Improved design and management of woodchip pads for sustainable out-wintering of livestock

Better Returns Programme

Compiled by Project Consortium Partners.

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Key messages

- Seek specialist, professional advice at an early stage of pad design.
- A gently sloping, south-facing site is ideal, away from public view, with easy access to off-pad yard area or grass paddocks.
- Only 5-10% of the nitrogen (N) and phosphate (P) excreted is contained in the effluent draining from the pad. Most nutrients remain within the surface layers of woodchip.
- Research has shown that much of the rainfall/excreta is absorbed by the woodchip, with additional evaporative loss from the surface.
- Perforated plastic piping, minimum 80mm in diameter, is recommended for drainage in shallow trenches with a minimum fall of 2%.
- Coarse chips (5-10cm) encourage rapid drainage and a clean pad surface. Finer chips are better for animal welfare. Best compromise is a 30cm base layer of coarse chip, with a 20cm surface layer of fine chip.
- Active management of pads is essential – particularly in difficult weather conditions such as freezing or very dry conditions followed by heavy rain.
- Heavily soiled woodchip is best removed and replaced with clean chip. Use of cultivators to alleviate heavy surface soiling is generally not successful.
- Direct application of dirty woodchip to grassland makes best use of the available N content. Fine chip becomes incorporated into the sward within a few weeks. Coarse chip is not suitable for applying to grassland.
- Feed fences and water troughs are best located outside the pad area on a concrete standing to minimise dunging on the woodchip.

Keywords:

Woodchip pad, Out-wintering pad, OWP, Over-wintering cattle, Effluent drainage, dirty water, Groundwater pollution

Contents

Foreword

Over-wintering cattle outside on a well-designed and managed woodchip pad offers many benefits including improved animal health and welfare; less damage to pasture from treading, reduced labour costs, and a cheaper alternative to constructing traditional buildings.

However, it is important that pads are properly designed, constructed and actively managed for the benefits to be realised and to avoid the risk of water pollution.

When woodchip pads were first introduced into the UK and Ireland ten years ago, the potential impact on water quality was overlooked, in particular on groundwater. As a result, a large number of low cost, unlined or unsealed pads were built.

Research in the last decade has clearly shown the vulnerability of ground- and surface water to pollution from unlined pads, and the need for robust lined systems with effluent collection.

In response, a thorough assessment of the costs and benefits of improved design, construction and management techniques has been conducted. Improved guidelines on handling contaminated water draining from pads, its safe collection and storage and use on land, have also been drawn up.

Farmers thinking of constructing a pad can use these guidelines, relating them to the specific conditions and circumstances of their site, as no one system fits all.

Taking time to attend to such detail will help avoid costly mistakes allowing farmers to reap the benefits of over-wintering on woodchip pads, whilst also protecting the environment.

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Woodchip pads can be used to facilitate early spring and late autumn grazing, where there is a risk of pasture damage. Cows can be allowed to graze for three to five hours and then held on the pad for the rest of the day.

They can also house stock continuously, where livestock are on the pad for several weeks or months.

Pad location could allow cattle access to self-feed silage either on the pad or better still, to a purpose-built clamp nearby. Or one side of the pad can be designed to include a concrete stance and feed barrier.

Many of the first out-wintering pads (OWPs) installed on UK farms were woodchip corrals - unlined excavations often on permeable sub-soil, with up to 1m depth of coarsely chipped wood chips. However, uncontained drainage from these unlined corrals presented an unacceptable risk of pollution to both ground- and surface-water.

Nevertheless, OWPs were shown to offer benefits in terms of reducing housing costs and in animal health and performance. So interest in woodchip pads has remained.

The guidelines in this document are based on the results of a research project undertaken as part of the LINK Sustainable Livestock Production Programme. The aim of the project was to determine the impact of important elements of design and management on woodchip pad animal performance, and the consequential risks of environmental emissions to air and water.

Planning requirements

The development of a woodchip pad on farm requires an application to be made to the local authority. Individual farm circumstances dictate whether this takes the form of a prior notification under Part 6 of Schedule 2 to the Town and Country Planning Act (General Permitted Development) Order 1995 or a Full Planning Application.

Prior notification route:

+ The farming unit has to be in excess of 5ha
+ The floor area should not exceed 465m^2
+ It should not be within 25 metres of a metalled highway
+ Any development involving the accommodation of livestock or farm waste should not be within 400 metres of a non-agricultural dwelling
+ The siting and design has to be justified and positioned to have minimal effects on the landscape

The main advantage of a prior notification is that subject to the above criteria being fulfilled, local authorities can only consider the proposal on its siting and design.

