The waste consists predominantly of calcium and magnesium carbonate with a proportion of calcium hydroxide. The neutralising value of the sludge is in the range of 10-20% in solid waste, but will vary with moisture content.

These wastes are a valuable replacement for other materials that adjust pH, liming benefit must be based on the neutralising value of the waste, see **Appendix B** Section 4.3 “Adjusting soil pH”.

The application to land of Lime (sugar) sludges Benefits and potential negative impacts of application to land
Potential benefits – correction of soil acidity – provides plant nutrients (N, P & K). **Potential negative impacts** – the use of these wastes is similar to using agricultural lime: applying too much lime to certain soils and crops can cause deficiencies of trace elements in crops and soils.

02 05 Waste from the dairy products industry

02	WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING
02 05	**wastes from the dairy products industry**

02 05 01	biodegradable materials unsuitable for consumption or processing
02 05 02	sludges from on-site effluent treatment
02 05 99	wastes not otherwise specified derived from the processing of dairy products

Dairy wastes, especially those that have been stored in silos on the site of production may provide an ideal environment for the proliferation of bacteria which may contribute to the odorous nature of the wastes and may pose a risk to livestock grazing land that has been recently spread with dairy wastes. Due to the odorous nature of this waste it is likely that a site specific risk assessment will be required for deployments of this waste.

Biodegradable materials unsuitable for consumption or processing

For information on **fat trap wastes see: 02 01**

Salty whey waste

Salty whey wastes can include:

- yeast cell debris with high protein content
- high salt content, usually in the form of sodium and potassium chlorides and,
- other compounds (such as nitrate and sulphate) which can add to the high electrical conductivity of the waste.

The application to land of salty whey waste

Benefits and potential negative impacts of application to land

Potential benefits

- sodium can be present in moderate to high amounts
- large concentrations of nitrogen, phosphorous and potassium (>1 kg m-3)
- specific crops (such as sugar beet and carrots) can use the potassium and sodium as plant nutrients and
- sodium may increase the palatability of grass

Potential negative impacts

- Salty wastes can present specific soil and crop problems, if applied to soils under the wrong conditions or repeatedly applied to soils over cropping seasons.

Salts added to soils can

- replace calcium and magnesium ions for sodium through cation exchange, which can significantly harm the soil's structure
- excess chloride increases the osmotic pressure of soil water, which reduces the crop's water uptake (induces artificial drought conditions)
- direct application can cause leaf scorch
- be toxic to plant growth and,

- cause high soil electrical conductivity if applied to land in dry conditions. The highest risk period is in the dry summer months when grass swards are often injected with wastes. This issue is the most common problem arising from applications of salty wastes. (see box below)

RB209 recommends adding sodium to most soils where beet is grown. The exceptions to this rule are Fen peat and some silt soils, which generally contain adequate sodium. Sodium is commonly applied as agricultural salt at 375kg/ha (200kg/ha Na2O) without any adverse effect on soil structure, even on soils of low structural stability. Some crops are more tolerant of salt than others so operators must know which crop is (or will be) grown on the land that receives the waste. **RB209** gives advice on the salt (sodium) sensitivity of different crops.

The risk of salt scorching or soil damage can be reduced by placing wastes on the soil surface when applying waste to an established crop and applying at a low rate and spreading the waste in multiple small applications over several months.

Conductivity

The safe range of conductivity for the application of wastes to crops is between 2000 and 4000uS/cm (micro-Siemens per cm). Leaf scorch in green crops may occur if wastes with higher conductivities are applies resulting in detriment to the crop growth and yield. Crop sensitivity varies, maize, peas and beans are among the most sensitive crops to high conductivity wastes and barley, sugar beet, kale and rape quite tolerant of high conductivity wastes. On both tolerant and intolerant crops the addition of salty wastes should be justified.

The application to land of salty whey waste

Applications involving salty whey waste

Checking the application:

- ensure the agricultural statement of benefit addresses the risk of salt damage i.e. it demonstrate that the waste-to-land activity will cause no harm
- ensure the operator uses appropriate application rates.

Natural Resources Wales role is to:

- raise the possibility of salt damage with the operator (if they have not raised it themselves)
- assess the operator's approach to avoiding salt damage.

Interpreting analysis

It is important to know whether the laboratory reports salt as Na (sodium) or as Na2O (sodium oxide). This is because sodium recommendations are given as kg/ha of sodium oxide and not as sodium. Conversion factors for converting sodium, sodium oxide and salt can be found in **RB209**.

Waste Milk

Milk which has become unsuitable for processing or consumption may be spread to land. The milk's high BOD (Biochemical Oxygen Demand) can require the waste to first be diluted prior to spreading. Waste milk from processing plants may be diluted with wash waters at the site of production (see permitting guidance in section 7.2 Kieselguhr sludge).

Spreading waste milk **Benefits and potential negative impacts of applications to land**
Potential benefits – milk contains very low nutrient values – irrigation benefit to some crops. **Potential negative impacts** – mixing milk with slurry in enclosed spaces can create toxic gasses – diluting milk with slurry increases the liquid fraction of the slurry, which may contribute to run-off problems – waste milk may contain antibiotics or other veterinary medicines, this risk can be lessened with dilution by the addition of slurry. Any spreading activity should comply with the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and must comply with **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

Waste milk spread on the farm where it is produced should be mixed with water or slurry in equal quantities prior to spreading. The spreading of waste milk in these circumstances may be due to periods of adverse weather or disease restrictions

Please refer to our **Extreme weather position statement** for more details on the declaration of extreme weather conditions.

02 05 02 sludges from onsite effluent treatment See 02 03 for more information

02 06 wastes from the baking and confectionery industry

02	WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING
02 06	wastes from the baking and confectionery industry
02 06 01	biodegradable materials unsuitable for consumption or processing
02 06 02	wastes from preserving agents
02 06 03	sludges from on-site effluent treatment
02 06 99	wastes not otherwise specified from the processing of materials used in baking and confectionary

Sludges from on-site effluent treatment

See **02 03 sludges from onsite effluent treatment and biological effluent treatment plants for food waste**

02 07 wastes from the production of alcoholic and non-alcoholic beverages (except coffee, tea and cocoa)

02	WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING
02 07	**wastes from the production of alcoholic and non-alcoholic beverages (except coffee, tea and cocoa)**
02 07 01	wastes from washing, cleaning and mechanical reduction of raw materials
02 07 02	wastes from spirits distillation
02 07 03	wastes from chemical treatment
02 07 04	materials unsuitable for consumption or processing
02 07 05	sludges from on-site effluent treatment
02 07 99	biodegradable wastes not otherwise specified from the processing of the raw materials used in the production of such beverages only

The production of alcoholic and non-alcoholic beverages produces large volumes of liquid waste. Much of the solid material from the process such as brewers grains are used as animal feeds.

Wastes from washing, cleaning and mechanical reduction of raw materials

The waste comes from washing or other processes that create weak effluents. Although weak in an agricultural sense, these effluents are usually very high in BOD (10-40 000 mg l-1) and are, therefore, expensive to discharge to sewer. BOD, unless extremely high, has little direct effect on soil but can have serious effects if high BOD wastes enter surface waters via run-off or via land drainage.

Waste beer and wash water

Benefits and potential negative impacts of application to land

The nutrient content of waste beer and wash water is usually low.

Do not apply this material to land with pH less than 5.5. Pre-treatment may be necessary to correct the acidity of the waste e.g. by adding caustic soda or similar alkali material.

Potential benefits

- due to the low solids content, this waste is usually weak in nutrients (<0.1 kg m-3), although some wash waters contain yeast, which provides a moderate nitrogen content
- if applied in large quantities (in excess of 110 m-3/ha) weak wash water waste can benefit the soil e.g. as part of a managed irrigation plan.

- Waste beer and wash waters contain carbohydrates in solution. As a result, they can become acidic unless neutralised.
- The brewing and soft drinks industry produce large quantities of water that contain residues of either carbohydrates or alcohol.
- Alcohol is a product of the fermentation of carbohydrates and is readily oxidised to become a weak organic acid.
- if left for any length of time, solutions of both carbohydrates (sweet water) and alcohols degrade to produce weak organic acids
- the acids are weak in the sense that they are poorly buffered and easily neutralised, but they can have a dramatic effect on the pH of the solution.
- Solutions at pH 7 can easily degrade to a pH as low as 2.0 if left for 24 hours.

Potential negative impacts

- if waste of such low pH is applied to the soil, it can severely stunt crop growth. The stunting effect is usually short-term because most soils have a buffering capacity capable of dealing with such weakly-buffered acid waste. However, to avoid any potential problems, waste producers must neutralise their wastes before collection and spreading.
- impacts on the soil will depend on soil type, operators should assess the potential risk to the soil, for example non calcareous sandy soils would be at higher risk from this type of waste
- applications to growing crops using high trajectory methods may cause leaf scorch, methods which place the waste on the soil should be used in growing crops.

Wastes from spirits distillation

Distilleries produce large quantities of weak wash water without any yeast or Kieselguhr waste. The pH of this waste can be low. Therefore operators should not apply it to land with soils of pH less than 5.5 unless the acidity of the waste has been neutralised by adding caustic soda or similar alkali material.

Distillery Waste

Benefits and potential negative impacts of application to land

Potential benefits

- effluents are often very weak in nutrients. If applied in large quantities (that is, in excess of 110 m-3/ha) they can be beneficial as part of a managed irrigation plan.

Potential negative impacts

- the distillery industry has traditionally used copper vessels in the brewing process and, as a result, copper is often found in this waste. The low pH can cause sludges to have significant levels of copper which can build up in the receiving soil.[5]

[5] Soil quality: Investigating the impact of applying sewage sludge and exempt waste to agricultural land

Wastes from chemical treatment

Kieselguhr Sludge

Kieselguhr is a clay mineral added to brewing to liquors to clarify them. The sludge that this process produces contains relatively large quantities of yeast debris and other solid matter, which result from the brewing process. The solids content and thixotropic nature of the waste means that it is usually mixed with weak wash waters. This allows the material to be pumped, making it easier to handle.

Thixotropy is the property of certain fluids that are viscous under normal conditions, but become less viscous over time when shaken, agitated, or otherwise stressed.

Kieselguhr sludge **Benefits and potential negative impacts of application to land**
Potential benefits – kieselguhr sludge is usually an ideal mix of plant nutrients, especially nitrogen, which is usually present in high (if not very high) amounts (>2 kg m-3). **Potential negative impacts** – kieselguhr sludge is often added to other waste liquors from the brewing process, the resulting mixture may have a low pH value – in these cases, operators should ensure the mixture is adjusted back to pH 6-7 before applying to land.

Where Kieselguhr sludge from brewing processes are mixed with other wash waters produced on the same site and any pH adjustment takes place as part of waste management practices at the site of production, the activity does not require a specific environmental permit, the waste must however be correctly coded and described when removed from the site of production for spreading.

Where this mixing activity takes place at another site, a site environmental permit for the treatment of the waste will be required for the mixing and treatment of the waste in addition to the standard rules mobile plant permit for spreading the waste on land.

The mixing of wastes on the site of a deployment for operational reasons only applies to wastes which are not being mixed for the purpose of treatment.

For more information on appropriate measures for storage of waste please refer to Section 1 (box 2.1.1 and table 2.1.1) of this document.

Trub and yeast waste

Trub and yeast waste contains the primary brewing materials and can be rich in brewers grains, malt and yeast debris.

Trub and yeast waste **Benefits and potential negative impacts of application to land**

This waste is often either mixed with other wastes and applied to land or sold separately as animal feed.

Potential benefits

– trub and yeast waste can contain large quantities of all the major plant nutrients, which can be highly beneficial.

Potential negative impacts

– this waste can be odorous.

Sludges from onsite effluent treatment

Waste from non-alcoholic drinks

Non-alcoholic drink manufacturers produce large volumes of wastes with low solids contents and with very low nutrient contents, but with very high levels of soluble sugars. This can give the waste a high biochemical oxygen demand (BOD) and a very low pH. The pulps from the mechanical juice extraction are frequently used in animal feeds or as feedstock in composting operations. Treating the waste by aerobic or anaerobic digestion reduces the BOD. This treatment produces a biological sludge with a nitrogen content that may have potential agricultural benefit or provide the means for ecological improvement.

Waste from non-alcoholic drinks

Benefits and potential negative impacts of application to land

Untreated waste

Because sugars do not contain plant nutrients, applying untreated waste is difficult to justify in terms of agricultural benefit. However, operators may find that applying untreated waste is valuable for irrigation purposes.

Potential benefits

– treating this waste can produce a sludge containing plant nutrients that are beneficial to the soil

Potential negative impacts

– the pH of this waste is normally low. Therefore the waste should not be applied to land with soils of pH less than 5.5 unless the acidity of the waste has been neutralised by adding caustic soda or similar alkali material

– this waste can be odorous.

03 Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard

03 01 wastes from wood processing and the production of panels and furniture

03	WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, PULP, PAPER AND CARDBOARD
03 01	**wastes from wood processing and the production of panels and furniture**

03 01 01	waste bark and cork
03 01 05	untreated sawdust and wood shavings other than those mentioned in 03 01 04 only
03 01 05	sawdust, shavings, cuttings, wood, particle board and biodegradable veneer other than those in 03 01 04

Waste bark and cork and untreated sawdust and wood shavings other than those mentioned in 03 01 04 only

Waste bark and wood contain high organic matter, giving them potential value as a soil conditioner. Chipped wood and bark can be used directly as a mulch to suppress weed growth and conserve moisture. Please refer to section 1, 20 02 01 (plant tissue waste only) for information on the landspreading of mulch. This section will consider issues specifically related to the use of waste wood from wood processing associated production on land.

Operators will need to confident in the source of the waste wood and its former uses. Material containing old fencing / waste wood may have been treated with preservative chemicals such as pentachlorophenol, lindane or copper chrome arsenate. Timber yard by-products may also contain persistent preservative chemicals containing dangerous or hazardous substances which may contribute to metals contamination.

If these chemicals may be present the operator should provide analysis to demonstrate that the waste does not contain these preservatives or any other chemicals associated with wood processing or use.

More information on treated wood can be found in our **Regulation of Wood** position statement.

The nature and origin of waste wood also needs to be considered in case diseased material is present that could act as a source of infection for succeeding crops. Rotten wood may harbour the honey fungus, Armilleria, which can destroy trees and shrubs.

Application to land of wood products with a high C/N ratio can temporarily remove plant available nitrogen from the soil. Additional inorganic nitrogen should be applied to the soil to compensate for this and avoid a reduction in crop yield and quality.

Sawdust, shavings, cuttings, wood, particle board and biodegradable veneer other than those in 03 *01 04*

Panel board manufacturing involves the use of resins and bonding agents that can contain contaminants, depending on the type and quantity of the bonding agent. Urea based resins can be a source of Nitrogen.

04 Wastes from the leather and fur and textile industries

04 01 Wastes from the leather and fur industry

04	WASTES FROM THE LEATHER, FUR AND TEXTILE INDUSTRIES
04 01	**wastes from the leather and fur industry**
04 01 07	sludges from on-site effluent treatment free of chromium

Sludges from on-site effluent treatment free of chromium

Waste from processing hides and fellmonger sludges come from the primary processing and curing of animal hides. Hides are transformed into leather by two main methods:

- chrome tanning
- vegetable (polyphenol) tanning.

Where the chrome tanning method is used, much of the chromium is recycled within the tannery, however even with chrome recovery some fellmonger sludges may contain levels of chromium and salt. Waste sludges containing chromium are not suitable for landspreading and alternative disposal routes should be identified. Sludges being put forward for land spreading should be fully described (including analysis as appropriate) to demonstrate they are free of chromium.

The chemical and other treatments given to hides in tanneries often disinfect the waste. UK tanneries are unlikely to produce waste that contains chromium (VI) because currently no tanneries are known to use chromium (VI) for their tanning process. Waste analysis should be used to assess the metals content of these sludges.

9.1.1 Waste from processing hides and fellmonger sludges **Benefits and potential negative impacts of application to land**
Potential benefits – major nutrients from the animal products and dirt remain in the effluent – the nutrient content is highly variable. **Potential negative impacts** The waste may contain various different contaminants. The contaminants depend on the processes that produce the waste. The main concerns arise from: – using dyes – the presence of organophosphorus pesticide residues – chromium – high levels of sulphide.

04 02 Waste from the textile industry

04	**WASTES FROM THE LEATHER, FUR AND TEXTILE INDUSTRIES**
04 02	**wastes from the textile industry**
04 02 10	organic matter from natural products only (wool only)
04 02 15	biodegradable wastes from finishing other than those containing organic solvents only
04 02 20	sludges from on-site effluent treatment other than those mentioned in 04 02 19

04 02 21	wastes from unprocessed biodegradable textile fibres only
04 02 22	wastes from processed biodegradable textile fibres only

Wool carpet wastes

Wool carpet waste (shoddy) has traditionally been applied to agricultural land as a slow release fertiliser. Wastes also include cropper dust (a type of floc) which arises from the finishing of carpets. Changes in production processes have largely replaced wool carpets with wool rich or totally synthetic carpets. Both contain plastic which prevents their direct use in land spreading operations.

Carpet backing materials, unless organic (e.g. Hessian), will also present difficulties in the use of the waste in land spreading activities.

Wool wastes may contain chemicals, used in the production: for example, pyrethroid insect-resist agents (moth proofers) and bleaches used to clean fibres.

Keratin is a major component of wool fibre and a source of slow release nitrogen. If composted first, the composting process may provide favourable conditions for keratinophilic fungi. These may be pathogenic to humans and animals coming into contact with the compost or receiving soil and crops produced from such soils for example: salad crops, eaten raw which may be contaminated with soil.

Wool carpet

Benefits and potential negative impacts of application to land

Potential benefits

- the addition of organic matter to the soil
- improved moisture retention
- plant nutrient inputs, typically nitrogen (2-15kg/ha), phosphate (0-15 Kg/ha), potash (0-7kg/ha) and sulphur (>50kg/ha)
- addition of natural fibre to the soil may reduce the effects of soil erosion and increase resistance to compaction
- the waste has a low neutralising value.

Potential negative impacts

- addition of non-degradable material such as plastic and polypropylene backing shred and synthetic fibres to the soil (see box 13.5.2 Composted wastes - Plastics in composted outputs)
- potential increase of keratinophilic fungi in the receiving soil
- addition of PTE's to the receiving soil such as zinc and chromium
- carpets and carpet fibres are treated with a variety of different substances. These include treatments to increase stain resistance, moth proofing such as pyrethrins and antimicrobial treatments. Carpet backing materials may also contain vulcanization agents such as styrene.

Waste from finishing processes

The textile industry includes ‘finishing processes’ that dye textiles. These processes produce large quantities of sludges and other process effluents, which are often mixed with bleaching agents such as ammonia.

Waste from finishing processes may be classified as hazardous waste by its properties or the threshold concentrations of certain compounds/elements. Further guidance can be found at: **Guide to hazardous wastes**

Waste from finishing processes **Benefits and potential negative impacts of application to land**
Potential benefits – The nutrient content is highly variable and depends on the constituents of the dyeing process. – the nitrogen content is usually very high (in the order of 5 kg m-3) due to the ammonia content – the waste often contains 1-2 kg m-3 of phosphate and potash. **Potential negative impacts** – the pH is frequently in excess of 7.0, due to the presence of ammonia, but this does not have a significant liming effect – dyes used in the textile industry may contain various metals or organic compounds, which contribute to the colouring effect. Although the dyes are not manufactured in the textile process, the washing process takes dye residues into effluent treatment plants, where the residues are concentrated into the sludge for disposal. This can create levels of metals of the order of several 100 mg/kg – textiles and textile fibres may be treated with a variety of different substances. These include treatments to increase stain resistance, moth proofing such as pyrethrins, water proofers and antimicrobial treatments.

Wool scouring sludge

The primary textile industries generate large quantities of waste from washing. The wash water often contains large quantities of:

- waste wool
- dags (that contain animal excrement)
- grease
- suint (which is a potash-rich animal residue)
- Organic matter from natural products such as greases and waxes.

The waste is likely to have similar properties to the **oily wastes.** A precautionary approach must be taken where grease and wax content exceeds 4% and justification of the benefit and environmental mitigation may be required.

Wool scouring sludge Benefits and potential negative impacts of application to land
Potential benefits – the nutrient content is highly variable and depends on the proportions of fibres and animal excreta in the sludge – the nitrogen content is usually high, 2-5 kg m-3 – the waste may contain moderate amounts of phosphate and potash (approximately 1 kg m-3) – improved moisture retention – adds organic matter to the soil. **Potential negative impacts** – The various washing processes that are carried out on fleeces create waste that contains pesticide residues and grease. – organophosphorus and organochlorine compounds and synthetic pyrethroid pesticides can be found in association with the grease fraction of the sludge. Most of these compounds are approved pesticide products but imported wool can contain Red List compounds such as gamma-HCH (lindane) DDT. Analysis can now detect very low levels of these materials in scouring sludge and producer sites should have carried out this testing. Operators wishing to spread this waste should provide this information with their deployment application.

05 Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal

05	WASTES FROM PETROLEUM REFINING, NATURAL GAS PURIFICATION AND PYROLYTIC TREATMENT OF COAL
05 01	**wastes from petroleum refining**
05 01 10	activated sludges from on-site oil refinery biological effluent treatment plants other than those mentioned in 05 01 09

Activated sludges from on-site oil refinery biological effluent treatment plants other than those mentioned in 05 01 09

Generic information on sludges from biological effluent treatment plants can be found in **02 03 sludges from onsite effluent treatment plants of food and drink waste**

10 Waste from thermal processes

10	WASTE FROM THERMAL PROCESSES
10 01	**waste from power stations and other combustion plants**
10 01 01	poultry litter ash, paper sludge ash and ash from wood chip boilers only

10 01 Waste from power stations and other combustion plants

Poultry Litter ash, Paper Sludge ash and ash from wood chip boilers only

For the purposes of landspreading permits ash is the term given to the products of incineration and burning of biodegradable materials and wastes only. Ashes derived from the burning of non-biodegradable waste are not suitable to be spread to land under these permits.