Full planning application

Unlike a prior notification, there are no set criteria that have to be fulfilled. However, any proposal under a full application is assessed against planning policy and is subject to comments from bodies such as the Highways Agency, Environmental Health, Environment Agency, and Conservation/Ecological Officers.

The following points are considered key when addressing the policies for planning applications for agricultural buildings/woodchip pads.

+ It has to be justified. For example, why the proposal is required in terms of the needs of the holding, together with its size and design.
+ The reasons why the proposed position has been chosen. Best practice, if practically possible, is to site structures adjacent to existing buildings to reduce impact on the landscape.

The above points need to be addressed in a report known as a Design and Access Statement, a statutory document that is submitted as part of the formal planning application form known as a 1APP. Along with correctly scaled drawings, supplementary reports may be required by the local authority such as a Landscape assessment/report and an Ecological Report.

Warning!

Planning criteria are subject to change. These details should be checked with the relevant local authority before proceeding with construction.

Installation costs

Conventional animal housing is expensive and partly explains the interest in woodchip pads for out-wintering.

Recent guideline costs (Nix, 2011) estimated covered straw yard cattle housing (allowing 4m^2 per animal) at £700 per head, and a slatted floor building for 120 growing cattle (1.7m^2 per animal) at £1400 per head.

In a scoping study of woodchip pads in England and Wales in 2005, farm estimates of construction costs excluding on-farm labour averaged £106/cow.

Rational costings procedure

Listing the individual components needed for a well-designed woodchip pad is an accurate and helpful way to work out potential installation costs. The figures in Table 1 can be used as a guide to likely costs of installation.

Table 1: Guideline summary of costs for the construction of a woodchip pad system (updated February, 2011)

Item:	Description	Rate: £	Total: £
1	Site Preparation: clearing site vegetation, bushes, scrub, undergrowth	1.20/m²	
2	Excavating topsoil by machine to an average depth of 150mm	1.60/m²	
3	Reduce level by digging into sub-soil to an average depth of 250mm	4.20/m²	
4	Profiling/contouring ground to assist sub-soil drainage	2.75/m²	
5	Disposal of surplus excavated material by machine with on-site spreading at an average of 50m distance	3.00/m²	
6	Compacting bottom of excavations	0.45/m²	
7	Impermeable membrane: Visqueen' sheeting 250 microns lapped joints	1.40/m²	
8	Perforated plastic drainage pipe: 80mm/diameter 100mm/diameter	 2.00/m run 2.50/m run	
9	Granular fill around drainage pipe	2.60/m run	
10	Stone layer (optional)	28.00/m³	
11	Separation membrane: Terram 500 or similar. Filter membrane one layer over granular material	2.00/m²	
12	Woodchip: different grades - fine, medium, coarse	30.00/tonne (Guide only: prices will vary)	
13	Manholes: brick manhole not exceeding 1m depth	500.00 each	
14	Glass fibre below ground tank	320.00/m³	
15	Land drainage around perimeter of works: excavation, gravel fill and pipe-work to 1m depth	35.00/m run	
16	Concrete slab: for feed stand/ tractor passage	60.00/m²	
17	Services: water: 25mm diameter pipe electrics: 25mm diameter cable	 5.50/m run 40.00/m run	
18	Post and rail fencing Steel stock fencing Galvanised gate + posts 3m	5.00/m run 25.00/m run 180.00 each	
19	Feed fence: tubular steel, diagonal type, galvanised plus steel feed trough	45.00/m 38.00/m	
20	Water troughs: galvanised 1.85m long	110.00 each	
21	Perimeter site works: bunding and landscaping (extremely variable depending on site specific requirements)		
22	Access tracks – hardcore track/road	6.80/m²	

Note: The above figures are exclusive of VAT, statutory and consultancy fees. All subject to infrastructure details. Source: Acorus Rural Property Services.

Regional and other variations

The figures included in Table 1 relate to the Midlands of the UK. There will be geographical variation, so apply regional adjustments based on local knowledge when preparing an estimate.

Cost savings can be made according to local opportunities, for example there may be cheap sources of chipped wood such as shredded pallets, or highway crash barrier steel for fencing.