The combustion process produces four types of ash:

- Fly ash (a pollution control residue)– this is the ash that rises with the flue gases and is collected via abatement measures such as cyclones to reduce the particulate matter released to the environment.
- Bag ash (a pollution control residue) - The incineration process often uses abatement measures to reduce chemical contaminants such as oxides of nitrogen released into the atmosphere from flue gases. These can be treated by the addition of ammonia or urea to the flue gas if required. This may result in generation of bag ash and other types of gas cleaning residues.
- Bottom ash or incinerator bottom ash (IBA) – this is the ash that sinks to the bottom and is discharged into the burning grate.
- Boiler dust – dust collected within the incinerator

Operators will need to ensure that they understand the source and type of the ash as this will affect the EWC code of the waste and potential contaminants and therefore sampling requirements.

Ash streams should be described and identified separately and be able to confer benefit in their own right when applying for deployment applications. These waste streams should not be mixed prior to characterisation and sampling.

Poultry litter ash (PLA)

Poultry litter mainly from the rearing of chicken for meat can be used as a feedstock in power stations. The material consists mainly of wood shavings, poultry manure, feathers and straw. The management within a poultry shed seeks to maintain litter in a dry friable state. Poultry litter ash has a calorific value approximately 50% that of coal and the ash contains useful quantities of Calcium, Potash and Phosphate.

The **Poultry litter ash Quality Protocol** has been developed for the designated market sector which is the use of PLA as a PK fertiliser in agriculture. If the PLA is compliant with this quality protocol this material may be spread to land as a fertiliser outside the controls of Environmental Permitting.

PLA not compliant with the Quality Protocol

Where the ash has been produced in accordance with the input materials as detailed in the box below, but for some reason fails to reach the standard required by the quality protocol (for example exceeds metals thresholds) then this ash may be spread to land under SR2010 No.4 to allow a site specific assessment to be made of the proposed ash application.

Operators should refer to the **Poultry litter ash Quality Protocol** for more information on substances likely to be present in this ash and the relevant thresholds.

Acceptable input materials

PLA should be produced using only the input materials shown in the table below. Ash that is produced from other wastes not included in the quality protocol (for example treated wood) is not suitable for use under this standard rules permit.

Poultry litter ash (PLA) **Acceptable input materials under the PLA Quality Protocol**
– Poultry litter (chicken and turkey): 02 01 02 – Forestry waste (woodchip): 02 01 07 – Horse bedding derived from untreated wood sawdust: 02 01 03 & 02 01 06 – Meat and Bone Meal and pet food (from Category 3 animal by-products): 02 02 02 – Feathers 02 01 02 – Any other high calorific alternative

Poultry litter ash (PLA) **Benefits and potential negative impacts of application to land**
Potential benefits: – provides phosphate and potash in readily available forms – ash is also a source of calcium and magnesium (NV typically 14%) – ash contains useful amounts of sulphur and sodium – trace nutrients include, copper, cobalt, boron, manganese, zinc and iodine **Potential negative impacts** – ash can be difficult to handle due to the dusty nature of the material – damping fine ash with water may reduce spreading accuracy as the ash will tend to form lumps and may coat machinery such as spinning discs and the moving floor mechanisms of spreaders – the ash may irritate the skin and eyes – ash can contain variable levels of PTE'S and dioxins.

Paper sludge ash (PSA)

Paper sludge is the waste product from the recycling of paper products at paper mills. Paper sludge is a combination of short cellulose fibres, water, ink, soap and other minerals (e.g. kaolin, carbonates and talc) separated from the recovered paper feedstock.

PSA is a residue from the incineration of paper sludge and other input materials from the recycling of newspaper-related products. The fly ash from the incineration of paper sludge contains a mixture of calcium and magnesium compounds which are capable of adjusting soil pH levels.

Production and end uses of PSA were being considered for development of a Quality Protocol. This quality protocol is no longer being developed and therefore PSA should now all be spread to land under environmental permits.

The rate at which PSA is applied to the land should be based on the comparative need for agricultural lime based on cropping, receiving soil type and current soil pH and intended target soil pH. The neutralising value of PSA is typically 37% or higher (CaO). Low neutralising value wastes result in higher application rates with higher neutralising value wastes application rates will be lower.

Paper sludge ash (PSA)

Benefits and potential negative impacts of application to land

Potential benefits

- the benefit comes from the waste's liming value. NV can vary depending on the source and moisture content of the waste
- some wastes may also contain small amounts of potash and phosphate however the benefit from these nutrients is negligible because the application rate will be dictated by the lime value.

Potential negative impacts

- PSA may contain residues from the combustion materials
- PSA may contain PTE'S and other contaminants
- PSA can produce very fine dust when spread which may be harmful to human health or cause nuisance
- PSA may be classified as hazardous waste if it possesses any of the hazardous properties H1–H14.

For more information on assessing the hazardous properties of waste, refer to our website pages on **Technical Guidance WM3** and **guide to hazardous wastes**.

Ash from biomass fuels (including woodchip boilers)

Wood ash is the inorganic and organic residue remaining after the combustion of wood or unbleached wood fibre. The physical and chemical properties of wood ash vary significantly depending largely on feedstock and the incineration process. Hardwoods usually produce more ash than softwoods and bark and leaves generally produce more ash than the inner woody parts of the tree. Wood ash composition can be highly variable depending on where the wood was originally sourced from.

The presence of organic chemical contaminants in the ash will depend largely on other feed stocks e.g. if the biomass is co-fired with treated timber wastes. It is therefore important for the operator to provide details of the fuel and combustion process. Operators should also

therefore be able to provide details of the input materials. For more information on treated wood please see our position statement on the **Regulation of Wood**.

Operators should consider the inputs and processes and also refer to the **Poultry litter ash Quality Protocol** and the table above for more information on substances likely to be present in this ash.

Ash from biomass fuels

Benefits and potential negative impacts of application to land

Potential benefits

- calcium is the most abundant element in wood ash and gives the ash properties that may be used to confer lime benefit. Wood ash has a pH in the range of 8 – 12
- ash is also a source of potassium, phosphorus, magnesium, and aluminium average wood ash is generally in the range of 0-1-3 (N-P-K)
- trace nutrients include, Boron and Sodium
- contributes to soil organic carbon
- contains the charred remains of plants and in a similar way to bio-char[6] will provide:
- cation exchange sites and soil organic carbon
- moisture retention
- soil conditioning material.

Potential negative impacts

- wood ash can be difficult to handle due to the dusty nature of the material
- damping fine ash with water may reduce spreading accuracy as the ash will tend to form lumps and may coat machinery such as spinning discs and the moving floor mechanisms of spreaders
- the ash may irritate the skin and eyes
- ash can contain variable levels of PTE'S.

For more information on assessing the hazardous properties of waste, refer to **Technical Guidance WM3** and **guide to hazardous wastes**

Ash from biomass fuels

Wood ash typically contains the following constituents (the concentrations of these constituents may vary)

	Coniferous forestry residue	SRC willow	Cereal straw	OSR straw	Miscanthus	Reed canary grass
Sulphur %w/w Dry ash free basis	0.04	0.05	0.1	0.3	0.2	0.2

[6] Bio-char is the charcoal like residue left following the pyrolysis of organic plant material

Chlorine %w/w Dry ash free basis	0.01	0.03	0.4	0.5	0.2	0.2
Al (mg/kg DM)	-	-	50	50	-	-
Ca (mg/kg DM)	5000	5000	4000	15000	2000	3500
Fe (mg/kg DM)	-	100	100	100	100	-
K (mg/kg DM)	2000	3000	10000	10000	7000	12000
Mg (mg/kg DM)	800	500	700	700	600	1300
Na (mg/kg DM)	200	-	500	500	-	200
P (mg/kg DM)	500	800	1000	1000	700	1700
Si (mg/kg DM)	3000	-	10000	1000	-	12000
Source: Biomass ash characteristics and behaviour in combustion, gasification and pyrolysis systems by W R Livingston						

Spreading farm produced incinerator ash on land

Farm produced incinerator ash from the incineration of pig and poultry carcasses can be mixed with farm manure and spread on land as a fertiliser or soil improver on the farm producing the ash.

This spreading activity must be carried out under a U15 exemption and should comply with the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

19 Wastes from the aerobic treatment of waste

19 05 Wastes from the aerobic treatment of waste

19	WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE
19 05	**wastes from the aerobic treatment of waste**
19 05 99	liquor and digestate from aerobic treatment of source segregated biodegradable waste only

Liquor and digestate from aerobic treatment of source segregated biodegradable waste only see section 2, **19 05 wastes from the aerobic treatment of waste** for more information.

20 Municipal wastes

20 02 Garden and Park Wastes

20	MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS

20 02	garden and park wastes (including cemetery waste)
20 02 01	seaweed only plant tissue waste only
20 02 02	soils and stones

Plant Tissue Waste only

Waste from the shredding of source segregated garden waste

This waste stream can include household green garden waste collections, usually undertaken by local authorities. The waste collected as part of local authority collection rounds is tipped and shredded prior to stockpiling and spreading. This process is often referred to as 'shred and spread'.

The waste acceptance procedure must include some form of inspection of the incoming wastes to remove and quarantine any unsuitable material prior to shredding, examples of suitable and unsuitable wastes are listed in the box below.

There is no recognised composting process employed in this activity which means that there will be no thermal pathogen or pest destruction, although some rotting will occur in the stockpiles pre and post shredding.

The lack of a recognised composting process means there is potential for transmissible plant diseases to survive the process and be spread on farmland which may subsequently be used in the production of susceptible crops (see **Code of Practice for the Management of Agricultural and Horticultural Waste** and the plant pathogens sections 1.5.1.6 &1.8). The waste may also contain kitchen vegetable scraps and animal faeces which may introduce Escherichia coli, Listeria monocytogenes, Salmonella serotypes and other animal pathogens and parasites into the shredded material.

The shredding activity may give rise to nuisance issues such as odour, noise and dust at the place it is carried out and during the stockpiling and spreading operations.

Shredded green material contains nutrients in non-readily-available but mineralisable and organic forms. The Carbon: Nitrogen ratio is variable with this waste material and is dependent on the wastes accepted, a high proportion of woody material in the waste will result in a high C: N ratio and may cause nitrogen lock-up in the receiving soil.

Nutrient additions should be quantified in the benefit statement as part of the justification for the application to land. The benefit statement should address the potential for pathogen and weed transmission, the risks posed by this material and preventative measures to be employed during and after the operation.

This waste is best incorporated soon after spreading to allow biological activity to release the nutrients contained within the material. Applications to grassland should be avoided to prevent livestock ingesting potentially harmful plant debris.

Waste from the shredding of source segregated household garden green waste **Suitable and unsuitable waste types for inclusion in shred and spread operations**
Many local authorities accept the following in their garden waste collection bins. These acceptable wastes are: – grass and hedge cuttings

- small plants and shrubs
- small branches, twigs and bark
- leaves and weeds
- flowers.

Wastes from the growing of vegetables in the garden such as potato haulms, diseased vegetables etc. which may carry transmissible plant diseases, or plant protection product residues may be collected.

Waste should not contain physical contamination such as:

- kitchen and food waste including vegetable peelings
- rubble, stones and soil
- large branches, logs and stumps
- treated timber containing dangerous or hazardous substances
- pet waste
- plastics (including bags and pots - see box 13.5.2 Composted wastes
- Plastics in composted outputs)
- glass or any other refuse
- batteries
- plasterboard
- sharps and metal.

Waste from the shredding of source segregated household garden green waste

Benefits and potential negative impacts of spreading shredded household green waste

Potential benefits may include

- adding green organic material to the soil in a similar way to a green manure crop such as mustard, if incorporated
- act as a soil conditioner
- addition of plant nutrients (N, P, K, Mg & S) to the soil
- may encourage biological activity in the soil.

Potential negative impacts may include

- contamination of soil or crops with plant diseases and fungal spores
- contamination of soil or crops with weeds or exotic species
- on grazing and conservation land exotic species may be harmful to livestock or contaminate silage/hay crops
- pet faeces may contaminate grassland or land destined for root or vegetable crops

- chemical residues such as slug pellets, weed killers or insecticides may contaminate soil, affecting soil biota and growing plants
- applications to cultivated land may affect the activity of herbicides and other agrochemicals (see box 2.3.3 below).

Applications of shredded green waste to land should be in accordance with the **Code of Practice for the Management of Agricultural and Horticultural Waste**

The effects of soil organic matter levels on applied agrochemicals

The effect of high organic matter content in the soil on applied agrochemicals including pesticides and herbicides is because many of these chemicals have a strong affinity to organic matter, this means when they are used on soils with a high organic matter content (>10%) they tend to be attracted to the organic material. The agrochemicals held by the organic matter can be broken down by microorganisms, although chemical processes such as hydrolysis and oxidation may also contribute to the degradation process. The rates of these processes depend on the agrochemical products chemical structure.

This may reduce the effectiveness in the field, for example with pre-emergent residual herbicides and other soil applied agrochemicals.

On sandy soils there is a risk of applied products containing herbicides or other agrochemicals leaching rapidly into the soil which can cause root and soil damage.

Biological Chemistry - Assessing the environmental safety of pesticides - Richard H. Bromilow and Pete H. Nicholls (2002)

Biobeds for treatment of pesticide waste and washings Paul Fogg and Lindsay Fogg, ADAS UK Ltd (April 2009)

Mulch

Waste from wood, bark and other plant tissue matter can be used as a mulch to suppress the colonisation of weeds and reduce the loss of water from the soil. This waste is also applied because the organic matter in the waste can provide nutrients or improvements to soil structure.

Mulch is unusual in that incorporation into the soil is incidental to the application. Incorporation may occur at the end of the crop cycle, which may last several years, for example soft fruit production.

Ecological enhancement applications may never mechanically incorporate the mulch but leave the material on the surface to decay over time as the vegetation it was placed to protect establishes.

Mulches should be applied as soon as possible after soil disturbance from the cultivation and planting operations has ceased.

- Mulch should ideally be between 50 and 100mm deep
- One tonne of timber can produce approximately two cubic metres of chips, depending on timber dry matter
- Shallower depths may be refreshed with further applications if cropping or planting allows. Deeper applications are generally one-off applications to allow establishment

- The oversize shreds produced from the screening of composted green waste (15mm +) are often used as mulch
- Application rates may vary between 5 and 80 tonnes per hectare depending on the depth and bulk density of the material.

Any application to use waste materials as mulch should be able to justify the suitability of the material in terms of potential contaminants and benefits. Wood wastes should not contain dangerous or hazardous substances. For more information see our **regulation of wood position statement**. Wastes containing hazardous or dangerous substances described in **Technical Guidance WM3** and **Guide to hazardous wastes**.

Waste which is at high risk of being contaminated with weed and plant pathogens should not be used unless it has undergone appropriate treatment e.g. composting or pasteurisation.

Where the waste has not been treated prior to mulching, there should be analysis to demonstrate the waste is not a risk to the receiving soils.

Mulch

What makes a good mulch

- the mulch should be free of weed seeds and plant pathogens
- the individual particle size should be large (15mm+), to improve persistence, aeration and drainage
- the nitrogen: carbon ratio should be close to that of soil to ensure that after application, nutrient lock up does not starve plants of nitrogen and/or phosphorus, and microbial activity does not starve roots and germinating seeds of oxygen
- the presence of salts such as sodium and potassium should be low enough so as not to give high conductivity results which may discourage biological activity in the top layers of the soil.

Mulch

Benefits and potential negative impacts of mulch

Potential Benefits

- mulch acts as a weed suppressant
- mulch offers protection against soil erosion
- mulch protects the soil from temperature variation (ground frosts)
- application of this material can increase water retention
- mulch reduces soil splashing from rain– beneficial for salad crops and soft fruits
- mulch contributes organic matter to the soil throughout its life
- mulch acts as a slow release source of nutrients
- the subsequent incorporation of used mulch increases soil organic matter and can improve soil bulk density.

Potential negative impacts

- the incorporation of large quantities of woody mulches may temporarily increase the carbon: nitrogen ratio in the soil causing a net lock up of crop available nitrogen
- there is increased risk of plant pathogens for untreated plant matter and woody material
- there is increased risk of pathogens harmful to humans and animals in untreated material
- applications to cultivated land may affect the activity of herbicides and other agrochemicals (see box 2.3.3 below).

Mulch

Suitable and unsuitable materials for the production of mulch

Materials suitable for mulching

- They should be clean and free from physical contamination.
- The material should last the crop season and be free from weed seeds.
- Wood chips should be from clean untreated timber
- Wastes from the processing of clean untreated timber
- Oversize chips from compost screening and,
- Composted segregated green waste.

Unsuitable materials

Mulches that contain excessive quantities of the following should be deemed unsuitable:

- plastics (see box 13.5.2 Composted wastes Plastics in composted outputs)
- untreated / un-sanitised green waste
- treated and/or painted timber products see box 2.1.4
- recognisable paper and cardboard
- foils
- plasterboard
- metals
- large pieces of masonry or stones and,
- glass.

The standards for assessment of contamination levels should be based on **PAS 100**. Further guidance on suitable and unsuitable materials can be found in our position statement on **the environmental regulation of waste wood** and the following WRAP reports:

- **Technical report on the manufacture of products from waste wood**
- **Options and Risk Assessment for Treated Wood Waste.**
- **Development of waste sawdust as a plant protection material for horticulture and agriculture**

Further guidance on sanitisation as a process involving the temperature degradation of pathogens through the correct management of the composting process can be found in the following documents:

- Review of the literature on eradicating Plant Pathogens and Nematodes during composting
- Review of the literature on the occurrence and survival of Pathogens of Animal and Humans in green compost

Mulch

Examples of potential chemical and biological contaminants of mulch

Chemical contamination

The chemical contaminants in the waste generally depend on the manufacturing or treatment processes that were applied to the wood or plant material before it became waste:

- sawdust can contain wood preservatives and pesticides such as pentachlorophenol and lindane
- applicants should test for organic contaminants unless the waste producer can give assurance that the waste is free from preservatives
- chemicals, such as copper chrome arsenate, were used in the past for wood preservation, paints and other wood coatings including varnishes and preservers containing dangerous or hazardous substances which may contribute to metals contamination
- the bonding agents used in the manufacture of particle board may be contaminants, depending on the type and quantity of the bonding agent.

Biological contamination

Operators should consider the properties and origin of waste plant matter because the waste may contain diseased material that could be a source of infection for crops. The following are examples of wastes that operators should not apply to land:

- waste containing haulms and tubers from potatoes infected with the potato blight fungus (Phytophthora infestans)
- diseased plant waste on agricultural land — see about diseased plant waste and the Plant Health Division, below
- To prevent the introduction and spreading of Rhizomania, which is a notifiable disease of beetroot, fodder beet crops and sugar beet, do not apply vegetable wastes, washing-waters and soil from the following sources:
- farms where rhizomania has been recorded
- the industrial washing, grading, packing and processing of imported vegetables.
- Phytophthora ramorum and Phytophthora kernoviae are serious fungus-like pathogens that cause damage to a wide range of trees and plants

- Trees and plants that are infected with P. ramorum or P. kernoviae are not suitable for composting or mulch production and it is not permitted by either Natural Resources Wales or Fera.

Further guidance can be found on the exemptions page of our website for disposing of trees infected with P. ramorum P. Kernoviae.

Further information and bio-security measures can be found on:

- **Natural Resources Wales website**
- **FERA website**

Plant Health Division PHD

The **Plant Health Division** (PHD) in Defra can advise on the policy for plant quarantine and plant certification in England and Wales (except in relation to the pests of forests, trees and wood). Plant Health (Great Britain) 1983 controls the disposal of diseased plant waste, this waste must be incinerated or sent to a landfill and cannot be applied to land.

The PHD:

- lead for the UK in international flora
- is the 'Single Central Authority' for plant health under EC legislation
- issues scientific licences for work on prohibited pests and plants and,
- issues phytosanitary certificates for some plant products.

You can find further information in the **Code of Practice for the Management of Agricultural and Horticultural Waste**, published by the former Ministry of Agriculture, Fisheries and Food (MAFF) in 1998.

Waste from foreign vegetables

Defra places controls on waste from foreign vegetables to prevent diseases spreading within England and Wales. They have particular concerns about the disease risk posed by foreign potatoes. The applicant must determine the origin of the vegetables in vegetable waste if there is the potential for foreign material to be present.

Municipal waste and House hold waste such as vegetable peelings which are shredded and spread to land may contain pathogens, unless it is effectively heat treated. Waste which is not treated is considered high risk and will need to undergo further testing.

Pathogens

Operators must examine waste materials for the presence and number of pathogens, unless the waste has been sanitised. If the waste has been sanitised the operator must be able to provide evidence that this has been undertaken correctly.

Sanitisation is a process involving the temperature degradation of pathogens through the correct management of the composting process.

- **Review of the literature on eradicating Plant Pathogens and Nematodes during composting**

- **Review of the literature on the occurrence and survival of Pathogens of Animal and Humans in green compost**

Microbiological analysis

Operators may need to conduct microbiological analysis:

- if there is uncertainty about whether the waste is a hazard i.e. wastes arising from household food or plant matter or food processing including the wastes from the processing of dairy products
- to prove that a hazard does not exist.

Harmful bacteria that may be present in food and vegetable processing wastes include, Escherichia coli, Listeria monocytogenes and Salmonella serotypes.

If there is any concern that the waste is a health hazard, contact the Local Authority Environmental Health Department for advice.

Incorporation in soil

Perennial crops such as strawberry and soft fruit production may require re-application of mulch to replace losses through natural oxidation and soil incorporation. In annual crops any remaining mulch on the surface will be incorporated with crop residue by the cultivations for the next crop. Mulch will be naturally incorporated into the upper layer of the receiving soil during its life due to biological action and oxidation caused by repeated wetting and drying of the upper surface of the mulch. Settlement throughout its life will further reduce the depth of mulch on a soil surface.

To achieve incorporation, an operator should spread a shallow layer of waste so that normal agricultural operations can incorporate the material into the agricultural soil profile (such as by deep, shallow and subsoil ploughing). To meet this requirement, the maximum depth of the waste following spreading is set out in box 2.2.5.1 below.