Costs are likely to be significantly reduced on sites with low permeability subsoils, as an impermeable base lining may not be required.

Depending on the design complexity of the pad, costs have been estimated to vary from around £190/head to £550/head for a woodchip pad sufficient for 100 beef cattle, assuming a 10m²/head space allowance. Note, the above estimates do not include the costs of effluent storage.

For sources of further, more detailed information on planning, and contact details for sources of professional advice see pages 15 and 16.

Site selection

Site selection is crucial to the success of an OWP as this impacts on many aspects of design and construction, as well as pad management. Apart from siting issues relevant to the planning application, the following points should be carefully considered.

+ Site exposure
  Where possible, select a sunny, south facing area without shade, but open to winds to promote surface drying. Avoid large trees or walls close to one side which tend to result in muck overload hotspots.
+ Shelter
  Whilst a pad will benefit from winds to assist surface drying, exposure to extreme cold winds and wet conditions can be a problem. Use of shelter such as windbreak material or a hedge can be beneficial for the welfare of less hardy breeds.
+ Public view
  It is important to locate the pad away from public view. Poor public perception of animals on woodchip pads has caused serious problems for some operators.
+ Land drainage
  Avoid low-lying sites, which could flood and would also prevent adequate depth of outfall for the drainage system. Avoid areas with springs or seepage lines upslope or beneath the site, and areas with rocky sub-soils which would compromise drainage.
+ There should be no land drainage system within at least 10m of an outwintering pad.
+ Proximity to water courses and water supplies
  Site pad at least 50m from a watercourse, or ditch; at least 50m from drinking water supply; avoid sensitive groundwater areas (i.e. where particular risks have been identified by the Environment Agency).
+ Sloping ground
  Areas with steep slopes complicate and increase the work for site preparation due to the need for excavation and ground contouring, increasing the cost. Gently sloping, 2 to 3° sites are ideal, allowing gravity drainage of effluent to store down-slope of the pad.
+ Field access
  Easy access to off-pad yard areas or grass paddocks is important to allow the removal of stock during extended periods of freezing weather.
+ Access to feed
  Close access to silage or other feed facilities minimises the work involved in daily feeding.

Design

Pad size should be based on:

+ Type of stock
+ Number of animals being kept on it
+ Minimum space requirements (Table 2)
+ Whether feeding on- or off-pad

Table 2: Minimum on-pad space allowances for animals accommodated continuously on an OWP system

	Minimum space requirements per animal (m^2)	
Animal type	On pad feeding	Off pad feeding
Dairy cow	18	12
Suckler cow	16	10
Beef cattle (>2 years)	16	10
Cattle (1-2 years)	12	8
Cattle (<1 year)	10	6

Source: Department Agriculture Fisheries and Food, Eire

Estimates of space allowances can be adjusted downwards if the animals are to have access to sheltered yard areas, or spend only part of their time on the pad, for example overnight. Trials have shown that animals with free access to both an OWP and sheltered housing, spend the majority of the time outside on the pad.

Effluent collection via a properly constructed drainage system is essential, below which there should be an impermeable base. On heavy clay soils this may or may not require compacting with a roller to provide an impermeable layer of at least 1m thick.

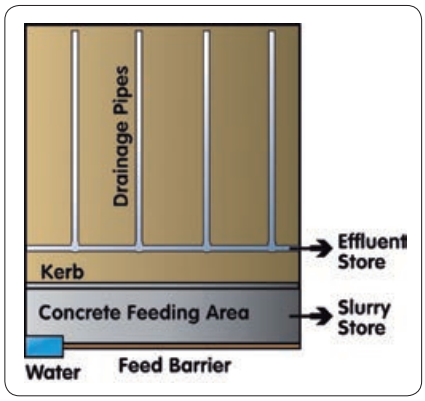
With other soil types an impermeable liner is required. A 5cm layer of sand below and 20cm of subsoil above the liner will protect the integrity of the membrane.

Figure 1: Dividing pads up allows different management of cattle groups

Drainage system

Drainage should comprise a minimum 80mm diameter perforated plastic pipe, installed at a maximum of 3m centres, in trenches or at the base of sub-soil ridges, with a fall of at least 2% (1:50) (Figure 2).

Figure 2: Ideal drainage for an OWP



These should drain to a 100mm diameter perforated plastic collector drain at the outfall. A permeable backfill stone layer of about 20cm depth to cover the pipe is an option.