Spreading volumes and depths
– 1 hectare = 10,000m2
– at 250t/ha spread depth is 0.025m e.g. soil
– at 1500t/ha spread depth is 0.15m e.g. sugar beet soil
– at 5000t/ha spread depth is 0.5m e.g. dredgings.
– The depths achieved using other wastes will depend on waste type and the bulk density of the waste (kg/m3).
– 'Spreading' means any method of applying waste to the surface of the soil or directly within the body of the soil (rooting zone).

Section 2: Wastes listed under SR2010 No4 and SR2010 No5

The wastes listed in this section may be spread for the following purposes:

- To agricultural and non-agricultural land for agricultural benefit/Ecological improvement (Standard Rules 2010 No4)
- To land that has previously undergone industrial/manmade development for agricultural benefit/ecological improvement Standard rules 2010 No5)

03 Waste from pulp, paper and cardboard production and processing

03 03 Wastes from pulp, paper and cardboard production and processing

03	WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, PULP, PAPER AND CARDBOARD
03 03	**wastes from pulp, paper and cardboard production and processing**
03 03 05	de-inked paper sludge and de-inked paper pulp from paper recycling only
03 03 09	lime mud
03 03 10	fibre rejects and sludges including mineral based fillers and coatings only
03 03 11	sludges from on-site effluent treatment other than those mentioned in 03 03 10

De-inked paper sludge and de-inked paper pulp from paper recycling only

Paper sludge is the residue from the preparation of recycled paper prior to its re- use in the paper production process, it may also be from the processing of virgin fibre from a variety of fibre sources such as wood or cotton.

Paper sludge contains short cellulose fibres which are not suitable for use in paper production, sludge from recycling also contains printing inks and mineral components such as kaolin, talc, and calcium carbonate.

The de-inking and bleaching process means paper sludge can vary in colour, it is typically light grey through to blue-grey but other colours such as pink are possible depending on the types of paper used in the recycling process.

The ink residue from the recycling process is the primary source of PTE'S in the sludge, however for many types of paper the PTE content of ink has been significantly decreased over the past 15 years to comply with the food packaging regulations and sludge now contains fewer PTE'S.

The main factor that influences agricultural benefits and potential negative impacts is the treatment given to the paper sludge before the operator applies it to land. Operators should assess the waste's potential for other contaminants. The contaminants depend on the nature of the manufacturing process and the waste treatment processes. See box below.

Waste from producing and processing pulp paper

Natural Resources Wales's research report SC030181/SR

Natural Resources Wales report contains the most up-to-date information on the extent, nature and environmental implications of applying paper waste to agricultural land in England and Wales.

The majority of paper waste is given some form of treatment, either biological or non-biological. The type of treatment appears to be the most significant factor that determines the composition of the waste and the benefits when applied to land e.g. the quantities of nutrients provided by paper waste depend highly on the waste's treatment before it is applied to land.

Paper waste can be split into two categories based on nutrient and heavy metal concentrations:

1. paper waste with a biological element in the treatment processes
2. paper waste containing no biological element in the treatment processes (that is, treatments are only chemical and physical)

Sludges consist of organic matter mainly in the form of cellulosic paper and lignin wood fibres. Paper is either de-inked or not depending on the product being made (packaging paper generally doesn't require de-inking while newsprint will). Sludges will contain short or rejected fibres unsuitable for further processing and varying amounts of fillers and coating compounds (clays, ash, chalks and alike and various chemicals including starches and some residual metals from printing inks containing copper). They are used to achieve particular properties in the final paper such as brightness, strength and smoothness etc.). Generally less fillers are used in board manufacture than fine papers although recent trend is the opposite with increased demands for quality, shelf ready printable packaging. If de-inking is carried out, the sludge may also contain de-inking substances or ink particles as well as detergents/surfactants used for the de-inking process.

Because nitrogen and phosphorus are essential for biological processes, they are added to secondary treatment processes. Therefore, the biologically-treated waste typically has higher nutrient and heavy metal contents than chemically- and physically-treated waste. These differences are a result of using biologically active materials such as sewage sludge to drive the biological treatment process.

Commonly, paper waste applied to land is a mixture of primary and secondary treated materials. Experimental data shows that the liming value of paper waste generally ranges between 0.1 and 0.7 pH units rise per 100 t/ha (fresh weight) of waste applied to the land. The TNV of paper sludge is typically between 1% and 21% with a mean of 8% (CaO) on a dry matter basis.

Natural Resources Wales's research report provides only limited information on how much plant nutrient is available. The report does, however, provide composition analysis for the different forms of treated paper waste.

Nitrogen lock-up can also affect crop growth Natural Resources Wales's research report identifies spring barley as a particularly vulnerable crop. Operators can use extra inorganic nitrogen to overcome nitrogen lock-up. The application rate is variable Natural Resources Wales's research report cites the mean application rate as 48 kg of nitrogen per hectare.

Applying paper waste has been shown to reduce nitrate leaching as a consequence of nitrogen lock-up. However, some of the locked-up nitrogen may be re-mineralised and leached, particularly in warm, damp weather.

The report can be downloaded from the following link: **Land-spreading on agricultural land: nature and impact of paper wastes applied in England & Wales, Report SC030181/SR**

Where paper sludge is applied to grassland splitting the application and allowing time between applications for the waste to incorporate into the sward is good practice, harrowing the spread fields following waste applications can increase the rate of sward incorporation by opening up the bottom of the sward and breaking up any larger lumps of paper sludge waste. The benefits of following an application of waste to grassland with harrowing are:

- reduce the visual impact of the activity
- incorporate the waste into the base of the sward, increasing soil contact
- reduce the possibility of stock ingesting the material when grazing.

Waste from producing and processing pulp paper

Benefits and potential negative impacts of application to land

Potential benefits

- liming value
- nutrient supply particularly for phosphorus, potassium and sulphur
- organic matter providing soil conditioning properties such as porosity, moisture retention, structural stability and improve soil bulk density
- increase biological activity in the soil
- improve the size of the microbial and faunal population.

Potential negative impacts

- high surface application rates to grassland may cause smothering and stock rejection
- high C:N ratio of the waste may cause nitrogen lock up; Nitrogen could be added to sludges to prevent this.
- paper sludge can contain PTE'S particularly copper in de-inking sludges from the printing inks
- organic contamination
- odours
- deterioration of soil structure can be caused by elevated sodium content (>2,500 mg/kg) in certain paper sludges.

Waste from producing and processing pulp paper

Application rates and cropping

Application rates

Mean application rates for biologically treated waste are around 40 t/ha fresh weight or lower based on addition of nutrients from the effluent treatment plant. Mean application

rates for chemically and physically treated waste are higher at 75 t/ha. However, there is significant variation in application rates, the application rate depends on:

- the current or proposed cropping regimes
- liming requirements
- the waste's composition
- the soil characteristics
- the highest application rates are commonly associated with grass re-seeding or arable cultivations, where cultivations incorporate the material through the plough layer
- lowest applications are on the surface of permanent grassland due to potential problems with smothering and stock rejection.

Winter sown crops

Over half the paper wastes are currently applied on land where winter-sown crops will be grown. This is because:

- ground conditions are usually more favourable from late summer to early autumn period
- spreading is onto stubble prior to cultivation so any rutting or compaction can be alleviated
- arable land tends to be low in organic matter
- the waste is incorporated during cultivation
- winter sown crops are generally less sensitive to nitrogen deficiencies than spring sown crops
- spring sown crops are more susceptible to nitrogen lock up as soil temperatures rise.

10 Waste from thermal processes

10 01 Waste from power stations and other combustion plants

10	WASTE FROM THERMAL PROCESSES
10 01	**waste from power stations and other combustion plants**
10 01 05	gypsum (solid) only
10 01 07	gypsum (sludge) only

Waste gypsum

Waste produced during the manufacture of plasterboard and treatment of waste plasterboard may be processed to provide a useful source of gypsum. This process must involve the removal of binding and backing materials. Although gypsum is the major component of plasterboard, waste plasterboard cannot be considered waste gypsum because plasterboard contains other materials such as flame retardants, binders and backing materials.

Waste gypsum and plasterboard

Quality standard: Specification for the production of recycled gypsum from waste plasterboard PAS 109:2008

Section 3.12 of PAS 109:2008 defines plasterboard as a product composed of:

- a gypsum plaster core encased in, and firmly bonded to, strong durable paper liner to form a flat rectangular board. The paper surfaces may vary according to the particular type of board and the core may contain additives to impart additional properties. The longitudinal edges are paper-covered and profiled to suit the application [BS EN 520:2004 definition 3.1] or,
- gypsum boards with mat reinforcement: a gypsum core firmly bonded to a woven or non-woven sheet of inorganic or organic fibres located on or just below the surface. The sheet may consist of single or multiple layers and may be reinforced by filaments or webs of fibre strands. The surfaces may vary according to the use and the core can also contain fibres, additives and/or fillers to impart additional properties. The surfaces and edge profiles vary according to the use of the particular type of board. [EN 15283-2:2008, definition 3.1] or,
- gypsum fibre boards: set gypsum plaster reinforced with dispersed fibres, which may be inorganic and/or organic, to form flat rectangular boards. They may contain additives and/or fillers to impart additional properties. The surfaces may vary according to the use. The edges and ends may be profiled to suit the application [EN 5283-2:2008, definition 3.1] or,
- plasterboard cornice: preformed paper covered gypsum section with profiled face supported by shoulders [EN 14209:2005, definition 3.1]and,
- certain types of specialist plasterboards (e.g. foil backed) cannot be recycled using today's technology, as the foil cannot be separated to a sufficiently high degree to meet plasterboard production requirements.

Gypsum contains large quantities of sulphur. With the reduction in atmospheric depositions of sulphur, many agricultural soils and crops may benefit from additional sulphur. As a result, artificial fertilisers containing sulphur are increasingly being used.

In recent years, applications of gypsum have sometimes produced unexpected improvements in crop yields, which have been attributed to a correction of a sulphur deficiency that had not been diagnosed.

The presence of other plant nutrients depends on the process that creates the gypsum waste. The levels of potentially toxic elements and heavy metals (with the possible exception of molybdenum) present in recycled gypsum are typically comparable to those present in the quarried gypsum.

Waste gypsum

Benefits and potential negative impacts of application to land

Potential benefits:

- gypsum is used to restore the soil structure of saline and sodic soils, especially those affected by flooding from sea water

- gypsum is also beneficial in less extreme cases, where long-term applications of gypsum at rates in excess of 5 t/ha improves non-calcareous and poorly structured clays
- source of sulphur, gypsum can contain up to 20% sulphur, depending on the purity of the waste
- improve the efficiency of inorganic fertilisers.
- Claims have been made that applying gypsum causes structural improvement by replacing magnesium cations, scientific justification of this claim on a case by case basis would need to be provided.

Potential negative impacts

- waste may contain contaminants that come from the manufacturing process
- binding agents such as fire retardants
- backing materials, such as paper, foils or card.

Application rates

- operators must base the application rate on appropriate technical expertise
- there is little (if any) structural benefit from applying gypsum to very light soils, such as sands and loamy sands.
- See Appendix B section 5.4 for further guidance on Sulphur application rates.

Further guidance on gypsum can be found in the: **Gypsum Quality Protocol and Technical Report** and **Recycled gypsum as a soil treatment in potato production.**

Flue Gas Desulphurisation (FGD) gypsum

Flue gas desulphurisation gypsum is associated with coal fired power stations, fitted with flue gas desulphurisation (FGD) equipment. The equipment uses limestone to remove sulphur dioxide (and up to 95% of the hydrogen chloride) from the flue gas. The chemical reactions in the FGD units result in the limestone being converted into gypsum.

Initially FGD gypsum from power stations was classified as a waste, but was re-classified as a by-product in September 2006. Currently all of the gypsum, which is produced by FGD from power stations, is used in the manufacture of plasterboard. Should this situation change then FGD gypsum may become available to be spread on land.

Waste gypsum in animal bedding

Operators should note that waste gypsum is not permitted for use in animal bedding and therefore should not be applied to land in used animal bedding. Please see our position statement on the **Restriction on the use of gypsum and plasterboard in animal bedding** for more information.

10 13 Waste from the manufacture of cement, lime and plaster and articles and products made by them

10 WASTE FROM THERMAL PROCESSES

10 13	wastes from manufacture of cement, lime and plaster and articles and products made from them
10 13 04	wastes from calcinations and hydration of lime
10 13 12*	cement kiln dusts and by-pass dust only
10 13 13	cement kiln dusts and by-pass dust other than those mentioned in 10 13 12 only
10 13 99	gypsum only

Lime dust

Lime dust is a waste produced during the processing of limestone (Calcium carbonate CaCO3) to produce lime products including quicklime (Calcium oxide CaO) and slaked lime (Calcium hydroxide Ca(OH)2) which is sold either as a slurry, milk of lime, or as a powder. The limestone is crushed and heated in a kiln to produce quick lime. The dust that arises from the filtration of the kiln exhaust gases is known as lime dust.

The heating temperature can vary from moderately low up to 1800°C depending on the reactivity and physical properties required of the final product. The most common heating fuel is gas, however secondary fuels such as, Cemfuel, waste solvents or oils can be used in the heating process. The lime dust may require analysis for dioxins, furans and PCB's and may be classified as hazardous because it is an irritant due to its free lime or calcium oxide content. Metals levels in this material may also pose a risk to the environment, see box 11.2.2.

The material is physically very similar to the commercial lime dust used in agriculture.

If analysis for contaminants produces satisfactory results, then operators should apply the waste at a rate based on:

- the neutralising value of the waste
- the lime requirement of the receiving soil.

Lime dust

Benefits and potential negative impacts of application to land

Potential benefits

- liming benefit. The NV of this material is lower than that of agricultural lime, 45-55%CaO (depending on type) and application rates may be higher to compensate.

Potential negative impacts

- the fine nature of this material may cause nuisance when handled and spread
- The material may contain PTE'S and other contaminants.
- Operators should avoid over-liming because this can induce deficiencies of trace elements in the receiving soil.
- Operators should avoid spreading this material close to sensitive receptors when there is a potential for nuisance for example: wind blowing dust toward sensitive receptors.

Further guidance on classification of hazardous waste is available in **Technical Guidance WM3** and **Guide to hazardous wastes.**

Cement kiln dust (CKD) and By-pass dust (BPD)

Wastes from cement manufacture are produced from the calcination and hydration of lime. The main process wastes are cement kiln dust (CKD) and by-pass dust (BPD). Both CKD and BPD are forms of kiln dust (pollution control residues) produced from the treatment of kiln gas streams, with the main difference being the point of production and the degree of calcination (free lime content).

What is the difference between CKD and BPD?

The cement industry refers to CKD (British Cement Association: Cement Kiln Dust, Bypass dust information relating to potential off site re use/recovery options, 07/11/2008) when it is produced from the abatement process of a kiln that does not have a bypass system. Such processes are wet kilns, long dry kilns, Lepol grate kilns and older generation preheater/precalciner systems.

CKD is collected from the gas stream arising from the manufacture of cement clinker in the kiln by abatement. The primary purpose of the abatement is to minimise the emissions of particulate matter and therefore its potential environmental impact. The CKD collected is the result of the processing of the raw materials used to manufacture cement clinker of which approximately 80 percent comprises chalk. A key stage in the processing of the raw materials is the calcination of the chalk. The CKD therefore consists largely of calcined chalk which has been picked up in the gas stream. In these systems the CKD is taken out of the kiln during its initial length where the temperature is lower and as a result the dust contains a higher proportion of calcium carbonate and in some cases larger particles.

The cement industry refers to BPD when it is produced from the abatement process as part of the bypass system. Bypass systems are fitted to newer generation precalciner kilns to bleed off volatile compounds in the raw materials such as alkalis. These compounds need to be controlled to avoid build up at cooling in the preheater and to maintain clinker quality.

There is a higher free lime content of BPD (greater than 10%) due to the raw materials being subjected to higher temperatures. The effect of temperature and calcination may result in BPD being classed as a hazardous waste stream according to Natural Resources Wales **Technical Guidance WM3** and **guide to hazardous wastes.**

Potential contaminants in CKD/BPD

The type and source of raw materials and the fuel used in the manufacturing process may cause contaminants in the waste. Using secondary fuel (Cemfuel) derived from high-calorific wastes (such as solvents, tyres and processed municipal waste) may increase the metals contamination.

Operators must analyse waste for contaminants such as metals (see box 11.2.2 High lead levels).

The waste is a fine dust which may cause negative impacts during handling and spreading close to occupied premises. Conditioned CKD and BPD which has been wetted to produce a granular material may be easier to handle and spread.

Cement kiln dust

Contaminants that may be present.

High contaminant levels may be encountered in some kiln dusts produced from the treatment of kiln gasses. For example high lead content may be a result of:

- fuels used in the cement manufacture process
- naturally high lead content in the source rock as the result of lead rich mineral veins within the quarried limestone and shale used in the process.

The box below lists the benefits and potential negatives of CKD/BPD applications to land.

Cement kiln dust

Benefits and potential negative impacts of application to land

Potential benefits

- liming benefit, NV can vary depending on the moisture content of the waste, but is usually in the range 20-45% CaO
- some wastes may also contain moderate amounts of potash (up to 30 kg/t) but the benefit from the potash is negligible because the waste is traditionally applied to the land at low rates.

Potential negative impacts

- the fine nature of this material may cause nuisance when handled and spread
- CKD and BPD contain PTE'S which will require waste and soil analysis to demonstrate no environmental harm
- CKD and BPD usually contain residues from the combustion materials. Some manufacturers have recently started using waste organic solvents as sources of fuel for these processes, such as Cemfuel. As a result, potentially harmful organic residues may occur in kiln dusts.
- Operators should avoid over-liming because this can induce deficiencies of trace elements in the receiving soil.
- Operators should avoid spreading this material close to sensitive receptors when there is a potential for nuisance for example: wind blowing toward the receptors and deposition on or near pH sensitive plant species.

Further guidance on classification of hazardous waste is available in **Technical Guidance WM3** and **guide to hazardous wastes.**

CKD/BPD Application rates

If the operator's analysis for contaminants produces satisfactory results, then operators must apply the waste at a rate based on:

- the neutralising value of the waste
- the lime requirement of the receiving soil.
- In comparison with agricultural lime, CKD and BPD are very fine grained materials which will provide a large surface area that will rapidly react with the soil. The reactive life of applied lime in the soil is approximately 1 to 2 years.
- Standard lime has a neutralising value of 50 – 55% CaO, CKD and BPD have values of between 20 and 45% and as a guide application rates should be between half and three-quarters more than standard lime applications.

17 Construction and Demolitions wastes

17	CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)
17 05	**soils (excluding excavated soils from contaminated sites), stones and dredgings**
17 05 04	soils and stones including chalk other than those mentioned in 170503
17 05 06	dredging spoil other than those mentioned in 17 05 05
17 08	**gypsum-based construction material**
17 08 02	gypsum only

17 05 soils (excluding excavated soils from contaminated sites), stones and dredging

Soil and stones including chalk other than those mentioned in 17 05 03

The 'soil and stones' category of wastes represents a broad spectrum of environmental impacts in terms of physical, chemical and biological contamination. The source of the waste and therefore its properties and potential benefits will vary greatly according to its previous use. This section refers to soil and stones from construction and demolition but is also relevant for 20 02 02: Soil and stones from garden and park wastes.

Operators will need to consider this variability when deciding what analysis is required and will also need to justify this decision where this excludes parameters relevant to soils.

For example soils arising from parks and gardens should require minimal analysis, where the operator knows sufficient history of the site. By contrast, materials excavated from a previously developed uncontaminated brownfield site may require extensive analysis.

Further guidance on handling soils can be found at **Good practice guide for handling soils** and **Construction Code of Practice for the Sustainable Use of Soils on Construction Sites**

The table below summarises the benefits and negative impacts of applying waste soil and stones to land:

Soil and stones Benefits and potential negative impacts
Potential benefits

As a long-term benefit, applying waste soil and stones provides a suitable medium to establish or support habitats and ecosystems. It can also be used to increase soil depths or replace soil lost from agricultural land (e.g. erosion gully).

The primary benefit comes from the soil's organic matter, which can improve the receiving soil's:

- structure
- porosity
- nutrient supply (phosphate and potash), retention and availability
- liming benefits from chalky materials
- water holding capacity.

Potential negative impacts

Soil and stones may contain contaminants and dangerous or hazardous substances. The potential for contaminants depends largely on the source of the waste soil and stones:

- for wastes from brownfield developments, the site's previous uses greatly affect the type and diversity of contaminants
- operators must use the history and location of the site when they identify the analysis that they must perform on the waste.

Chemical contamination

The standard rules for permits which allow the deposit of waste on land for agricultural or ecological benefit specifically exclude the spreading of soil from contaminated sites containing dangerous or hazardous substances on agricultural or operational land.

The analysis of waste soils which are to be spread to land under a standard rules mobile plant permit should be from an MCERTS approved laboratory, see section “2.2.5 MCERTS for waste soils” in the Technical Guidance Note EPR 8.01related to this appendix.

Pathogenic agents in soils and plant tissue waste

Pathogenic agents in soils and plant tissue waste Considerations for applications to soil
The following are examples of factors that operators must consider when they apply waste soil: – does the soil come from land that was occupied by livestock suffering from one of the infectious animal diseases (listed below in box 1.3.2)? – does the waste come from land and gardens where there is a possibility of the waste containing fungi, bacteria, or nematodes which may be harmful to crops, or encourage the spread of plant pathogens? – does the waste contain other plant diseases that the operator must consider when assessing waste.

Examples: onion white rot, honey fungus (Armillaria) and rhizomania. Further information about Potato Cyst Nematode (PCN), onion diseases, honey fungus, rhizomania, clubroot and verticillium wilt can be found below. Guidance on Phytophthora ramorum and Phytophthora kernoviae can be found in section “2.1.4 Mulch, Examples of potential chemical and biological contaminants of mulch”.

Applicants should ensure that the waste soil's levels of pathogenic agents and the potentially infectious stages of parasites are the same or less as the background levels in naturally occurring soils.

Pathogenic agents in soils and plant tissue waste continued **These are infectious animal diseases covered by the Animal Health Act 1981**:	
Foot & Mouth disease	Tuberculosis
Swine vesicular disease	Swine fever
Newcastle disease	Aujeskys disease
Teschen disease	Brucellosis
Fowl plague	Equine infectious anaemia
Bovine spongiform encephalopathy (BSE)	Dourine
Rabies	African swine fever
Anthrax	

The probability and extent of pathogenic activity in any waste soil depends mainly on the previous use of the land. Applicants must ensure that the waste soil's levels of pathogenic agents and potentially infectious stages of parasites will not have adverse effects on the intended future use of the land receiving the soil.

Further guidance on importing and using soils can be found in the publications:

Construction Code of Practice for the Sustainable Use of Soils on Construction Sites

Honey fungus

Honey fungus is a disease of trees, shrubs, woody climbers and, rarely, woody herbaceous perennials. The disease is caused by species of the Armillaria fungus. All Armillaria species found in the UK live on dead and decaying woody material. Only two of these species are known to attack living plants.

Honey Fungus **Soil treatment options**
There is no agro-chemical solution to the fungus the only option is to grow resistant plant varieties. Preventing infection spreading:

- physical measures put in place to prevent the transmission of infested soil between fields
- a physical barrier such as a 0.5m deep vertical strip of geo-textile buried in the soil will block the rhizomorphs
- regular deep cultivation will also break up rhizomorphs and limit their spread.

Heat treatment:

- if the waste has not been heat treated the waste should be tested.
- Composting temperatures over 70°C for over 3 days may be sufficient to eradicate pathogens including Armillaria (Yuen and Raabe 1984).

Invasive and injurious species in soil

Invasive non-native plants are species that can dominate habitats, excluding native plants and animals and potentially causing economic harm. There are over thirty plants listed in Schedule 9 of the Wildlife and Countryside Act 1981 (WCA 1981) including Japanese Knotweed Himalayan balsam and Giant Hogweed. Many species listed on Schedule 9 are aquatic plants which can be safely spread to land, if the site is nowhere near a watercourse, ditch or drain.

A fragment of Japanese Knotweed rhizome as small as 0.8 grams can remain viable and grow to form a new plant. Soil should be inspected for knotweed rhizome using the identification guide provided within the knotweed code of practice.

Invasive and injurious species in soil

Further information

Schedule 9 and subject to section 14 of the Act 1981, which makes it an offence to plant, or cause this species to grow, in the wild.

Both the Police and local authorities have enforcement functions for the WCA 1981. Soil containing Japanese knotweed rhizome has to be disposed of at a suitably licensed site. Alternatively, it can be reused on the site of production after it has been treated, as prescribed within the knotweed code of practice (link below). Soil containing viable seeds or propagules of other Schedule 9 species should not be disposed of in a manner that will cause them to re-grow in the wild.

Further information:

- **The GB Non-Native Species Secretariat website**
- **Department for Environment, Food and Rural Affairs (Defra) website.**
- **Code of Practice for the Management, Destruction and Disposal of Japanese Knotweed.**

Several other species are also considered to be invasive non-native species, including floating Pennywort, Parrot's Feather and Himalayan balsam. **Guidance for the control of invasive weeds in or near freshwater.**

Injurious species

Injurious species are five injurious weeds mentioned in the Weeds Act 1959. These weeds are pernicious weeds of pasture and can contaminate hay. Common ragwort is poisonous to livestock and particularly horses. The five weeds are:

- Common Ragwort
- Spear Thistle
- Creeping Field Thistle
- Broadleaf Dock; and
- Curled Dock.

The Secretary of State can serve an enforcement notice against occupiers of land on which such weeds are growing, requiring them to take action to prevent them spreading.

Levelling the land using soil

More information has been provided on levelling the land in Section 2 of this guidance document. Further information on using waste soils for this activity are also found below.

Levelling land
Benefits and potential negative impacts of levelling land
Using waste soils to level agricultural land benefits the land when levelling results in: – improved drainage – improved landform to reduce erosion and runoff – the filling or repair of gullies associated with water erosion. The benefit statement should provide the justification for the operation and methods to be employed. The location plan should indicate the area to be treated. The waste application on agricultural land should not exceed the limits set within the permit Dredging spoil from inland waterways 5000 tonnes per hectare Soil from sugar beet processing (washing & cleaning) 1500 tonnes per hectare. All other wastes (except those mentioned above) 250 tonnes per hectare. Potential negative impacts of levelling land: – the use of soil from the cleaning and washing of some crops can lead to disease spread e.g. sugar beet may result in the infection of land with Rhizomania – see section 1 of this document, 02 04 01 soil from cleaning and washing beet.

The guidance document, **RGN13 Defining Waste Recovery: Permanent Deposit of Waste on Land** gives information to help assess if a proposed waste-to-land operation is for recovery or disposal.

Drill cuttings

In the management of construction projects involving tunnelling and drilling drill cuttings of soil and stones can be settled out of the drilling muds. Typically they are given the European Waste Catalogue code 17 05 04. Provided the soil and stones are not mixed with drilling muds or drilling fluid additives, these muds may be applied to land. If they are mixed the waste is typically given the European Waste Catalogue code EWC 17 09 04. These cannot be spread to land under a standard rules permit. Our **drilling muds position statement** provides more information on this waste.

Dredging spoil other than those mentioned in 17 05 05

The mud fraction of dredgings, which contains a high proportion of mineral matter (especially silts and clays), is good at absorbing:

- metals
- persistent organic residues
- bacteria
- viruses.

Operators must assess the likely contaminants in dredging spoil using local knowledge of historical up stream discharges and advice from external organisations. Examples:

- sporadic cases of anthrax in farm animals grazing on pastures after deposition of sediment during flooding or bank collapse (such as sporadic outbreaks on the River Taff described in the Government Veterinary Journal vol-1801) are thought to be caused by spores from tanneries, knackers yards and gelatine factories that once discharged waste into the river, allowing spores to enter sediments.
- a number of exotic species of salmonella have been found in estuaries downstream of fertiliser compounders (such as the Hull area) as described in McCoy 1971.

Dredging spoil **Benefits and potential negative impacts of application to land**
Potential benefits – dredging spoil can supply organic matter and nutrients in the form of phosphate and organically bound nitrogen (the mineralisation rate for dredging spoil is assumed to be 3%) – dredging spoil can supply mineral (e.g. sandy) material in soil forming operations for land restoration and habitat creation projects. **Potential negative impacts** – many inland waterways (canals in particular) run through urban and industrial areas. Sediments from these waterways may be polluted with various contaminants. These contaminants typically come from historical industrial and other discharges and may contain dangerous and hazardous substances – high suspended solids content sludges may coat plants either suffocating them or temporarily reducing their ability to photosynthesise

– oils and tributyltin residues may be present in some dredging spoil from both commercial and leisure boating centres especially where boat building and maintenance yards are located.

Spreading activities must comply with **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules)**. Dredgings, defined in Leaflet 2 of the NVZ guidance as a substance containing nitrogen that is neither a manufactured nitrogen fertiliser nor an organic manure, do not need to be taken into account in the N – Max calculation when spread as a nitrogen fertiliser. The availability of nitrogen in dredgings is approximately 3%.

For further information on dangerous and hazardous substances can be found in: **Technical Guidance WM3** and **guide to hazardous wastes**

17 08 Gypsum based construction material

17	CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)
17 08	gypsum-based construction material
17 08 02	gypsum only

Gypsum only

For more information on gypsum please refer to 10 01 05 – Gypsum only.

19 Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use

19 02 Waste from the physico/chemical treatment of waste

19	WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE
19 02	wastes from physico/chemical treatments of waste (including dechromatation, decyanidation, neutralisation)
19 02 03	cement kiln dust and by-pass dust from cement kilns conditioned with water only
19 02 04*	cement kiln dust and by-pass dust from cement kilns conditioned with water only

This waste code refers to Cement Kiln Dust (CKD) and Bypass dust (BPD) that has been conditioned by adding water only. Please therefore refer to section 10 13 for information on this waste stream.

19 05 Wastes from the aerobic treatment of waste

19	WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE
19 05	wastes from the aerobic treatment of waste
19 05 03	compost from source segregated biodegradable waste only
19 05 99	liquor and digestate from aerobic treatment of source segregated biodegradable waste only

Compost from source segregated biodegradable waste only

The composting process

In order for any compost to be spread under standard rules permits the processes and end products must comply with following definitions.

Natural Resources Wales defines compost as a solid particulate material that is the result of composting, which has been sanitised and stabilised, and which confers beneficial effects when added to soil, used as a component of growing media or used in another way in conjunction with plants.

Natural Resources Wales define “composting” as the managed biological decomposition of biodegradable waste, under conditions that are predominantly aerobic and that allow the development of thermophilic temperatures as a result of biologically produced heat and that result in compost.

Input materials

Source segregated green waste largely comes from segregated municipal waste collections, waste transfer stations and civic amenity sites.

Guidance on suitable waste wood materials for inclusion in compost can be found in the position statement **The environmental regulation of waste wood** and the following WRAP technical reports:

- **Technical report on the manufacture of products from waste wood**
- **Options and Risk Assessment for Treated Wood Waste**

Wastes collected for composting should be subject to inspection and any contaminants must be removed before the waste is shredded prior to composting.

Further information on composting waste and acceptable input materials can be found in:

- The **compost quality protocol** and **BSI. PAS 100-2011**
- **Investigation of clopyralid and aminopyralid in commercial composting systems**

Please note that leaf litter collected from dedicated road sweeping collections are not suitable input materials for compost derived from source segregated biodegradable waste. This waste stream is not considered to be source segregated and potentially contains contaminants such as metals and hydrocarbons. Therefore if this waste stream is included

in compost the resultant waste will be considered ‘Compost Like Output’ (CLO) which can only be spread under SR2010 No5 to non-agricultural land. Please see section 3 of this document, 19 05 99 for further information on CLO. For more information on recovery options for road sweepings please see our **street sweepings guidance document**. For clarification on the composting of dedicated leaf litter collections please see the **update statement** released in autumn 2012.

Compost from source segregated biodegradable waste

Unsuitable waste types

The following wastes are examples of unsuitable wastes for composting operations:

- wastes containing hazardous contaminants
- road sweepings
- non source segregated wastes (if the compost is to be spread onto agricultural land)
- wastes containing sharps or other physical contaminants
- wastes containing non-biodegradable fractions that cannot be separated by pre-treatment:
- treated and/or painted timber products see box 2.1.4
- foils
- whole plasterboard
- metals and sharps
- masonry or stones and
- glass.

Trees and plants that are infected with ash dieback, P. ramorum or P. kernoviae are not suitable for composting and it is not permitted by either Natural Resources Wales or Food and Environment Research Agency (Fera).

Further guidance on P. ramorum or P. kernoviae can be found in our **regulatory position statement** on our website for disposing of trees infected with P. ramorum P. Kernoviae. Further information on ash dieback and bio security measures can be found on:

- **Natural Resources Wales website**
- **FERA website**

Physical contaminants in composted outputs

Physical contaminants comprising plastics, glass and metal do not confer benefit to soil. They can be a nuisance and can confer a disbenefit, for example in cleaning requirements for root crops such as potatoes and other vegetables that grow low to the soil such as cabbage and cauliflower. There is also the potential for plastic, metal or glass fragments to be picked up by grazing livestock and taken up by grass cutting and silage making machinery and incorporated into silage.

Deliberate spreading of physical contaminants to land will usually be viewed as a disposal operation. The incidental presence of low levels of contaminants may be acceptable, for example in accordance with the levels set out in the PAS 100 specification for compost.

Where physical contaminants are known to be present in the input materials they should be removed prior to the composting or in the final screening process i.e. in order to achieve the levels set out in PAS 100 Quality Protocol.

The Compost Quality Protocol

Operators demonstrating that compost is compliant with BSI PAS100: 2011 and Natural Resources Wales Quality Protocol may supply and spread their compost as non-waste material outside the controls of the Environmental Permitting Regulations. Where an operator cannot or chooses not to comply with these requirements the compost will remain a waste and must be spread in accordance with the Environmental Permitting Regulations under either SR2010 No.4 or 5.

Compost not compliant with the Quality Protocol

Compost may have been produced in accordance with the input materials as detailed in

PAS100:2011 and information given below, but for some reason fail to reach the standard required by the quality protocol (for example exceeds metals thresholds). In these circumstances this compost may potentially be spread to land under SR2010 No.4 or 5 to allow a site specific assessment to be made of the risks from the proposed compost application. Operators should refer to **BSI. PAS 100-2011** for more information on substances likely to be present in compost and the relevant thresholds.

Operators will need to ensure that they account for the potential contaminants and environmental risks posed by composts as detailed above. In order to do this the operator should identify and analyse all substances reasonably likely to be present in the compost based on the input materials and the composting process. Please see **Section 2** of this guidance, guidance and technical standards for deployment applications for more information on the range of substances that could be tested for.

Compost from source segregated biodegradable waste

Benefits and potential negative impacts of application to land

Potential benefits

- moderate levels of nitrogen, potassium and phosphorous at a pH around neutral
- provides a source of organic matter and acts as a soil conditioner
- improved soil structure and aid drainage, decrease in soil bulk density, increase nutrient retention
- improve workability on heavy soils
- improved water holding capacity especially on lighter soils
- slow release of plant nutrients and increase in soil mineralisable N.

Potential negative impacts

- cause temporary nitrogen lock up if it contains high C: N ratio materials
- reduce the effectiveness of herbicides (see box 2.3.3)
- can increase the likelihood of mineral deficiencies in some cases
- potential PTE's and metals contamination
- potential to cause odour problems
- variation in composition of the waste due to variety of sources and may contain inorganic or organic contaminants
- may contain significant levels of other metals.

Organic compounds and certain chemical contaminants may be reduced by aerobic composting see **investigation of clopyralid and aminopyralid in commercial composting systems**

Composted waste bio-bed material

Bio-beds are small scale lined lagoons filled with biologically active organic material for the attenuation of non-hazardous pesticide solutions or washings. The material used within a bio-bed can be formed from the following:

- straw
- composts
- biologically active soil.

The bio-bed should be capped with turf. Bio-bed contents should be replenished annually and replaced after 15,000 litres of material has been treated or after 5 to 7 years. Old bio-bed material must be stacked and allowed to compost aerobically for at least 12 months prior to be spreading.

Old bio-bed material

Benefits and potential negative impacts of application to land

Potential benefits

- the compost is a good source of general nutrients N, P, K plus a range of trace elements
- soil conditioner adding organic matter
- increasing soil organic carbon
- improves water holding capacity
- improving soil structure.

Potential negative impacts

- the material may contain persistent chemical residues (**investigation of clopyralid and aminopyralid in commercial composting systems**)
- high levels of organic matter may reduce the effectiveness of herbicides and other agro-chemicals (see box 2.3.3)

- the concentrations of these chemicals can be reduced by stacking and turning following removal from the bio-bed and allowing a 12 month period of aerobic composting and maturation.

Any spreading activity should comply with the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and must comply with **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

Further information can be found in **Design and use of biobeds**

Co-digestion or co-composting of source segregated biodegradable waste and sewage sludge

Co-digestion and co-composting can be used to biologically treat sewage sludge with source segregated waste, for example green waste collected by local authorities. The green waste for addition should meet the standards in the section for 19 05 03 compost of this document. Though sewage sludge is not regarded as a source segregated waste, composting or digestion of sludge with source segregated green waste can produce a compost or digestate which can be spread under the relevant standard rules permit. However, the process does not produce treated sludge for recycling to land under the Sludge (use in Agriculture) Regulations 1989.

The **Code of Practice For Agriculture Use Of Sewage Sludge** requires that composting sewage sludge be maintained at 40°C for at least 5 days and at a minimum of 55°C within the body of the pile for 4 hours during the process. A period of maturation to ensure that the compost reaction process is substantially complete.

The resulting compost should be analysed for pathogens and PTE content in a manner which demonstrates it can be used on agricultural land in accordance with the pathogen limits given in the Safe Sludge Matrix and PTE limits given in the Sludge (Use in Agriculture) Regulations.

Co-digestion or composting of green waste and sewage sludge

Benefits and potential negative impacts of applications to land

The fertiliser manual **RB209** contains useful information on the nutrient benefits of sludge for agricultural land applications.

Suitable wastes for co-digestion or co-composting with sewage sludge include:

- source segregated green waste
- sawdust and wood shavings from untreated timber
- shredded untreated timber.

For clarification on treated and untreated timber please see our position statement on **the Regulation of Wood**.

Potential benefits

- composted sludge contains nitrogen and phosphate in significant quantities which will contribute all or part of crop requirement

- nitrogen in the composted sludge will predominantly in mineralisable forms unlike ammoniacal nitrogen which is readily available for plant uptake
- approximately 50% of the phosphate in sludge is available to the crop in the first year
- compost treated sludge contains trace elements such as sulphur, magnesium and boron which may be of advantage to the crop
- composted sludge is a useful source of organic matter which can improve nutrient retention, water holding capacity and soil structure
- composting of the sewage sludge increases its total solids, reducing losses through leaching.

The temperatures required to be achieved during the co-digestion or composting process should be sufficient to sanitise the sludge.

Potential negative impacts

- the application of sludge outside the window of maximum crop uptake may result in nutrient loss to surface or ground water
- composted sewage sludge will contain metals (PTE's) which may limit the application rate depending on the receiving soil
- soils below pH 5 should not receive composted sludge applications and soils between pH 5.0 and 5.2 should only receive composted sludge with the justification of a properly qualified person
- issues such as odour may cause problems during composting, maturation, storage and spreading
- leachate from the composting process should be collected and adequately treated or disposed of.

The application rate must reflect the nutrient requirement of the current or proposed crop for nitrogen and phosphate in accordance with the fertiliser recommendations in **RB209** and the requirements of other legislation such as **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

The receiving soil analysis should include levels of PTE's already present as these may limit the application rate.

Where you propose to use biodegradable wastes for co-digestion or co-composting you may require a site environmental permit for the treatment or composting of waste.

The waste acceptance for the biodegradable waste streams will need to ensure that all waste accepted is suitable for the process in which it is to be included and that any non-biodegradable physical contaminants such as plastics, metals, foils and glass are removed prior to digestion or composting.

The resulting output from the co-digestion or composting process should be analysed for pathogens and PTE content in a manner which demonstrates it can be used on agricultural land in accordance with the pathogen limits given in the Safe Sludge Matrix and PTE limits given in the

Sludge (Use in Agriculture) Regulations

This co-composting or co-digestion process can produce a compost or digestate which can be spread under the relevant standard rules permit.

Wastes from aerobic digestion

Aerobic digestion of waste is the natural biological degradation and purification process in which bacteria that thrive in oxygen-rich environments break down and digest the waste. During the digestion process, waste is broken down into carbon dioxide, water, nitrates, phosphates, sulphates and biomass. By controlling the oxygen supply with aerators, the process can be managed to ensure efficient degradation of the incoming waste.

The main benefits of aerobic biological processes are that many contaminants are actually degraded and treated, rather than concentrated in the treatment process.

The process involves the passage of air through the waste and is often found in the secondary treatment of sludges and slurries. This produces a mineralized sludge, with remaining organic materials comprised of cell walls and other cell fragments that are not readily biodegradable.

Wastes from aerobic digestion
Suitable waste materials for aerobic digestion
Suitable waste types: – biological treatment sludges – source segregated biodegradable wastes. Pre-treatment requirements can include: – removal of any non-biodegradable packaging – removal of other non-biodegradable fractions. Unsuitable waste types: – wastes containing hazardous or toxic contaminants – non source segregated wastes (unless waste is to be spread onto non-agricultural land) – wastes containing sharps or other physical contaminants – wastes containing non-biodegradable fractions that cannot be separated by pre-treatment.

During aerobic biological treatment, organic compounds can be largely oxidised to carbon dioxide and water, and ammoniacal nitrogen (ammoniacal-N) can be removed by oxidation (nitrification) to nitrate.

Feed stocks are fed into a digester where air is forced through the material to encourage the growth of aerobic microbes. The process is exothermic and the heat is typically maintained between 55-65oC.

The retention time of material in the process is usually between two and five days. Following digestion the digestate is usually dewatered or dried, resulting in a stackable stable material.

Digestate can be separated mechanically in the same manner as animal manure. Separation creates two outputs, a liquid and a fibrous material, that need to be stored and

handled separately. The high dry matter and fibrous fraction can be a useful compost feedstock.

There are a number of digestate/manure separation methods. Some of the commonly used mechanical separators but may also be by non-mechanical methods, such as sedimentation or filtration through geo-textile tubes.

Wastes from aerobic digestion **Benefits and potential negative impacts of application to land**
Potential benefits – moderate levels of nitrogen, potassium and phosphorous at a pH around neutral – provides a source of organic matter and acts as a soil conditioner – low carbon – nitrogen ratio giving a net release of nitrogen to the receiving crop – reduces the biochemical oxygen demand (BOD) and chemical oxygen demand (COD) of liquors. – Liquors from the aerobic digestion process should be injected into soil or incorporated at the time of spreading to reduce odour. **Potential negative impacts** – may contain inorganic or organic contaminants – potential to cause odour problems – variation in composition of the waste due to variety of sources – Biochemical Oxygen Demand (BOD) measures the rate of oxygen uptake by micro-organisms in a sample of water at a temperature of 20°C and over an elapsed period of five days in the dark. Chemical Oxygen Demand (COD) is commonly used to indirectly measure the amount of organic compounds in water. Most applications of COD determine the amount of organic pollutants found in surface water, making COD a useful measure of water quality. It is expressed in milligrams per litre, which indicates the mass of oxygen consumed per litre of solution.

Any spreading activity should comply with the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and must comply with **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

19 06 Wastes from the anaerobic treatment of waste

19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 06	**wastes from anaerobic treatment of waste**
19 06 05	liquor from anaerobic treatment of source segregated biodegradable waste

19 06 06	whole digestate and fibre digestate from anaerobic treatment of source segregated biodegradable waste

Whole digestate and fibre digestate from anaerobic treatment of source segregated biodegradable waste

Anaerobic digestion of waste is the biological degradation process in which bacteria that thrive in anoxic (oxygen free) environments break down and digest waste. Wastes from anaerobic digestion include digestate sludge and the separate fractions, fibre and liquor.