Laying the pipes in trenches or sub-soil ridge bases, minimises cost as stone is not required across the whole pad area, only directly above the pipe-work (Figure 3).

Figure 3: Base with ridges and permeable fill over drain pipes

External access to the drainage system is advisable, for example via an extension of capped lateral pipes beyond the banks of the OWP. This allows jetting clearance of any blockages with solids within the pipes from the woodchip or slurry. A coarse geo-textile membrane, such as Terram 500 laid above the drainage stone can also minimise the ingress of solids and help protect the drainage system.

Effluent drainage from the pad

It is essential to calculate the effluent production from both the pad and any slurry collected from the concrete feed stance (Figure 4). Under current NVZ regulations effluent is classed as slurry. Farms in NVZs must show their storage requirement calculations and provide five months storage for effluent.

Figure 4: Effluent Collection

The reduction in effluent volume draining from the pad as a result of absorption and surface losses, has been estimated in the research at >1.1mm/day. For a 1000m^2 pad, this reduction in effluent volume would amount to around 8m^3/week, or 1700 gallons.

To estimate effluent volumes and the amount of slurry collecting on a concrete feeding stance, the daily deposition of dung and urine has to be calculated for the time the animals spend on the OWP. These can be based on standard figures for excretal output from livestock as summarised in Table 3.

Research from the LINK Research Project indicates that cattle spend approximately 33% of their time on the feed race and 66% on the woodchip pad. These observations agree closely with advice in Irish guidelines drawn up in 2007, and are taken into account within the calculations of effluent production and slurry from the feed stance.

Woodchip bed

Spreading woodchip within the pad should be undertaken carefully to avoid damaging the drainage system. Chipping onto the pad reduces the need for wheelings. Spreading should begin from the edge allowing the loader to work on the spread chip.

The recommended depth of woodchips has reduced from 1m in the original corral designs, to a minimum of as little as 0.2m, in guidelines drawn up by researchers in Ireland.

However, experience in the UK suggests a minimum of 0.4m is advisable, allowing greater protection for the drainage system if machinery has to enter to remove dirty surface layers of woodchip.

Woodchip may also be sourced as sawmill by-products such as chipped logs/forestry thinnings, or recycled timber. There are strict controls regarding the use of 'recycled timber' such as timber off-cuts from saw mills or from joinery /manufacture using virgin timber. The Environment Agency has issued a position statement on the regulation of wood.

Where waste wood is being used, for example, shredded pallets, all wire and nails should be removed. Also it must not be mixed with other materials, such as plasterboard, plastic, metal, cabling or MDF board, etc.

If in doubt about the suitability of a potential material, seek guidance from the Environment Agency.

The wood chips should be suitable for purpose and not have any foreign material in them. They should not be produced from treated, coated or painted wood. It must be clean uncontaminated and untreated.

Farmers require a waste exemption to use untreated waste wood. A U8 exemption has to be registered before use.

Table 3: Standards for daily excretal output for cattle, with estimated contribution to effluent volume from woodchip pad area, and to slurry production from concrete feed stance

Stock	Class	LW (kg)	Daily excreta (kg or l)	Daily excreta (kg or l)	For off-pad feeding, contribution (kg or l/day) to:	
			Average[1]	Dry period[2]	Effluent from pad[4]	Slurry from feed stance[4]
Beef suckler	Large	600	45		30	15
Beef suckler	Small	450	32		21	11
Grower	>2 years		32		21	11
Grower	18 mths	520	26		17	9
Grower	3-12 mths	270	20		13	7
Calf	1-2 mths	65	7		5	2
Dairy cow	High yield	600	64	45[3]	30	15
Dairy cow	Ave yield	600	53	37[3]	24	13
Dairy cow	Small	500	42	29[3]	19	10
Dairy heifer	2-12 mths	50-310	20		13	7
Dairy heifer	13-24 mths	310-580	40		26	14

Notes: [1]Source: Cottrill, B.R. and Smith,K.A. (2010). Nitrogen production standards for livestock excreta. Final report, Defra Project WT0715NVZ. March, 2010. Available via Defra website: http://www.defra.gov.uk/environment/quality/water/water quality/diffuse/nitrate/documents/; [2]Source: Smith, K.A. & Frost, J.P. (2000) Nitrogen excretion by farm livestock with respect to land spreading requirements and controlling nitrogen losses to ground and surface waters. Part 1: Cattle and sheep. Bioresource Technology 71, pp 173-181; [3]For adult dairy cattle, usually only dry cows might be kept on OWPs. Estimates derived from Smith & Frost, 2000; [4] For off-pad feeding, estimates based on approx 33% of time on feed stance and 66% of time on pad area.