Input materials

The composition of waste inputs and management of the digestion system largely determine the potential benefit or improvement provided by the digestate. Appropriate monitoring helps establish confidence in the consistency of the waste's composition. The **regulatory statement about the use of anaerobic digestion** contains useful information about the Agency's position on this process.

Wastes from anaerobic digestion

Suitable waste materials for anaerobic digestion

Anaerobic digestion increases wastes nutrient content per weight/volume. Suitable waste types:

- wastes mentioned in Annex B of the **Quality Protocol PAS 110**
- food processing industry waste
- agricultural wastes
- wastes from abattoirs.

Pre-treatment requirements can include:

- removal of any non-biodegradable packaging.
- maceration of the wastes.

Unsuitable waste types:

- wastes containing hazardous contaminants
- non source segregated wastes (unless waste is to be spread onto non-agricultural land)
- wastes containing sharps or other physical contaminants
- wastes containing non-biodegradable fractions that cannot be separated by pre-treatment.

Wastes from anaerobic digestion

Benefits and potential negative impacts of application to land

Potential benefits

- the fibre may contain moderate levels of nitrogen, potassium and phosphorous

– provides a source of organic matter and acts as a soil conditioner – waste pH is typically between pH 6.0 and 8.0 – low carbon: nitrogen ratio giving a net release of nitrogen to the receiving crop. **Potential negative impacts** – may contain PTE's, inorganic or organic contaminants – may give rise to ammonia volatilisation when surface spread – there may be a potential for nitrate leaching if applied when crops are not actively growing – potential to cause odour problems notably with the use of the liquor especially with high trajectory spreading methods – variation in composition of the waste due to variety of sources.

Any spreading activity should comply with the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and must comply with **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

Further guidance on anaerobic digestion products can be found at: **Task 37 - Utilisation of digestate from biogas plants as biofertiliser**

19 09 Waste from the preparation of water intended for human consumption or water for industrial use

19	WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE
19 09	**wastes from the preparation of water intended for human consumption or water for industrial use**
19 09 02	sludges from water clarification

Sludges from water clarification

Water clarification sludges should be analysed for iron, aluminium, sulphur and manganese. The sulphur content of this waste can be the main beneficial component. If the benefit justification claims that the waste provides sulphur, the waste should be applied to a responsive crop such as grass, cereals or oilseed rape. Where aluminium content is high, operators should take care to prevent the waste entering a watercourse because aluminium can harm aquatic life.

Waste from the preparation of water intended for human consumption or water for industrial use **Types of sludge**
Coagulant sludges

Sludges from treating raw waters (usually surface waters) with a coagulant (usually aluminium sulphate or ferric sulphate) contain the following, which are removed from the raw water:

- aluminium hydroxide flocs
- iron hydroxide flocs
- impurities (colour and turbidity).

Natural sludges

Natural sludges can contain:

- filtering raw waters through slow sand filters (usually without additional chemicals) to remove impurities from the raw water together with biological growth from the filter, sometimes known as the 'Schmutzdecke'.
- biological material
- sands and grits.

Groundwater sludges:

- the oxidation of dissolved metals (usually iron and manganese) in groundwater
- metal hydroxide/dioxide floc.

Softening sludges:

- from the softening hard waters calcium carbonate, which has a lime value in agriculture.

The types and characteristics of the sludge from water clarification depend on the water treatment process and the quality of the raw water. The main concern with this type of waste sludge is its high aluminium content. Although aluminium is a major component of soils, aluminium becomes mobile in the soil at low soil pH values (pH 5.0). Aluminium can stunt root growth and cause induced phosphate deficiency in crops. As a precautionary measure, sludge from alum water treatment should only be applied to soils of pH 6 and above.

As a precautionary measure, excessive build-up of aluminium and iron levels in the surface layer of pasture grass should be avoided where the pasture grass receives repeated top dressings of alum-rich or iron-rich sludges. This avoids possible effects on ruminant animals when they directly ingest the sludge.

Waste from the preparation of water intended for human consumption or water for industrial use

Benefits and potential negative impacts of application to land

Potential benefits

This waste does not have high content of major nutrients but contains:

- some nitrogen and potassium in the form of bacterial cell debris, which is greatest in natural sludges (see types of sludge from water clarification)
- precipitated phosphate
- this waste's main benefit is as a source of the secondary plant nutrient, sulphur

- this waste may also contain trace elements such as manganese
- sludges derived from peat run-off in upland areas may contain a significant amount of organic matter
- sludges may provide valuable sources of sands and fine grit which can improve the drainage of heavy soils and add body to medium and lighter soils
- sludges can vary widely depending on the geology of the area. Some sludges can provide a liming benefit.

Potential negative impacts

The fertiliser manual **RB209** contains useful information that:

- at low pH, Calcium, Magnesium and Molybdenum are less available
- at low pH, Aluminium, Manganese, Iron and Zinc become more available and may induce plant toxicity, it is rare to see toxicity across an entire field but areas within a field due to soil depth, type, drainage and pH may exhibit symptoms
- phosphorus becomes less available at both extremes of pH, the optimum range for phosphorus availability is between pH 6.0 and 7.0 at low pHs aluminium can lock up phosphate within the soil
- iron staining on crops.

Effects of Aluminium

Potential negative impacts of high aluminium content waste applications to land

Elevated aluminium levels in soil, damage roots and can cause foliage to show signs of toxicity, although this is often compounded by phosphorus deficiency and soil acidity. Aluminium is known to affect the growth of plants in 2 ways:

- through inhibition of cell division in roots and,
- by reducing the transport of phosphorus from the roots to the shoots. This reduction in phosphorus transport results in the development of phosphorus deficiency.

Section 3: Wastes listed under SR2010 No.5 only

Table 2.3 in SR2010 No.5 contains wastes from waste management facilities, off site waste water treatment plants. These wastes can only be spread to land under SR2010 No.5 for the reclamation, restoration or improvement of land that has been subject to industrial or other manmade development. These wastes cannot be used to treat land that is intended to be used as agricultural land used for growing food or fodder crops or grazing livestock, or on any land that is likely to be used for that purpose in the future. For our definitions of agricultural land please see our glossary in **Appendix D.**

19 Wastes from waste management facilities, offsite waste water treatment plants and the preparation of water intended for human consumption and water for industrial use

19	WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE
19 05	**wastes from the aerobic treatment of waste**
19 05 99	compost derived from non-source segregated biodegradable waste
19 06	**wastes from the anaerobic treatment of waste**
19 06 03	liquor from anaerobic treatment of non-source segregated biodegradable waste
19 06 04	whole digestate and fibre digestate from anaerobic treatment of non-source segregated biodegradable waste

19 05 Wastes from the aerobic treatment of waste

Wastes from treatment of non-source segregated biodegradable waste

Non-source segregated composts and digestate can only be spread under SR2010No5 or a bespoke permit. These wastes are restricted to non-agricultural land which is not intended to go back into use as agricultural land at some point in the future, including forage cropping and grazing. You cannot use such wastes on land that is, or is likely to be, used for agriculture unless Natural Resources Wales has issued you a bespoke permit under the Environmental Permitting (England and Wales) Regulations 2016. Please see our **Additional guidance for trials for the recovery to land for agricultural benefit of compost-like outputs from the treatment of mixed municipal solid wastes (EPR 6.15).**

Compost like output (CLO)

Compost Like Output (CLO) comes from the mechanical – biological treatment (MBT) of mixed municipal solid wastes at MBT plants that employ biological treatment processes including stabilisation by composting and/or anaerobic digestion. MBT feedstock contains non source segregated municipal waste sources, such as black bag household wastes. CLOs can potentially be a source of plant nutrients, but they may also pose a risk to the environment and/or human health when spread on land. Therefore CLO can only be spread

to non-agricultural land. There must be no intention for this land to return to agricultural use in the future.

Input wastes

Producers of CLO must ensure that all inputs into the composting and anaerobic digestion processes are biodegradable. Where required, pre-treatment should remove any non-biodegradable fractions in the input waste.

Treatment Processes

In order for a waste to be considered a CLO it must have undergone treatment through a composting and/or anaerobic digestion process with the objective of stabilising and sanitising the waste. The processes producing CLO must be carried out in accordance with the definitions below:

- Composting is defined as the managed biological decomposition of biodegradable waste, under conditions that are predominantly aerobic and that allow the development of thermophilic temperatures as a result of biologically produced heat and that result in compost.
- The Anaerobic Digestion process is defined as a process of controlled decomposition of biodegradable materials under managed conditions where free oxygen is absent, at temperatures suitable for naturally occurring mesophilic or thermophilic anaerobe and facultative anaerobe bacteria species, which convert the inputs to a methane-rich biogas and whole digestate.

This resultant CLO is a solid particulate material that is the result of composting or anaerobic digestion, which has been sanitised and stabilised, and which confers beneficial effects when added to soil, used as a component of growing media or used in another way in conjunction with plants. It must be suitable to be spread to land without further treatment. Wastes that have not been properly treated in accordance with these definitions are not considered to be CLO and will not be considered for land treatment activities under this Standard Rules permit.

The output from autoclave or heat treatments is not regarded as a CLO because it has not received a biological treatment to satisfactorily stabilise and sanitise the waste (MHT codes).

CLO **Benefits and potential negative impacts**
MBT CLO comprises organic matter, grits/sands and other inert materials (e.g. plastic and glass). **Potential benefits** – soil conditioner as part of a land reclamation or restoration scheme – contributing to soil organic matter – reducing use of artificial fertilisers, CLO can contain nitrogen, phosphate, potash and sulphur

- the pH of CLO ranges from mildly acidic to mildly alkaline, with a neutralising value typically in the range of 1 to 8%CaO. The material is however not suitable as a liming agent.

CLO is considered to be a soil conditioner and therefore cannot be used as a soil substitute. Section 3, 19 12 12 soil substitutes discusses soil substitutes in more detail.

Potential negative impacts

We are concerned with minimising and managing the risks of:

- the chemical contamination of food and grazing crops
- the physical contamination (glass, metal, plastic, foils etc.) of soils
- the longer term, cumulative risks to the environment and to the continuing, sustainable use of land from persistent contaminants
- the high degrees of variability of the quality of CLOs coming out of MBT processes.
- these materials may have a comparatively high C: N ratio, which may immobilise (lock-up) nitrogen when the operator applies it to land depending on the feedstock and processes.

Although no specific standards exist for CLO, PAS100 is typically used as the most suitable guideline when proposing to apply this material to land. Please refer to **BSI. PAS 100-2011** for these reference values. Reference can also be made to the metals limits set in the **Sludge (Use in Agriculture) Regulations 1989.**

Additional information on the use of CLO in land reclamation including site and waste suitability can also be found in the **SNIFFER Code of Practice** and **technical report** for using recycled organic materials in land reclamation.

19 08 Waste from waste water treatment plants

19	WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE
19 08	**waste from waste water treatment plants**
19 08 02	washed sewage grit (waste from desanding) only
19 08 05	sludges from treatment of urban waste water

Washed sewage grit (waste from desanding) only

Benefits and potential negative impacts of sewage grit
Sewage grit is the inorganic material consisting of sand, gravel, road stone, glass etc. that is routinely removed from the influent at waste water treatment works. The de-watered grit can be used in the reclamation of land which has been previously subject to industrial or other man-made development and will not be returned to agricultural use. The grit should be washed prior to use.

Potential benefits:
Contributes fine aggregate to the finished soil profile.
Potential negative impacts:
May contain PTE'S and other contaminants such as glass, rags and plastics.

Sludges from the treatment of urban waste water

For more information on the regulations governing the use of sewage sludge applications to land, advice on the risks and benefits of sewage sludge and advice on which permit to use see section 4 of this guidance for SR2010 No.6. Further advice is also contained in:

- **The Safe Sludge matrix for Agricultural Land.**
- **The Safe Sludge matrix for Industrial crops.**
- **Code of Practice for the use of sludge, compost and other organic materials for land reclamation.**
- **Technical document: for the use of sludge, compost and other organic materials for land reclamation.**

19 12 Wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified

19	WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE
19 12	**Wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 12	soil substitutes other than that containing dangerous substances only

19 12 12 Soil Substitutes What is a soil substitute?

A soil substitute is a material that serves as a direct replacement for soil. On the basis that they must substitute for a soil profile a soil substitute can only be used on a site where there is no existing soil profile. An example of a requirement for a soil substitute may be on landfill sites where part of the restoration programme will include the need to create a soil profile in order to create a vegetated area.

Natural Resources Wales accept that to create a complete soil substitute wastes may need to be blended with other imported soil substitutes to form a soil. The resultant soil should be created to an appropriate standard, usually the "British Standard Specification for topsoil and requirements for use (BS.3882:2007)" and **1989 Sludge (Use in Agriculture) Regulations** reference values for acceptable thresholds of PTE'S in the soil.

Where a soil profile already exists on a site, any use of a 19 12 12 material would appear to be as a soil conditioner/improver, given the waste is being used to improve and enhance an

existing soil. The use of 19 12 12 as a soil conditioner/improver is not acceptable under a SR2010No5 permit.

Soil substitute

Suitable wastes for the production of soil substitutes

Soil substitutes can be produced from the following wastes **under Standard Rules permit SR2010 No.12**

- ash, slag, rock or clinker
- waste from construction, demolition or excavation work
- wood and bark
- paper and straw
- dredgings
- composts
- solid fraction of aerobic and anaerobic digestates
- gypsum waste.

No hazardous waste or dangerous substances may be included.

The soil substitute should be free from contaminants such as asbestos fragments, plastics, glass, metals, treated timber, foils and films.

Any spreading activity should comply with the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** and must comply with **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

Wastes containing hazardous or dangerous substances described in **Technical Guidance WM3** and **guide to hazardous waste** and should not be used in the production of soil substitutes.

Soil substitutes

Benefits and potential negative impacts of applications to land

Potential benefits

- improved structure and drainage in heavy soil from addition of grits and sands for land restoration and reclamation schemes
- improve soil bulk density (see box 1.1.2 below)
- replacement of soils lost by erosion
- addition of organic matter to the soil, beneficial to soil structure.

Potential negative impacts

- contamination with metals from treated products included in the process
- potential contamination with plant disease vectors
- dust raised from on-site activities and during spreading may cause nuisance

- contamination with undesirable waste types, plastics, glass etc.
- nitrogen lock up can be induced if high C: N ratio material is spread, such as shredded wood and timber wastes such as sawdust.

Where metals are found to be present in the soil substitute these should not exceed the levels specified by the **1989 Sludge (Use in Agriculture) Regulations** in the receiving soil.

Where incorporation is by ripping, chisel plough or other deep incorporation cultivation practices, previous land uses should be considered and buried obstacles such as carcass burial pits, drains and services such as pipelines should be avoided.

Soil substitutes

Benefits and potential negative impacts of improving soil bulk density when creating a soil substitute

In general, practices that improve soil structure will decrease bulk density by increasing pore spaces and adding less dense material such as organic matter.

Potential benefits

- improved drainage (via large pore spaces)
- increased water retention (in smaller pore spaces)
- makes the soil easier to work
- improves rooting depth
- improves the mobility of nutrients.

In some cases these improvements may only be temporary such as cultivations and seed bed formation which temporarily decreases bulk density and breaks up any compacted soil layers, subsequent traffic from machinery, rainfall events, animals, and other disturbance activities may re-compact soil. Organic matter additions tend to have a more prolonged improving effect on soil bulk density.

Potential negative impacts

- potential for increased soil erosion by surface water
- rapid surface drying may lead to a potential for soil loss by wind erosion
- increased oxidation of organic matter.

Further guidance on handling soils can be found at **Good practice guide for handling soils** and **Construction Code of Practice for the Sustainable Use of Soils on Construction Sites**

For more information on using soil substitutes for levelling the land please see **section 2** of this document.

19 13 Wastes from soil and groundwater remediation

Sludges from soil remediation other than those mentioned in 19 13 03

Operators wishing to spread this waste will be required to provide detailed information on the substances likely to be present in this waste. This information should include the methods

and purpose of remediation. For more information on characterising your waste see section 2 of this guidance: Guidance and technical standards for deployment applications.

Section 4: Wastes listed under SR2010 No.6

Regulation of Sewage Sludge in land treatment

Treated sewage sludge or ‘bio-solids’ is the solid fraction produced by the treatment of urban waste water at waste water treatment works. The **1989 Sludge (Use in Agriculture) Regulations** specify 'treated sludge' in the definitions as: "sludge or septic tank sludge which has undergone biological, chemical or heat treatment, long-term storage or any other appropriate process so as to significantly reduce its fermentability and the health hazards resulting from its use". **The Code of Practice For Agriculture Use Of Sewage Sludge** and **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** provide practical advice on the application of sludge to land.

Which permit do I use?

The application of sewage sludge to non-agricultural land or energy crops not in a short term rotation is not covered by the Sludge (Use in Agriculture) Regulations 1989 and is controlled by deployments under SR2010 No.6.

The application of sewage sludge for the purposes of reclamation, restoration and improvement is controlled by deployments under SR2010 No.5 only and further details can be found in this section.

The application of compost derived in part from sewage sludge is controlled by deployments under SR2010 No4 and information on this can be found in section 2 under 19 05 03: compost from source segregated biodegradable waste.

Sewage Sludge in land treatment

Benefits and potential negative impacts of applications to land

The fertiliser manual RB209 contains useful information on the nutrient benefits of sewage sludge/biosolids for agricultural land applications.

Potential benefits

- sludge contains nitrogen and phosphate in significant quantities which will contribute all or part of crop requirement
- nitrogen availability in the sludge depends on the treatment process, aerobically treated sludges release nitrogen over a prolonged period whereas anaerobically treated sludges tend to be high in ammoniacal nitrogen which is readily available for plant uptake
- approximately 50% of the phosphate in sludge is available to the crop in the first year
- sludge contains trace elements such as sulphur, magnesium and boron which may be of advantage to the crop
- sludge contains organic matter which can improve nutrient retention, water holding capacity and soil structure

- the Carbon: Nitrogen ratio of sludge is similar to that of organic manures and composts which means there is a net release of nitrogen to the soil
- some residual liming benefit is available from lime treated sludges however not in sufficient quantities to adjust soil pH.

The lime treatment is designed to kill pathogens in the sludge by raising pH and possibly temperature at the time of treatment and in some cases de-water the sludge.

Potential negative impacts

- the application of sludge outside the window of maximum crop uptake may result in nutrient loss to surface or ground water
- sewage sludge contains metals which may limit the application rate depending on the receiving soil
- soils below pH 5 should not receive sludge applications and soils between pH 5.0 and 5.2 should only receive sludge with the justification of a properly qualified person
- issues such as odour may cause problems during storage and spreading.

The application rate must reflect the nutrient requirement of the current or proposed crop for nitrogen and phosphate in accordance with the fertiliser recommendations in RB209 and the requirements of other legislation such as **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).**

The receiving soil analysis must include levels of PTE'S already present as these may limit the application rate.

Uses of sewage sludge in forestry

- forest stand history: waste incorporation is only possible before tree planting, or restocking
- slope: the greater the slope, the greater the risk of run-off
- groundwater: sludge should not be applied in sensitive areas where there is a risk of groundwater contamination
- soil fertility and type: application should only be to sites with very poor or poor soil nutrient classes, suitable soil classes are Podzols, Iron pan soils, Littoral soils, disturbed and restored sites
- soil drainage characteristics and wetness: sludge should not be applied to land when the water table is less than 1m from the surface or when the soil is saturated
- buffer strips: sludge must not be applied close to water features
- nature conservation: wastes must not be applied in Sites of Special Scientific Interest (SSSIs), National Nature Reserves (NNRs), Special Protection Areas (SPAs), Special Areas of Conservation (SACs) or woodlands and forest stands subject to management for nature conservation, for example ancient woodlands, plantations on ancient woodland sites (PAWS), Sites of Importance for Nature Conservation (SINCs) or Local Nature Reserves (LNRs)

- archaeological and heritage sites: all scheduled archaeological sites should be excluded, guidance should be sought from competent authorities about unscheduled sites or monuments
- sensitive receptors: these include both dwellings and areas of recreation, the storage and application of sludge should not cause nuisance in terms of noise or odour.

The application rate must reflect the nutrient requirement for nitrogen and phosphate and the requirements of other legislation such as the **1989 Sludge (Use in Agriculture) Regulations**, and **The Nitrate Pollution Prevention (Wales) Regulations 2013 (NVZ rules).** The receiving soil analysis must include levels of PTE'S already present as these may limit the application rate.

Appendix B – Soils and Land treatment activities

This appendix provides additional guidance about characterising the receiving soil for waste to land operations. Section 8 also discusses the effects of metal additions to soils and guidance on limits for those metals in waste to land operations.

1. Physical and chemical analysis

Soil provides a physical growing medium and a reservoir of nutrients that plants and organisms can draw upon as required. For waste applications to land, a proposal should include a physical description and chemical analysis of the soil. The chemical analysis sets a base line for what is present in the soil prior to the waste application. This allows benefits and potential negative impacts to be properly addressed so an assessment based on the merit of the deployment application can be made.

Landspreading activities that provide soil conditioning benefits will typically need to consider both the physical and chemical properties of the soil.

Where analysis of a waste indicates that a potential toxic element that could build up in the soil is present in the waste, the application of the waste should not exceed the levels specified by the Defra Sludge Code of Practice in the receiving soil. This will require the analysis of the receiving soil to reflect the metals present in the waste see section 3.1.3 of this appendix.

1.1 Physical and chemical characteristics of soil
The parameters that the operator should analyse depend on: – the soil's descriptive type (using the approach given in RB209) – the soils chemical properties using the analysis outlined in RB209 or Defra Sludge COGAP as appropriate – the benefits and improvements that the waste will provide. Soil analysis should be no more than 4 years old (p35 RB209) for nutrient and pH amendments. Waste analysis must be: – for stable processes, for example paper pulp – once every 12 months – for processes which change more frequently, analysis frequency must reflect this and may be required on a batch basis. – waste analysis should use total values for P, K, Mg and S with accompanying information on the availability if applicable provided in the benefit statement.

2. Soil descriptions

The physical properties of a receiving soil are mainly determined by its texture (percentage of sand, silt and clay), organic matter content, depth and underlying geological parent material. Physical properties cannot be significantly altered but management and additions to the soil can improve structure and fertility (especially through addition of organic matter).

The accurate assessment and description of the soil helps in understanding the influence applied materials will have on its pH, nutrient reserves and availability as well as the behaviour of any trace minerals and PTE'S.

The description of the soil enables the accurate assessment of nutrient requirement in terms of buffering capacity, nutrient retention, and leachability, potential for run-off and soil nitrogen status (SNS) based on soil type and previous cropping.

2.1 Soil descriptions **Generic soil groups**	
There are 6 generic soil groups:	
Soil group	**Texture**
Light sand soils	sand, loamy sand or sandy loam to 0.4m depth and are sand or loamy sand between 0.4m and 0.8m, or over sandstone rock
Shallow soils	soil over chalk, limestone or other rock (excluding sandstone) less than 0.4m deep
Medium soils	sandy loams over clay, deep loams, and silty or clayey topsoils that have sandy or loamy subsoils
Deep Clay soils	sandy clay loam, silty clay loam, clay loam, sandy clay, silty clay or clay topsoil overlying clay subsoil to more than 0.4m depth.
Deep Silty soils	sandy silt loam, silt loam or silty clay loam textures to 1.0m depth or more
Peat and organic soils	Defined by percentage of organic matter.
(a) Organic soils	10 to 20% organic matter.
(b) Peaty soils	over 20% organic matter.
See RB209 page 88 and Appendix 1 for further details.	

Further guidance on soil assessment and soil texture identification is available in Natural Resources Wales publication 'Think soils, soil assessment to avoid erosion and runoff' as well as other sources. Think Soils is available for download from our publications webpage via this link: **Think Soils Electronic Publication**

Published mapping resources can be used to identify the type of soil on the land intended to receive the waste. However these are no substitute for field assessments. For example, soil mapping information on Soilscapes is available at www.landis.org.uk/soilscapes

2.2 Soil descriptions **Further information on assessment tools and guidance**
Further information regarding soil can be found on the following web sites.

Defra website – soil guides and advisory leaflets – soil erosion manual and soil erosion field guide.

Natural Resources Wales website – thinksoils, best farming practice, nutrient management planning.

Fertiliser Manual RB209

3. Sampling the soil, methods and frequency

DEFRA Fertiliser Manual (RB209) contains guidance on the methods and frequency of soil sampling. As a general rule soil sampling for nutrients and pH should be carried out approximately every 4 years. Soil samples need to represent the soil over the whole of the receiving land and include the date of sampling.

Additional nutrient justification can be submitted using the Field Assessment Method referred to in **RB209**. This can be used in the intervening years between soil sampling and is based on previous cropping, fertiliser and manure use, soil type and annual rainfall. The field assessment method is however not a replacement for a regular programme of soil sampling.

3.1 Sampling the soil

Box 3.1.1 summarises requirements for sampling the soil, further information can be found in **RB209** appendices 2, 3 and 4. Please see box 3.1.3 for additional sampling requirements for the assessment of Potentially Toxic Elements in soil.

If a particularly sensitive crop is to be grown as part of the rotation, for which benefit is being claimed, the soil should be sampled well in advance of the planting of this crop to allow for soil adjustment.

3.1.1 Sampling the soil

Taking soil samples

Avoid taking samples when the soil is very dry

Leave as long as possible between the last fertiliser, manure or waste application. If possible sample after the last application has been cultivated into the soil

Do not sample within six months of lime or fertiliser application (except nitrogen)

Sample areas should be representative of the area which is to receive the waste (for heavy metal assessment see the box 3.1.3 below)

Avoid sampling atypical areas within blocks for example areas where stock congregate, bonfire sites, gateways and manure heap sites

Sample depth should reflect the cropping rotation on the receiving land

Take cores in a ‘W’ or ‘M’ pattern across the field, for nutrients sampling should be done in 10 hectare blocks

Take 25 individual sub-samples (cores) per uniform area (10 ha block) for nutrient sampling

The samples must reflect variations across the receiving land of:

- soil type, nutrient status (P, K, Mg), pH and if applicable PTE'S – the crops grown and,
- the application of manures, fertilisers and wastes.

The type of cultivation system employed on land to be sampled for P, K, Mg and pH can affect the distribution of nutrients within the top soil, see box 3.1.2.

3.1.2 Sampling soil

Effects of cultivations on sample depth

Sampling has to be representative of the nutrients available in the plough layer. Account should be taken of the effect of 'Min Till' with or without 'occasional plough' (after several years).

A standard depth of sampling depending on crop rotation for pH and nutrients and operational monitoring of PTE'S is:

- arable and field vegetables sample to 150 mm and
- long term grassland sample to 75 mm depth.

This is most applicable to regular plough systems and should be used for soil analysis with regard to waste applications.

However in different cultivation systems nutrient profiles may vary.

Regular plough systems

The nutrients are mixed in a homogenous soil layer in the plough layer 150mm to 300 mm deep, nutrient concentrations in a core taken at 150mm will be representative of the entire layer.

Regular shallow cultivation to 50mm depth (Min-Till)

Applied nutrients will tend to accumulate in the top 50 mm layer leading to stratification through the top 300mm of the soil. A core taken at a depth of 150mm will not be representative of the nutrients and may lead to an under estimation of the availability of nutrients to the following crop.

Occasional ploughing systems with 'Min-Till'

The top 50mm of the soil layer is occasionally inverted to plough depth, 150mm to 300mm and may not be sampled if the sample core depth is 150mm. This may lead to an under estimation of the availability of nutrients to the following crop.

For more information on soil sampling, see appendices 2, 3 and 4 of **RB209**.

3.1.3 Sampling soil

Sampling the soil for receiving heavy metals (Potentially Toxic Elements)
For soil that receives sludge or waste containing heavy metals use the sampling regimes set out in the following for the potentially toxic elements: – schedule 2 of **The Sludge (Use in Agriculture) Regulations 1989** and, – page 5 of the **Code of Practice for Agricultural Use of Sewage Sludge Version 2, 1996.**

4. Crop and plant requirements

The provision of crop and plant nutrients is usually the most common benefit claimed when a waste material is applied to land. This section provides further guidance on adjusting soil nutrients, pH and organic matter.

4.1 Limiting plant nutrient levels

Using an Index system, DEFRA fertiliser manual **RB209** recommends setting nutrient levels at the economic optimum for crop production.

If an applicant wants to set plant nutrient levels above the levels recommended by RB209, they should:

- justify the nutrient level with appropriate technical expertise
- include the nutrient level in their environmental risk assessment and
- state the source of information that they used to set the nutrient level.
-

4.1.1 Limiting plant nutrients **Example:**
Due to the variable composition of waste, a proposal for a waste-to-land activity that rectifies a deficiency of one essential plant nutrient by following **RB209** levels may over apply levels for other nutrients. This must be taken account of in the statement of benefit and supporting risk assessment, for example the non-essential nutrient additions associated with the application may satisfy crop off-take so there is no net increase in indices or nutrient level in the receiving soil

Where waste is being applied for the creation or improvement of habitats further information can be found in:

Wildlife management & habitat creation on landfill sites[7] which contains:

- best practices for creating a range of habitats on former landfill sites
- nine case studies of habitat creation.

[7] Wildlife Management & Habitat creation on Landfill sites, a manual of best practice. Written by Duncan Watson & Valerie Heck Published by Ecoscope Applied Ecologists, ISBN 0-9539189-0-4 (published in 2000).

Natural England (in collaboration with other organisations such as Natural Resources Wales) has created guidance on restoring and maintaining of a range of habitats.

4.2 Adjusting the soil's chemical properties

This section describes the methods and available guidance to allow assessment of the adjustments that can be made to a soil's chemical properties.

4.2.1 Adjusting metals levels including PTE'S

Much of the land available for waste to land applications in England and Wales will already contain some metals including PTE'S.

4.2.1 Potentially Toxic Elements (metals)
Sources of metals and PTE'S in soil
Deposition of atmospheric pollutants, for example: – historic lead particulates from exhausts – industrial air pollution. Previous land use, for example: – pig slurry applications (historically high in copper and zinc) and applications of other types of slurry and manure, fertilisers or soil conditioners – sewage sludge applications (PTE'S) – water treatment sludge applications containing iron and aluminium and, – previous waste applications.

Soil analysis for the addition of wastes containing metals including PTE'S should therefore take into account the background levels in the receiving soil.

If there are metals or PTE'S present in the waste(s) to be spread and the application rate(s) are such that the addition of these elements to those already existing in the soil may exceed **The Sludge (Use in Agriculture) Regulations 1989** or the values in the **Code of Practice for Agricultural Use of Sewage Sludge Version 2, 1996** then the soil must be sampled for the relevant metals to ensure compliance with the regulations.

The assessment for the addition of PTE'S is based on the limits set in **The Sludge (Use in Agriculture) Regulations 1989** and **Code of Practice for Agricultural Use of Sewage Sludge Version 2, 1996.**

The mobility and hence availability of PTE'S and other metals in the soil is also pH dependant. Soil pH adjustment is discussed in section 4.3 of this appendix.

Section 8 of this document has information on the PTE'S and common sources of various metals, the availability of these metals and the effect on plants and animals of excessive levels of these metals.

When applying waste or sewage sludge to land the **Sludge (Use in Agriculture) Regulations 1989** limit the metals levels based on the following:

– the maximum permissible concentration of metals in the soil and,

– the maximum amount that operators can apply over a 10 year period.

These limits are principally derived in order to protect livestock health and the food chain. Any application exceeding the levels in the sludge regulations will require site specific justification.

4.2.1 Potentially Toxic Elements (metals)
Statutory and advisory metals
When applying sludge under the Sludge Regulations and Environmental Permitting Regulations permits it is a requirement to meet the limits of: – Zinc – Lead – Cadmium – Nickel – Copper – Mercury The guidance limits for the following metals are also available: – Molybdenum – Arsenic – Selenium – Fluoride

4.2.2 Other metals not in the soils metals and PTE guidance

Where a waste analysis indicates high levels of an element that **The Sludge (Use in Agriculture) Regulations 1989** and **Code of Practice for Agricultural Use of Sewage Sludge Version 2, 1996** do not include as PTE'S, the addition may have significance in relation to the background levels in the locality such as underlying geology and soil mass of the cultivation layer.

Example: The addition of iron, aluminium and manganese from the application of water clarification sludge.

Information on background soil levels can be obtained from:

– Published soil memoirs

– local sampling and,

– geo-chemical surveys.

Information on background soil contaminants can be found in various publications, including the following reports:

– British Geological Survey or Wolfenholme geo-chemical atlas of England and Wales.

– Natural Resources Wales Information on land quality in the UK, R&D Technical Summary PS275, 2002.

4.3 Adjusting soil pH

Soil pH is a measure of the soil's acidity or alkalinity. It ranges from about pH 4 (very acid, when most crops will fail) to about pH 8 for soils that are naturally rich in lime or are over-limed. The soil pH has a significant influence on nutrient availability and the mobility of metals.

Most plants can tolerate a wide range of hydrogen ion concentrations providing a proper balance of other elements is maintained. Maintaining soil pH at or close to optimum levels is important in preventing the leaching of PTE'S in the soil.

4.3.1 Effects of adjusting pH

In mineral soils as soil pH falls the soil solution concentration of hydrogen ions increases. At low pH the concentrations of aluminium, manganese, iron and zinc in the soil solution will also tend to increase. A fall in soil pH (increase in acidity) can be caused by, amongst other things, rainfall, the application of ammonium sulphate fertilisers, organic manures and natural soil processes.

Aluminium and iron have the ability to fix phosphorus in plant unavailable forms which can induce phosphorus deficiency in the plants. The degree of phosphorus fixation is least at soil pH7 and increases as soil pH decreases (phosphorus deficiency can also be seen in alkaline soils where reactions with calcium fixes phosphorus in unavailable forms).

Applying waste containing lime to the soil adjusts the pH, which affects the chemical, physical and biological properties of the soil matrix.

The chemical effects of changing a soil's pH include:

- several trace elements (such as iron, manganese and zinc) are less available as the pH rises from 5.0 to 7.5 or 8.0
- molybdenum availability is affected in the opposite way and availability increases at higher pH levels
- only a small fraction of soil phosphate is in soil solution at any one time, although most plants seem to extract it from the soil with least difficulty at pH 6.5 and,
- at pH values below about 5.0, aluminium, iron and manganese are often soluble in sufficient quantities to cause harm to the growth of sensitive plants, Iron and aluminium may affect phosphate availability at low pHs.

Metal containing waste and sewage sludge should never be applied to soils below pH 5.0 and only to soils below 5.5 with 'properly qualified advice'.

4.3.1 Effects of adjusting pH **Target soil pH's**	
The target pH's for soil types and cropping are shown in the table below, RB209 uses the liming values in bold type: The target pH is always slightly higher than the optimum pH to allow for longer periods between lime applications.	
Soil type	Target pH

	Arable soils	Grassland soils
Light Sand Soils	6.5	6.2
Medium Soils	6.5	6.2
Deep Clay Soils	6.5	6.2
Deep Silt Soils	6.5	6.2
Organic soils (10 – 25% OM)	6.4	5.9
Peats (25% + OM)	6.0	5.5
Adjusting soil pH is as important to ecological improvements as it is to agricultural benefits. This is because soil pH is the main factor that controls the availability of essential plant nutrients. The appropriate application rate of waste depends on the plant species and habitat that the operator wants to introduce, restore or maintain.		

Further information on adjusting soil pH for agricultural crops can be found in the Fertiliser Manual **RB209**. The **Agricultural Lime Association** can provide a 'ready reckoner' of lime requirements based on soil type and cropping.

4.3.2 Adding Liming materials to the soil

The use of some artificial fertilisers, cropping regimes, and natural leaching all contribute to lowering soil pH over time. For non calcareous soils, the addition of liming materials helps to redress the pH balance.

The biological advantages of liming include:

- stimulating heterotrophic soil organisms, which favour the formation of humus and also encourage the elimination of certain organic intermediate products that are toxic to some plants
- improving soil structure
- the stimulation of bacteria that fix nitrogen from air, both non-symbiotically and in the nodules of legumes.

Chemical advantages of liming include:

- maintaining the nutrient balance in the soil
- reducing the mobility and uptake of PTE'S
- favours healthy plant growth
- increases nutrient availability and plant uptake.

4.3.3 Comparing liming materials

The total neutralising value (TNV) is the standard basis for comparing liming materials.

4.3.3 Comparing liming materials

Use of neutralising value to compare liming materials
TNV is expressed as a percentage of the effect that is obtained if pure calcium oxide (CaO) is used. Example: if a sample of ground limestone has NV = 55, then 100 kg of this material would have the same neutralising value as 55 kg of CaO. Typical values are: – ground chalk – 50% – ground magnesium limestone (15-20% MgO) – 50 to 55% – hydrated lime – 70% – Burnt lime (CaO) not generally used on farm – 80 to 95% Waste materials tend to have lower neutralising values which are reflected in the need for typically higher application rates than agricultural lime.

The reactivity of a lime material describes its speed of action. The finer grained materials and dusts tend to be quickest to react in the receiving soil, typically 1 to 2 years, whereas lumpy or poorly ground material is slower to react.

The reactivity in soil of some waste materials will be similar to virgin product because of their physical and chemical characteristics, for example cement kiln dust. The speed of reaction within the receiving soil is not the principle benefit in terms of the recovery of the waste. The addition of a material that is fit for the purpose of amending soil pH is the principle benefit, the speed of reaction is a matter for the operator and farmer to discuss regarding taking into account suitability of the waste material, soil type, pH amendment required and cropping.

Lime recommendations for on field application can be given in terms of the weight of CaO required (Soffe (ed.) The Agricultural Notebook, 19th edition (1995), London: Blackwell Science) however many are given in tonnes per hectare of standard agricultural limestone - CaCO3.

The value of recommendations depends on the soil's pH and the buffering capacity of the soil.

4.3.4 Applications that use a liming material

To use a particular waste as a liming agent the operator must:

- provide analytical evidence of the liming capability of the waste, expressed as an Neutralising Value (NV) and,
- match the lime requirement for the receiving soil with the proposed application rate. This is linked to soil type, cropping, soil pH, target pH and the field factor (the amount of lime required to raise the soil type selected by 1 pH unit, a reflection of the soils buffering capacity).

Please note:

- not all alkaline wastes are effective liming materials
- total calcium is not a suitable measure of liming ability.

4.3.5 Disease control using pH adjustment

4.3.5 Disease control using pH adjustment
Club root
Club-root is caused by the soil - borne microbe (Plasmodiophora brassicae). Its spores remain viable in the soil for at least a decade reducing the effect of crop rotation as a method of control. The use of lime is fundamental to club-root control. Detailed research over many years has identified that the mobility of P. brassicae and its ability to multiply is impaired when the pH is alkaline and calcium is present. Soil pH should be between 7.0 and 7.2 with between 8000 and 10000mg/l Ca2+ ions.

5. Adjusting soil nutrients using soil indices as a guide

The DEFRA fertiliser manual **RB209** contains information on soil indices for:

- phosphorus, potassium and magnesium
- recommendations also provided for sulphur and sodium (other trace elements should be amended in the soil on the basis of soil analysis)

Soil indices are a simple measure of the nutrient status of the soil (the concentrations of nutrients), they are indicative of a nutrients concentration range in the soil, for example Phosphate at index 2 is the range of phosphate concentrations between 16 and 25mg/l.

5.1 Nitrogen

There is no index for nitrogen in RB209, however if the waste supplies the soil with nitrogen an assessment of this nutrient is required.

The most common benefit conferred by waste applied to land is the provision of nitrogen in both plant available mineral forms and stable organic forms which mineralise slowly and become available over time.

The nitrogen requirement of a crop depends on type and growth of the crop and may increase if higher than average yields are expected. Certain crops may require extra nitrogen such as milling wheat.

Crop N requirement = Crop type, yield & quality

To determine how much additional nitrogen is required from the waste the following must be considered:

- how much nitrogen is left in the soil
- how much of this residual nitrogen will become available to the next crop
- how much nitrogen from other sources, wastes, manures and artificial fertilisers is required to meet crop demand.

The amount of Nitrogen made available from waste should not cause the Nitrogen supplied to exceed the crop need identified in RB209 without agronomic justification.

RB209 has further guidance on the assessment of crop nitrogen requirements using the Soil

Nitrogen Supply (SNS) for arable and root crops and Soil Nitrogen Supply Status for grassland.

5.1.1 Applications of nitrogen

Forms of soil nitrogen

There are four main forms of soil nitrogen:

- humus, comprises older stable organic matter, mineralises slowly and is important in soil structure
- recent organic matter, comprising of crop residues, manures, waste materials applied and dead soil biota
- biomass, comprising living soil organisms
- mineral nitrogen, comprising nitrate, ammonium and nitrite. This is the form that is plant available. Ammonium ions are held on cation exchange sites whereas nitrate ions are held in solution and prone to leaching.

Nitrogen in the soil is in constant circulation between the different forms.

5.1.2 Ammonia and nitrogen volatilisation

The storage and subsequent applications to land of high nitrogen content wastes have the potential to increase the air concentration of ammonia through volatilisation. The ammonia can settle-out (nitrogen deposition) on land causing a fertiliser effect, which may have an impact on sensitive receptors in the local environment. The deposition of ammonium compounds can affect the availability of elements both essential and toxic to plant growth. In addition, ammonia as a source of nitrogen (N) contributes to eutrophication, or nitrogen enrichment of nutrient-poor soils. This process, which can also occur in surface waters, disrupts the balance of sensitive ecosystems, causing either excessive growth or disappearance of plant species. High ammonia emissions may also directly affect trees or vegetation by damaging foliage and retarding growth. Ammonia can be acutely toxic to certain species of plants, for example, mosses and lichens which cannot tolerate increased ammonia in the air.

Where sensitive receptors have been identified such as SSSI's you should check the site citation document for sensitive species and the "Operation Likely to Damage" (the OLD list) on the **Natural Resources Wales website** or contact them regarding the site.

When you identify sites that may be vulnerable to ammonia emissions from your activity you need to address the risk in your environmental risk assessment and you may need to change the application rate and/or method to remove or where this is not practicable, reduce the risk.

The **UK Air Pollution Information System (APIS)** can be used to check the background levels for a site as part of your environmental risk assessment.

5.1.2 Applications of nitrogen

Ammonia volatilisation

Emissions of nitrogen and ammonia can lead to their deposition on vegetative surfaces through processes of wet and dry deposition. Excess nitrogen deposition to terrestrial plants can lead to nutrient enrichment (eutrophication) effects, and put plant communities at risk. It can lead to increased risk of competition from neighbouring invasive species, such as fast growing grasses. The most sensitive communities are those where mosses and lichens are integral to their structure and function, and where species richness is comprised of slow growing species.

.

5.1.2 Applications of nitrogen

Factors in reducing ammonia volatilisation

Waste type:

- high nitrogen content wastes such as food processing wastes are prone to volatilisation
- liquid wastes tend to volatilise readily especially if spread using high trajectory spreading techniques however slurries and high nitrogen solid wastes may also pose risks to sensitive habitats.

Receiving soil type:

- compacted and heavy soils with a low permeability will increase risks of volatilisation.

Weather conditions:

- hot dry conditions increase the likelihood of volatilisation.

On site storage:

- losses from storage on site can be reduced by covering waste or efficient delivery programmes.

Method of application:

- injection with slot closure by rollers is an effective method of reducing losses through volatilisation.

In some cases the nature of the waste and the degree of sensitivity of the receptor may result in alternative sites for the waste being required.

Further information can be found in **Guidance on control techniques for preventing and abating emissions of ammonia** and **Ammonia in the UK**.

5.2 Phosphate adjustment

5.2.1 Phosphate adjustment

Phosphate indices

Phosphate is not very mobile within the soil and needs to be in close proximity to roots to be effective.

The ideal index levels are:

- Arable, forage and grassland cropping: index level 2 (16 – 25mg/l)

- Vegetable growing: index level 3 (26 – 45 mg/l).

For other indices:

- at indices 0, 1, and 2, operators may be able to justify applying more phosphate than the crops will remove over the rotation to build up the amount of phosphate in the soil
- at index 3, exceeding maintenance may also be justified in other cases, see examples below
- at index 4 and above it is difficult to justify additions above those of crop offtake.

Phosphate applications prior to potatoes in a rotation will provide much if not all of the following crops phosphate requirement and a useful addition to the crop following after that, because of the poor rooting of the potato crop and the immobility of phosphate in the soil, a similar case can be made for maize and field vegetables.

Where phosphate is not applied, off take in grain alone can lead to a gradual decline in soil phosphate reserves, which could reduce yields, profitability and nitrogen fertiliser use efficiency.

Phosphate is available in several forms (see box 5.2.2 below). Soluble phosphates become readily available to the crop very quickly and insoluble phosphates which are released in the soil slowly over time. If a waste analysis or benefit statement indicates phosphate solubility it can be used to gauge the effectiveness of the phosphate application.

5.2.2 Phosphate adjustment

Phosphorus in the soil

The fertiliser manual **RB209** contains useful information on the applications of phosphorus for agricultural cropping. The phosphorus in the soil can be in several states:

- soluble phosphate available phosphate ions within soil solution
- readily available phosphate where the phosphate ions are weakly attached to soil mineral or organic matter particles. This source provides the reservoir to replenish the soluble phosphorus within the soil solution. Excess readily available phosphorus can move to become less available and vice –versa
- less available phosphate this is phosphorus which is more tightly bound to soil particles and organic matter, it converts slowly to and from this state depending on the levels of readily available phosphorus and therefore plays an important part in the soil phosphorus reserve
- organic phosphate from added wastes, humus and decaying biomass is cycled in and out of the forms above.

High organic matter levels in soil provide a good supply of phosphorus through mineralisation and can also provide a reservoir holding phosphorus and impeding the processes which fix phosphorus in its unavailable forms:

- fixed phosphate this is where soil conditions allow phosphorus to become bound in insoluble forms, these conditions include high and low pH soils.

The organic matter content of a soil influences the amount of biodiversity the soil, the interaction between soil organisms and organic matter can affect the movement of phosphate in the soil.

Phosphate can be lost through leaching at high index levels (index 5 and above)

In non-agricultural settings for example landscaping projects where slow release phosphate fertilisers are preferred and repeated addition of phosphate is either not possible or avoided, the soils should be high in organic matter and provide a reservoir of phosphate.

This can be achieved by the addition of composts, other organic wastes or manures additional phosphate can be provided by using a woody mulch on the surface which will protect the surface of the soil, help retain decaying biomass from leaf fall and return phosphate back to the soil and as the material is slow to degrade contribute a slow release of phosphate to the established plants. Management techniques for maintaining such sites might include the re-application of mulch or the re-use of shredded trimmings from maintenance on the site.

If phosphate is to be applied at index 3 or above, the operator should:

- explain why the increased levels are appropriate for the receiving land and,
- address the increased risks from the application in the risk assessment within the benefit statement.

RB209 and **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** gives guidance on phosphate inputs relative to soil type, cropping and soil index.

The operator should support their explanation with the appropriate technical expertise i.e. qualified FACTS advice.

5.3 Potash adjustment

RB209 and the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** for farmers give guidance on potash inputs relative to soil type, cropping and soil index.

If potash at index 3 or above, the operator should:

- explain why the increased levels are appropriate for the receiving land and,
- address the increased risks in the risk assessment within the benefit statement, for example luxury uptake in favour of magnesium in grazing grass in spring.

The operator should support their explanation with the appropriate technical expertise i.e. qualified FACTS advice.

5.3.1 Potash adjustment

Potash indices

Potash is more mobile within the soil than phosphate and is prone to leaching, especially from light sandy soils.

The ideal potash index levels are:

- Arable, forage and grassland cropping: index level 2- (121 – 180mg/l)
- Vegetable growing: index level 2+ (181 – 240 mg/l).

Maintenance applications to account for crop requirements are justified at these levels.

For other indices:

- at indices 0, 1, and 2, operators may be able to justify applying more potash than the crops will remove over the rotation to build up the amount of potash in the soil
- at indices 3 and above, operators may be able to justify applying the amount of potash that the crops will remove in the rotation.

Further useful information on potash requirements and off-take can be found in the **Fertiliser Manual (RB209)** and the **Potash Development Association** website.

5.3.2 Building up and running down phosphorus and potash reserves in the soil

Where soil index levels are below the target level it is advisable to apply extra to build up the soil nutrient levels. RB209 includes a degree of 'build up' in its recommendations however this requires continual applications over many years.

Experimental data has indicated that to raise the index level from 0 to 1 would require up to 1100kg/ha of triple super phosphate (TSP) or 670kg/ha of muriate of potash (MOP) depending on soil type, in addition to maintenance dressings for the growing crop.

5.4 Magnesium adjustment

RB209 and the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** for farmers give guidance on magnesium inputs relative to soil type, cropping and soil index. If magnesium is to be applied at index 3 or above the operator should:

- explain why the increased levels are appropriate for the I receiving land
- address the increased risks in the risk assessment within the benefit statement.

The operator should support their explanation with the appropriate technical expertise i.e. qualified FACTS advice.

5.4.1 Magnesium adjustment

Magnesium indices

Magnesium behaviour in the soil is similar to potassium. Additional magnesium becomes available from non exchangeable forms.

Most combinable crops with the exception of peas and beans do not benefit from magnesium additions unless the soil index levels are very low (index 0).

Peas, beans and root crops, including maize and fodder beet require an index level of 1 or above.

Grassland is not responsive to magnesium however herbage levels should be maintained to prevent 'Grass Staggers' in lactating animals. Soil can be maintained at index 2 on grassland. Potassium applications in spring can reduce magnesium uptake resulting in 'Staggers'

Potential negative impacts of high magnesium levels:

- high magnesium levels, index 5 and above can reduce potassium availability

– high magnesium levels have been associated with cultivation difficulties.

5.5 Sulphur adjustment

RB209 and the **Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** for farmers give guidance on sulphur inputs relative to soil type, cropping and soil index.

Atmospheric sulphur contributions are reducing and as a result there is an increasing risk of sulphur deficiency across a wide range of crops and soils. Sulphur deficiency depends on soil type with the highest risk on sandy, shallow or medium textured soils especially those low in organic matter. The risk of deficiency also increases in all arable rotations and low rainfall areas.

Certain wastes such as gypsum contain useful quantities of sulphur which may provide all or some of the crop requirement at the chosen application rate.

5.5.1 Sulphur adjustment **Analysis and treatment**	
Analysing for sulphur levels: – soil analysis are not reliable – RB209 has a sulphur deposition map allowing the annual atmospheric deposition to be gauged – grain analysis can be used retrospectively and, – plant tissue analysis is generally the most accurate.	
Where a requirement is identified:	
Crop	Application rate
Cereals	25 - 55kg/ha SO3
Peas	25 – 50
Oilseed Rape	50 – 75
Potatoes	No requirement, however crop removal
Sugar Beet	can be 50kg/ha SO3
1st Cut silage (removal 38kg/ha)	25 – 40 kg/ha SO3
2nd Cut Silage (removal 30kg/ha)	25 – 40 kg/ha SO3
3rd Cut Silage (removal 22kg/ha)	25 – 40 kg/ha SO3
Autumn applied sulphur is at risk of leaching, especially from soluble sulphur sources such as gypsum. Symptoms of sulphur deficiency can resemble those of nitrogen deficiency such as chlorosis (yellowing) of the younger leaves in cereals.	

6. Adjusting the soils physical properties

This section describes the methods and available guidance to allow assessment of the adjustments that can be made to the soils physical properties.

The physical properties of the soil include organic content, structure and carbon to nitrogen ratio.

6.1 Adjusting the soil's organic content

The organic matter in the soil is an accumulation of partly decayed and partly synthesised plant and animal residues. Soil micro-organisms are continually breaking down this material.

Consequently, soil organic matter is a transitory soil constituent and must be renewed constantly by the addition of plant residues and other organic material.

6.1.1 Adjusting the soils organic content

benefits and potential negative impacts of organic matter addition

The benefits of adding organic matter to the soil include:

- increase the amount of available nitrogen (mineralised N) for crop uptake – acts as a soil conditioner
- stabilise poorly structured soils and aid drainage
- improve the workability of heavy soils (increase granulation and reduces plasticity and cohesion)
- increase a light soil's resistance to drought and in general increases water retention across most soils
- increases resistance to compaction
- increase light soils resistance to erosion
- increase nutrient retention
- organic matter supplies a substrate to various beneficial organisms such as bacteria and earthworms.

Potential negative impacts of high organic matter levels:

- increase the likelihood of mineral deficiencies (magnesium and copper)
- high organic matter can affect herbicide activity (see Appendix A box 2.3.3).

The 'Walkley Black method' of measuring soil organic matter is one of the most reliable methods (% soil organic carbon x 1.72).

The organic matter content of a soil is typically lower in arable soils (typically 2-7%) than under grassland (typically 8-15%) because of continual oxidation due to cultivation.

An organic soils is still predominantly mineral but with 6 – 20% organic matter.

Peaty soils are low density black soils derived from vegetable matter and contain more than 20% organic matter.

Sandy and silty soils typically have lower organic matter contents than clay soils.

Raising the organic matter content of soil is a slow process and is only achievable over a long time period with multiple applications of organic material. This is best achieved when the operator incorporates the waste into the soil so that it acts as a conditioner.

6.1.2 Adjusting the soils organic content

Justifying applications of organic matter

Application rates of highly organic wastes should be based on the % of organic matter content in soil.

Soil organic matter status	% Organic matter	Justification
very low	less than 1%	typically does not require justification.
low	1.0 – 1.7	typically does not require justification.
moderate/low	1.8 – 3.0	typically does not require justification.
moderate	3.1 – 5.0	maintenance dressings can be applied without qualified justification.[8]
high	5.0 – 8.0	qualified justification is required.
very high	more than 8	qualified justification is required.

Organic matter status of mineral soils – Soils, K Simpson

In the justification, the applicant should:

- explain why the increased levels are appropriate for the receiving land
- support the explanation with the appropriate technical expertise
- address the increased metal levels in their environmental risk assessment.

The percentage of organic matter in a waste can be checked using the waste analysis.

For results based on dry matter the percentage organic matter equals:

- 100 - % ash.

For results based on sample as received organic matter equals:

- (100 - % ash) x dry matter/100.

[8] * Typically the rate of loss of soil organic matter is between 0.75 and 1.25t/ha/yr. To maintain the level of organic matter in the soil where levels of soil organic matter are moderate would require applications of farm yard manure between 10 and 25t/ha/yr are seen as maintenance dressings (additions should allow for losses through decomposition).

Organic matter status of mineral soils – Soils, K Simpson

6.2 Improving the soil structure with gypsum

Gypsum (calcium sulphate) can be used to restore or improve the following types of soil:

- sodic soils
- soils that were flooded with sea water and,
- some non-calcareous clay soils.

Gypsum replaces sodium cations with calcium cations in the layers of clay particles in the soil environment. There are also claims that gypsum causes the exchange of other cations such as magnesium.

These dynamic reactions are commonly referred to as cation exchange. Cation exchange is one of the most common and important soil reactions. It takes place on the negatively-charged surfaces of soil particles. The soil's capacity to exchange cations is used to determine the appropriate application rate.

The following information is required to determine an appropriate application rate:

- assess the soil's sulphur requirement
- calculate the CEC using the method in: The Specification for Topsoil, British Standard 3882, 1994, Annex D (normative), Extraction of exchange cations in soil.

6.3 Adjusting the soil's carbon: nitrogen ratio

There is a close relationship between the soils organic matter content and the soil's nitrogen content. Because carbon makes up a large proportion of organic matter, the carbon to nitrogen ratio (C: N ratio) is fairly constant in soils.

A 'high C: N ratio' means there is a large proportion of carbon when compared to the proportion of nitrogen. Adding wastes with a high C: N ratio to soils can cause a net lock up of available nitrogen. Certain wastes such as paper sludges and timber residues have a high C: N ratio.

When a waste with a high C: N ratio is added to soil, the soil organisms begin to break down the waste. The soil organisms need nitrogen to process the carbon and reproduce but the waste does not supply enough nitrogen. So the soil organisms remove the nitrogen from the soil that would otherwise have been available to the plants. This process is called nitrogen lock up.

The operator should consider the soil type and cropping when applying waste to add only organic matter to the soil and take into account the potential for nitrogen lock up.

Where an operator applies waste to supply organic matter to a soil, they are unlikely get real benefits from surface spreading a bulky organic material on permanent grass fields. The waste may cause smothering at high application rates and incorporation may be difficult in well-established grass swards. However, operators may see a benefit if they apply waste to a short-term ley that is subsequently ploughed during a rotation.

6.3 Adjusting the soil’s carbon: nitrogen ratio

Potential benefits and negative impacts

The demand for nitrogen from the soil organisms can deplete available soil nitrogen, which results in:

- decreased crop growth and yield
- a decline in the population of soil organisms.

As the soil organisms slowly break down the waste, the C: N ratio lowers, eventually reaching the point when nitrogen is available for plant use.

The period of nitrogen lock-up may be long or short depending on conditions such as:

- the greater the application rate of waste with high C:N ratio, the longer the period of nitrogen lock-up
- the narrower the C:N ratio of the waste, the shorter the nitrogen lock-up period
- soil temperature has a minor effect on nitrogen lock up caused by high C: N ratio waste applications, application rate is the most important factor.

After applying high C: N ratio wastes, the soil may require mineral nitrogen in the form of fertiliser to maintain crop yields in the short term (see waste from producing and processing pulp paper — paper waste).

There is a need to recognise the significance of the C:N ratio when controlling:

- the available nitrogen
- total organic matter
- the rate of decay.

Where organic waste is applied to grassland splitting the application and allowing time between applications for the waste to incorporate into the sward is good practice, harrowing the spread fields following waste applications can increase the rate of sward incorporation by opening up the bottom of the sward and breaking up any larger lumps of paper sludge waste. The benefits of following an application of organic waste to grassland with harrowing are:

- reduce the visual impact of the activity
- incorporate the waste into the base of the sward, increasing soil contact
- reduce the possibility of stock ingesting the material when grazing or incorporation into silage or hay crops.

7. Adjusting the soil's water content

The water content of a soil depends on a number of factors:

- time of year
- crop cover
- soil type (e.g. texture and depth)
- soil condition (e.g. structure and drainage status).

Water is essential for plant growth and a wide range of biological transformations in the soil environment and acting as the carrier medium for soluble nutrients. Water can be

conserved in the soil by injecting liquid wastes and using minimum tillage operations for establishing the following crop. When injection is used operators need to take into account soil conditions and under drainage.

7.1 Adjusting the soil's water content

Benefits and potential negative impacts of adjusting the soils water content

The main benefit from applying waste with high water content is to meet a plant's requirements for water. Additional benefits include the following:

- the waste may contain traces of plant nutrients
- the water in the waste may wash fertilisers or manures from the surface into the soil.

Example: fertilisers or manures may be applied to the surface between grass cuts and watery wastes applied to wash them in.

Timescale for adjusting water content

Waste with high water content is most likely to provide benefits during the months of active plant growth i.e. in the period May to September inclusive.

Potential negative impacts of applying watery wastes:

- run off may occur on slopes and where the soils are saturated, compacted or have a high degree of impermeability
- pollution may occur if the application follows or is followed by heavy rain
- high water tables may lead to rapid soil saturation and creation of anaerobic conditions and surface ponding.

Methods of application:

- application to the soil surface via trailing shoe or dribble bar places the waste, reduces odour and aerosol drift
- high trajectory application by splash plate or irrigation guns can lead to odour and aerosol drift affecting sensitive receptors.
- An application rate of 250m3/ha is approximately equivalent to 25mm of rain/ha.

8. Metal additions to soils

The movement of metals including Potentially Toxic Elements (PTE'S) in the soil is closely related to the soil pH see the table 1.1 in section 1 of this appendix. It is important when applying waste to land that the additions of metals and their effect on the soil and plants are adequately considered in terms of risk.

8.1 Permissible levels

The following table is derived from The Sludge (Use in Agriculture) Regulations 1989. It is recommended to be used as a guide for levels of Potentially Toxic Elements (PTE'S) which would be acceptable in the soil when wastes are applied.

Waste applications which apply PTE'S to the soil at greater levels than those described in table 1.1 below should be justified in the certificate of benefit written by a "suitably qualified person".

8.1 Permissible levels **Maximum permissible and advisable concentrations of potentially toxic elements (PTE'S) in soil after the application of sewage sludge to agricultural land and maximum annual rates of addition in mg/kg**					
Maximum permissible concentrations of PTE (mg/kg					Maximum permissible average over a 10-year period (kg/ha)[9]
	pH[10] 5.0-5.5	pH[7] 5.5-6.0	pH 6.0-7.0	pH[11] >7.0	
Zinc	200	200[12]	200[10]	300[10]	15
Copper	80	100	135	200	7.5
Nickle	50	60	75	110	3
For pH 5.0 and above					
Cadimum	3				0.15
Lead	300				15
Mercury	1				0.1
Chromium	400 (provisional)				15 (provisional)
[13]Molybdenum[14]	4				0.2
[11]Selenium	3				0.15
[11]Arsenic	50				0.7
[11]Fluride	500				20

[9] The annual rate of application of PTE to any site shall be determined by averaging over the ten year period ending with the year of calculation.

[10] For soils in the pH ranges 5.0-5.5 and 5.5-6.0 the permitted concentrations for lead, zinc, copper, nickel and cadmium are provisional and will be reviewed when current research into their effects on certain crops and livestock is completed.

[11] The increased permissible PTE concentrations in soil of pH greater than 7.0 apply only to soils containing more than 5% calcium carbonate.

[12] These zinc concentrations are advisable limits as given in The Code of Practice for Agricultural Use of Sewage Sludge (revised, 1996).

[13] These parameters are not subject to the provisions of Directive 86/278/EEC

[14] The accepted safe concentration of molybdenum in agricultural soils is 4 mg/kg. However, there are some areas in UK where, because of local geology, the natural concentration of this element in the soil exceeds this level. In such cases there may be no additional problems as a result of applying sludge, but this should not be done except in accordance with expert advice. This advice will take account of existing soil molybdenum levels and current arrangements to provide copper supplements to livestock.

8.2 Typical top soil concentrations

The following material is taken from the former **'Code of Good Agricultural Practice for the Protection of Soil'**, often referred to as the 'Soil Code'.

The concentration of potential contaminants in soils in England and Wales has been reported in a Soil Geochemical Atlas by McGrath and Loveland based on samples taken on a 5 km grid survey.

The table below shows the most commonly occurring concentrations (median value) together with the values below which 10% of soils fall (ten percentile) and above which 10% fall (ninety percentile). The average concentration (arithmetic mean) is also shown.

Table 8.2 reports total metal concentrations in top soils. The table does not represent particular conditions or levels of contamination to be expected on any one site, and it is not a substitute for a site assessment if you suspect or know of contamination.

8.2 Typical concentrations

Typical concentrations (mg/kg dry matter) of metals in soils of England and Wales

Metal	Tenth percentile	Median	Ninetieth percentile	Arithmetic mean
Zinc	38	82	147	97
Copper	9	18	37	23
Nickel	7	23	42	25
Cadmium	0.2	0.7	1.4	0.8
lead	20	40	131	74
Chromium	15	39	64	41

8.3 The effects of metals in soils

8.3.1 The effects of metals in soils

Zinc

Zinc is an essential trace element for crop growth but in high concentrations it is toxic to plants. It is easily taken up by plant roots and moves to the leaves. Too much zinc restricts plant growth and affects how the plant deals with elements such as iron, resulting in a severe yellowing of the whole plant. These symptoms usually occur at concentrations well below those which cause any risk to an animal's health. It affects animals by interacting with other elements, such as copper.

Concentrations of zinc (up to 2000 mg/kg of soil) from materials such as mine-spoil may be tolerated by certain plants depending on the pH of the soil and other factors. For clover and productive grass species at a pH of 6.0, the maximum recommended concentration is 1000 mg/kg.

Zinc from industrial wastes, atmospheric deposition or sewage sludge is more available to plants, and sensitive species may be affected above about 300 mg/kg of zinc in the soil when the pH is between 6 and 7.

An Independent Review commissioned by the Government (Review of the Rules for Sewage Sludge Application to Agricultural Land. Soil Fertility Aspects of Potentially Toxic Elements) concluded that some soil micro-organisms may be affected by additions of zinc above 200 mg/kg in some soils but how important this is for soil fertility is not clear. Further research was recommended and this is in progress.

Zinc alone is unlikely to affect animals until they eat more than 300-1000 mg/kg of dry food, depending on the type of animal, the form of the zinc and the balance of other nutrients in the diet. Concentrations in herbage greater than about 220 mg/kg of dry matter are likely to have a significant effect on copper metabolism in grazing livestock.

8.3.2 The effects of metals in soils

Copper

Copper is held by organic matter in the soil and is not as easily taken up into the leaves of plants as zinc, but it can accumulate in the roots. Soil pH has little effect on the amount of copper the plant takes up, except in very acid conditions (less than pH 4.5) when it appears to be more available and is taken up by acid tolerant species. Although copper is an essential plant nutrient, it can be toxic to plants at high concentrations. If material containing copper (such as pig slurry) is applied to a growing crop, copper can be adsorbed by the leaves. The resulting forage may be a health risk to grazing sheep.

At a soil pH of 6.0 or above, a total soil concentration of copper from geological materials of up to 500 mg/kg of dry solids would allow the growth of productive grasses, but clovers and other sensitive species may be affected at 250 mg/kg. The effect of a given concentration of copper on livestock depends upon its chemical form and on how it interacts with other elements.

When the concentration of copper in soil is more than 500 mg/kg, the soil and plants are likely to exceed the toxic threshold and may poison susceptible animals, especially sheep and lambs.

A copper concentration in the diet greater than 10 mg/kg of dry food is toxic for the most susceptible breeds of sheep. If you have to let livestock graze on contaminated land, they should only be grazed for short periods and with adequate herbage on offer so that the amount of soil eaten is kept to a minimum. Cattle are unlikely to be affected by copper.

8.3.3 The effects of metals in soils

Lead

Lead in soils with a pH of above 6.0 is not usually toxic to plants but eating soil contaminated herbage can be dangerous to livestock. Monogastric animals (pigs, poultry and horses) are considerably more at risk of lead poisoning than are ruminants such as cattle and sheep.

Consider precautions where soils have a natural total lead concentration greater than about 300 mg/kg of dry solids. In alkaline soils (pH of more than 7), lead is not available to plants. If contaminated soil is eaten by grazing animals, the lead may be absorbed by them whatever the soil pH. The chemical and physical form of the lead will affect its absorption.

Lead contamination of crops is unlikely to exceed the legal limit for food offered for sale of 1 mg/kg lead in fresh material, except when vegetables are grown and sold from a soil which contains lead at more than about 300 mg/kg of dry solids.

Under these circumstances you should take care that the crop is not contaminated by soil to ensure that this limit is not exceeded. Crops grown on high lead soils for home consumption should always be thoroughly washed before being eaten.

8.3.4 The effects of metals in soils

Cadmium

Cadmium is often found with geological deposits of lead and zinc. It is taken up by plant roots and moves to the leaves and seeds. This effect is greater at low pH and varies with the type of plant. If a grazing animal ingests cadmium, it builds up in that animal, especially in the kidneys and the liver.

The guideline concentration of 3 mg/kg of cadmium in soil is set to protect the food supply of animals and man. Plant growth is not affected at this level. The amount of cadmium that plants take up varies according to the physical and chemical form of the cadmium and the species of plant.

The total cadmium concentration limit in soil of 3 mg/kg of dry solids must not be exceeded when you apply sewage sludge to agricultural land and you should observe this limit in other situations.

If land is contaminated by wastes from lead mines, the high concentrations of zinc and lead will have a much greater effect on plants and animals than the cadmium. Although the cadmium content of fertilisers is generally lower than it was 15 years ago much of the cadmium added to agricultural soils still comes from phosphate fertilisers.

8.3.5 The effects of metals in soils

Arsenic

Plant roots absorb and store arsenic. In high concentrations, it may kill them.

However, it does not move freely to leaves or stems. An arsenic concentration of 250 mg/kg of dry soil is not likely to cause any ill effects to plants or animals.

Concentrations above 500 mg/kg can result in animals eating sufficient soil whilst grazing to increase the arsenic in their liver and kidneys and, in extreme cases, to poison them. Soil concentrations of arsenic in land used to grow fresh produce should not exceed 50 mg/kg of dry soil. This will minimise the risk of exceeding legal limits in food (generally 1mg/kg).

8.3.6 The effects of metals in soils

Fluoride

Fluoride in soils is normally present as insoluble calcium fluoride. In this form it is not readily taken up by plant roots. If soil that is high in fluoride, or grass that is contaminated by waste materials containing fluoride, is eaten over a long period, the teeth and bones of livestock can suffer due to a condition called fluorosis.

A total concentration of fluoride, from whatever source, of 500 mg/kg of dry soil could result in the diet of grazing animals, exceeding the safe limit of 30 mg/kg of dry matter.

8.3.7 The effects of metals in soils

Nickel

Nickel is toxic to most plants. In order to protect against damage to crops or animals, a limit for nickel of 75 mg/kg of dry soil exists for soil at pH 6-7 receiving sewage sludge. Other limits apply for different soil pH values.

8.3.8 The effects of metals in soils

Chromium

There has been some concern about chromium being added to soil because the chromate (VI) ion is toxic to plants and animals.

However, due to the conditions found in organic waste materials or in soil, it will only exist as the relatively inactive chromic (III) ion.

Chromium (III) is unlikely to be toxic to plants except in extremely acidic soils. Land which has sewage sludge applied to it must contain chromium at less than 400 mg/kg of dry soil.

8.3.9 The effects of metals in soils

Mercury

The amount of mercury in soil which will kill plants is far greater than that which arises under natural conditions or from any likely form of contamination.

Plant roots do not take up mercury very effectively. However, mercury is one of the most poisonous elements to many animals and man. Soil concentrations of mercury should not be greater than 1 mg/kg of dry soil.

8.3.10 The effects of metals in soils

Selenium

Where soils are contaminated by selenium, the safe concentration of 2 mg/kg of dry matter in plants can be exceeded.

Livestock are not normally poisoned until they take in selenium at more than 5 mg/kg of dry food. To minimise risk, the concentration of selenium in soil should be kept below 3 mg/kg.

Soils naturally high in selenium are very rare in England and Wales but may be a risk to grazing livestock where they occur.

8.3.11 The effects of metals in soils

Molybdenum

High molybdenum levels in soil may result in the need to take precautions to limit the amount taken in by livestock. High molybdenum in plants (more than 5 mg/kg of dry matter) reduces the availability of copper to livestock and may cause a copper deficiency.

Do not apply waste materials to land if this would raise soil concentrations of molybdenum above 4 mg/kg of soil. However, if the concentration in the soil is naturally higher than this value, and livestock are receiving copper therapy, you can apply sewage sludge which only contains trace levels of molybdenum.

Obtain veterinary advice before you take any action. Some clay and shale soils naturally contain molybdenum at more than 100 mg/kg of soil.

3.12 The effects of metals in soils

Sodium and chloride

Plants growing on sea-flooded land may be damaged by lack of oxygen or by the soil around their roots being disturbed.

Salt water deposits sodium and chloride in the soil. High chloride levels restrict plant growth and decrease the ability of their roots to take up water from the soil. High levels of sodium in the soil will disperse clay particles and cause problems in soil structure, especially in non-calcareous soils.

Appendix C - Benefit statement template

This appendix contains a template for a benefit statement - the document that an operator needs to produce to support a waste to land activity. . For more information on what to include in this statement see:

- **Section 2** of this guidance: Guidance and technical standards for deployment applications
- **LPD1 form and guidance**

Remember to include all soil analysis, waste analysis, location maps and any other relevant documents with the benefit statement and deployment notification form.

Farm details including postcode. **1.1 Person with appropriate technical expertise and permit details**
Give us a brief introduction including: – who you are – relevant qualifications – brief summary of your experience in this field – permit number under which this deployment application is being made.

Farm details including postcode. **1.2 Where the waste is to be spread**
Farm address: Stock pile grid reference: Area of the receiving land: Quantity to be stored at any one time: Total quantity to be spread: Location maps showing the field and receptors, temporary tank position and spreading control measures:

Farm details including postcode. **1.3 What is the waste to be spread**
Waste producer: name and address EWC code: selected from the relevant tables in your mobile plant permit Waste description: please expand upon the simple description in the waste lists. Additional information: any other relevant information on the production process the waste arises from and other information for example is the waste classified as ABPR?

Farm details including postcode.

1.4 Operational details

Cropping details:

- current crop including projected yield if known,
- is the straw removed (cereals, OSR, pulse crops),
- the following crop and any sensitive crops within the rotation which you amending the soil for in good time.
- when do you intend to apply this waste, post-harvest - pre ploughing, during seed bed cultivations, on the stubble over winter?
- how is the waste to be stored e.g. mobile tank or field heap?
- where is the waste to be stored prior to spreading (grid reference)?
- why was this storage location chosen?
- how is the waste to be spread and why is it to be spread that way?
- how do you plan to incorporate the waste following application?

With liquid wastes is there any mole draining or sub-soiling planned are there land drains in the field (this is important where wastes are injected especially during or following dry weather when the ground may have fissured)?

Other operational details for example: is the stubble to be left to protect emerging seedlings?

Farm details including postcode.

1.5 Compliance with NVZ requirements

Does the site fall within a designated NVZ?

Do closed periods apply for waste type?

Will application rates comply with crop requirement and field/whole farm limit?

Have other organic waste/manure applications been taken into account?

Has adequate justification been included to cover NVZ requirements?

Has information for the land owners recording requirements been provided?

Farm details including postcode.

1.6 Benefits and nutrients supplied to the soil or crop from this application

This is where you need to tell us what the benefits of this application will be.

You will need to provide justification based on the waste and soil analysis, the crop nutrient requirement and the nutrient status of the receiving soil. You will need to provide details of:

- nutrients supplied by the waste (kg/Ha)

- nutrient status of the receiving soil
- application rate (t/Ha)
- nutrient requirement for the proposed crop
- additional fertiliser or manure inputs will need to be recognised if the waste does not supply all the crop requirements.

Farm details including postcode.

1.7 Potential negative impacts to the soil or crop from this application

In this section you need to address any potentially negative impacts that may arise from the application of the waste:

- potentially toxic elements additions to the soil may require additional justification
- site topography, slopes and other natural features that affect the operation
- any characteristics of the waste that may affect the receiving land and any mitigation to justify or reduce their effects, for example: pH, oils and fats, conductivity and salt content
- impact of the operations on the receiving soil for example wheel ruts, compaction, structural damage, soil erosion and run-off
- odour and noise control
- any other potential negative impacts from the operation, for example: traffic management, anti-vandalism measures.

Farm details including postcode.

1.8 Sensitive human and environmental receptors

Sensitive human receptors

- dwellings
- business premises
- footpaths
- amenity areas
- boreholes, wells springs or private water supplies.

Sensitive environmental receptors

- surface water, groundwater source protection zones
- habitats, designated areas
- hedge lines and ditches.

Sensitive receptors should be highlighted on an overview map.

Farm details including postcode.

1.9 Practices to reduce the impacts of the operation on identified sensitive receptors
In this section you should set out the measures to be taken to reduce the impact of the operation on the receptors identified for example: – reducing the potential for odour from the spreading operation – the predominant wind direction – spreading will only be undertaken when weather conditions are suitable – spreading will only take place during the week when use of this right of way is low – buffer strips keeping any operations more than 10 metres from receptors – machinery operations will take account of soil conditions, slope etc. – machinery will be checked daily – machinery turns will not be executed in the buffer strips – Waste deliveries to field will be supervised to minimize impacts – Spreading restrictions within the '**Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)** will be adhered to – All machinery is regularly serviced and spreading equipment is calibrated.

Farm details including postcode.
2.0 Contingency planning
Tell us about the measures you have in place in the event of: – machinery breakdown – staffing problems due to sickness, holidays etc. – prolonged adverse weather – waste storage measures in the event of prolonged storage.

Appendix D – Glossary and further information

Glossary	
Term	Definition
soil substitute	is a material that serves as a direct replacement for the soil profile on a site where no in situ soil profile exists
soil improver	Is a material added to an in-situ soil that improves or enhances an existing soil's physical, chemical or biological properties
compost	solid particulate material that is the result of composting, which has been sanitised and stabilised, and which confers beneficial effects when added to soil, used as a component of growing media or used in another way in conjunction with plants
composting	the managed biological decomposition of biodegradable waste, under conditions that are predominantly aerobic and that allow the development of thermophilic temperatures as a result of biologically produced heat and that result in compost
Compost like output (CLO)	a soil improver generated from the composting of non source segregated biodegradable waste
'the waste'	the material that the operator applies to the land.
'the land'	the area, such as a field, to which the operator applies the waste.
'land spreading' and 'spreading'	describes the application of waste to land. Any method of applying waste to the surface of the soil or directly within the body of the soil (rooting zone).
'the receiving soil' and 'the receiving land'	the soil or land to which the operator applies the waste.

‘agricultural land’	Agricultural land is defined under section 109 Agricultural Act 1947. This includes land used for: horticulture, fruit growing, seed growing, dairy farming, livestock breeding and keeping, grazing land, meadow land, osier land (growing willow), market gardens and nursery grounds. It also includes woodlands where that use is ancillary to the use of land for other agricultural purposes. This definition includes all arable and livestock farming. Land also includes in this instance, land that is used for the production of timber, fibre and non-food agricultural crops (e.g. biomass), land used in farm diversification projects such as camping or caravanning, livery and horse grazing. Where energy crops or other non-food crops can fit onto an agricultural rotation this land is considered to be agricultural land.
‘non-agricultural land’	Non-agricultural land means any other land which is not covered in the definition of agricultural land and can include parks, gardens, recreational and amenity woodlands and forest, sports grounds, cemeteries, churchyards, verges and landscaped areas. Land which has been subject to industrial or other development e.g. brownfield site and/or derelict land, operational land of a railway, water undertaker, internal drainage board, British Waterways board, or Natural Resources Wales. Non-agricultural land may also include biomass crops that do not form part of a normal agricultural crop rotation. Unlike arable crops which are mostly annual, biomass crops can typically remain in place for between 7 and 25 years, harvesting cycles can be long (1-4 years), harvesting is normally in spring and the crops are deep rooting, very dense and tall (3-4m). Under these circumstances this may be considered agricultural land. Please contact your local Natural Resources Wales office for further information.
‘agricultural benefit statement’ and ‘statement of agricultural benefit’	The statement supplied by the applicant containing justification of the benefit the waste(s) will impart to the receiving land, the statement should also address any potential risks or potential negative impacts to the land or surrounding area and include risk assessments based on source-pathway-receptor method.
‘ecological improvement statement’ or ‘statement of ecological improvement’	The statement supplied by the applicant containing justification of the benefit the waste(s) will impart to the habitat to be created or improved, the statement should also address any potential risks or potential negative impacts to

	the land or surrounding area and include risk assessments based on source-pathway-receptor method.

Sources of additional information

An Environmental Risk Management Framework for Composting Facilities in England and Wales, Natural Resources Wales, 2004 This document provides guidance on assessing the adequacy of a bio aerosol risk assessment.
Ancient Monuments and Archaeological Areas Act 1979 This Act can be found on the UK Statute Law Database (SLD) available through the Office of Public Sector Information (OPSI).
Animal Health Act 1981 see Office of Public Sector Information website. This Act can be found on the UK Statute Law Database (SLD) available through the Office of Public Sector Information (OPSI) and Defra.
Ammonia in the UK Ammonia in the UK, 2002, DEFRA Publications Admail 6000, London SW1A 2XX Tel: 08459 556000.
BS EN ISO/IEC 17025:2000 (accredited by United Kingdom Accreditation Service (UKAS)) This standard details the requirements that laboratories have to meet if they wish to demonstrate that they operate a quality system, are technically competent, and are able to generate technically valid results.
British Standard Specification for topsoil and requirements for use (BS.3882:2007). This standard specifies requirements for topsoil. It describes grades of material and gives recommendations for use and handling. British Standards are published by the British Standards Institute, 389 Chiswick High Road, London, W4 4AL.
Business Environment update This update provides information on news and updates to legislation and guidance. Customers can sign up for a monthly newsletter
Code of Practice for Agricultural Use of Sewage Sludge Version 2, 1996 This code is available from DEFRA Publications Admail 6000, London SW1A 2XX Tel: 08459 556000.
Code of Practice for the Management of Agricultural and Horticultural Waste This code, updated in 2008, is available from the Food and Environment Research Agency (Fera) website or the PHSI office at York: 01904 46562.
The Conservation of Habitats and Species Regulations 2010 (490) These regulations can be found on the UK Statute Law Database (SLD) available through the Office of Public Sector Information (OPSI).
Construction Code of Practice for the Sustainable Use of Soils on Construction Sites Published 2009, available from Defra Soils Policy Team 3C Nobel House London SW1P 3JR Telephone: 020 7238 6419.

The Environmental Permitting (England & Wales) Regulations 2016
Directive 2009/147/EC (Birds Directive) Adopted in 2009, available from the Joint Nature Conservation Committee, Monkstone House, City Road, Peterborough, PE1 1JY. Tel: 01733 562626 Fax: 01733 555948.
Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. Adopted in 1992, available from the Joint Nature Conservation Committee, Monkstone House, City Road, Peterborough, PE1 1JY. Tel: 01733 562626 Fax: 01733 555948.
Code of Good Agricultural Practice for the Protection of Water, Soil and Air for Wales (2011 No.20)
DEFRA Risk Management Guidance This document provides guidance on environmental risk management and is available from Defra, based on the DETR guidance published in 2000. Defra Customer Contact Unit, Eastbury House, 30 – 34 Albert Embankment, London, SE1 7TL.
Guidance for farmers in NVZ designated areas: leaflet 3 Standard values, manure sampling protocol and glossary These documents including leaflets 1 – 9 are available through Defra.
Design and use of biobeds (2004) (PDF 1.37MB) Available from Environment Agency, ISBN 1-84432-246-7.
Drainage Act 1991 This Act can be found on the UK Statute Law Database (SLD) available through the Office of Public Sector Information (OPSI).
EC Directive concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EC) This directive written in 1991 has been adopted through the Nitrate Pollution Regulations SI 2008/2349.
EC listed pests — Potato cyst nematodes European Directive 2007/33/EC introduces new requirements on the control of potato cyst nematodes and takes effect from 1 July 2010. This document is available from Defra.
Japanese Knotweed (2006) This code of practice is available from the Environment Agency
Fertiliser Manual (Reference Book RB209), Defra- Edition 8, June 2010
Forestry Commission - Use of sludges and composts in forestry This leaflet published in 2006, is available from the Forestry Commission, 231 Corstorphine Road, Edinburgh, EH12 7AT.

Framework for the classification of contaminated soils as hazardous waste, version 1 This document available from Natural Resources Wales supports Technical Guidance WM3 Hazardous Waste – Interpretation of the definition and classification of hazardous waste, and should be read in conjunction with it. Griffiths Complete Building Price Book, 48th Edition 2002, page 775, Produced and published by Franklin & Andrews.
Good practice guide for handling soils This series of 19 factsheets was published by MAFF in April 2000. The guide was prepared by Humphrey Rowell Associates. The full series of fact sheets are available from Defra.
Explanatory memorandum on the Groundwater Regulations 2009 This memorandum is available through the Office of Public Sector Information (OPSI).
Guidance for the control of invasive weeds in or near freshwater This document (revised in 2010) provides guidance on the identification, control and disposal of invasive weeds.
Guidance on control techniques for preventing and abating emissions of ammonia This guidance was published in July 2001 by United Nations Economic and Social Council. The publication is available from the: UN Economic Commission for Europe, Information Service, Palais des Nations, CH - 1211 Geneva 10, Switzerland, Phone: +41 (0) 22 917 44 44, Fax: +41 (0) 22 917 05 05, e-mail:info.ece@unece.org
Gypsum and acid soils: The world scene. Advances in Agronomy, Vol.51, 1-32 Sumner M.E. 1993. Gypsum and acid soils: The world scene. p. 1-32. *In* D.L. Sparks (ed.) Advances in agronomy, Vol. 51 Academic Press, Inc., San Diego, CA.
Information on land quality in the UK, R&D Technical Summary PS275, 2002 The publication is available from Natural Resources Wales.
Investigation of the criteria for, and guidance on, the landspreading of industrial wastes, WRc Report, Davis and Rudd, 1998 The report is available through Defra. Defra Customer Contact Unit, Eastbury House, 30 – 34 Albert Embankment, London, SE1 7TL.
Landspreading on agricultural land: nature and impact of paper wastes applied in England and Wales, Science Report SC030181/SR, August 2005 This report and the report summary document are available from the Environment Agency.
MCERTS Performance Standard for Laboratories Undertaking Chemical Testing of Soils is published by The Environment Agency. MCERTS website provides further guidance.
Model Procedures for the Management of Land Contamination, Contaminated Land Report 11, Defra/Natural Resources Wales, 2004 The publication is available from both Defra and Natural Resources Wales.
Plant Health Division Plant Health Strategy for England 2005 Available from Defra, Nobel House, 17 Smith Square, London SW1P 3JR Tel: 020 7238 6000.

Farmers guide to SSAFO (SSAFO guidance) These Guidance Notes published by the DETR in 1997 are available from: Defra Customer Contact Unit, Eastbury House, 30 – 34 Albert Embankment, London, SE1 7TL.
The Sludge (Use in Agriculture) Regulations 1989 SI No. 1263 These regulations can be found on the UK Statute Law Database (SLD) available through the Office of Public Sector Information (OPSI).
The Sludge (Use in Agriculture) (Amendment) Regulations 1990, SI No. 880 These regulations can be found on the UK Statute Law Database (SLD) available through the Office of Public Sector Information (OPSI).
Soffe (ed.) The Agricultural Notebook Edition 20 (2003) Published by Blackwell Science, 2003. ISBN – 0632058293.
Survey of wastes spread to land WRC report CO 4953-2 July 2001 This document is available from Europa – Office for Official Publications of the European Communities, 2001 ISBN 92-894-1732-3.
Technical Guidance WM3 Natural Resources Wales Technical Guidance WM3 advises on the interpretation of the definition and classification of Hazardous Waste. The document is available from Natural Resources Wales.
The Animal By-Products Regulations 2011 These regulations can be found on the UK Statute Law Database (SLD) available through the Office of Public Sector Information (OPSI).
Think Soils – Soil assessment to avoid erosion and runoff.
The Nature and Properties of Soils 8th Edition, Nyle C. Brady MacMillan Publishing 1974, ISBN: 9780132279383.
The Safe Sludge Matrix for the application of sewage sludge to agricultural crops, BRC, Water UK, and ADAS, April 2001. The Safe Sludge Matrix for the application of sewage sludge to industrial crops, BRC, Water UK and ADAS, April 2001. Both of these leaflets are available from ADAS, Woodthorne, Wergs Road, Wolverhampton, WV6 8TQ. Tel: 0845 766 0085.
Wildlife and Countryside Act 1981 The regulations are available through the Office of Public Sector Information (OPSI).
Wildlife Management & Habitat creation on Landfill sites, a manual of best practice. Written by Duncan Watson & Valerie Heck Published by Ecoscope Applied Ecologists, ISBN 09539189-0-4. (Published in 2000).
WRAP Guidance and Quality Protocols WRAP Protocols and TAG reports are available from: WRAP, The Old Academy, 21 Horse Fair, Banbury, OX16 0AH.