Size of woodchip

Fine woodchip appears to be better for animal welfare but retains more dung solids, and may result in dirtier animals. However, greater retention of solids by the chip may help to keep the drainage system clear and reduce the nutrient content of the effluent.

In Ireland, chip size <5cm is favoured, often over a coarser base layer.

A fine chip surface layer overlying a coarse chip base seems to be a good combination, allowing comfort for the animals and ease of removal when the solids build-up becomes excessive.

Figure 5: a-d. Woodchip sizes used for OWPs

(a): 5-7.5cm

(b): 2-3cm

(c): 1-2cm

(d): Sawdust

Feeding system

Feeding may be arranged either on- or off-pad. Experience suggests that feeding and watering facilities are generally better placed outside the pad area, as this reduces dunging on pad and any potential slurry hotspots. This decreases the need, or frequency of removal and/or replacement of the surface woodchips.

The feed stance should be concrete and designed to allow regular, three times a week scraping of slurry.

A step up, or down to the woodchip with a kerb, helps exclude slurry from the pad. A step or kerb at the base of the feed barrier prevents contamination of feed with muck.

The feed stance should also be wide enough to accommodate all the animals feeding at one time, and deep enough to take the whole animal without fouling the woodchip area behind it.

Free and rapid access to the feed area is best practice, rather than through a gate or narrow ramp. It is important to avoid overloading with slurry solids any area that has restricted access (Figure 6).

Figure 6: Feeding off the pad area reduces dunging on the pad and reduces the need to replace soiled woodchip

It should be noted that water supply pipes should be lagged for cold winter periods. This is often overlooked, as outside troughs are normally switched off in winter when animals are housed.

Key points

Pads do not manage themselves; 'Low maintenance ≠ No maintenance'.

The surface must be actively managed. Heavily soiled, wet areas need to be cleaned off and if necessary the chips replaced (Figure 7 and Figure 8).

Figure 7: Heavily soiled areas must be cleared off

Figure 8: Heavily soiled areas must be scraped off and replaced with clean chip

Attempts to clear heavily soiled layers of chips on research and commercial farms, using a range of cultivators have given little success.

Stock can be moved to one side of the pad whilst maintenance takes place. There is no need to house animals.

Stocking rates and space allowance

Sensible stocking rates depend on daily intensity of pad use, the length of time the animals will be kept on the pad, and on feeding arrangements. Feeding on the pad greatly increases the loading of slurry solids and therefore reduces potential stocking rates (Figure 9 and Figure 10).

Figure 9: Correct stocking rates are key to maintaining good pad conditions

Figure 10: Feeding on the pad has led to fouling of the lying area

Maintaining the correct stocking density is essential. Guidelines developed in Ireland are in line with the experience gained in the LINK funded research, where increasing area allowance was associated with faster growth rates in cattle weighing between 470 - 670kg liveweight. However there was acceptable performance even at the tightest stocking density (Table 4).

Table 4: Impact of area allowance on cattle growth rate in research at North Wyke, Devon.

Area allowance (m^2/animal)	11.8	14	18.6
Growth rate (kg/hd/day)	1.20	1.39	1.40

The management of the pad impacts directly on the viability and operation of the system and its efficiency. Woodchip pads fail most often due to a rapid accumulation of slurry solids. A prolonged period of dry weather, followed by heavy rainfall often causes problems with surface accumulation of slurry.

Hotspot areas on the pad where slurry solids accumulate are often associated with the presence of trees or other shelter features. They also occur where concrete feed stances do not have adequate slurry management features, or where there are feed areas with restricted access.

Regardless of cause, some, or all of the top layer of soiled chips should be removed and replaced with new chips. The number of times this needs doing will vary (Figure 7 and Figure 8).

In prolonged freezing weather conditions animals must be taken off the pad, as the drainage of urine and effluent down through the woodchip will be impeded.

If animals remain on a frozen pad it is likely to become dirty and soiled and need clearing up after the thaw.

Woodchip pads for dairy cattle

Woodchip pads are a common feature of dairy systems in New Zealand and Ireland; less so in the UK and France.

They are suitable for heifers and dry cows and lactating animals where they also have access to daytime grazing. Pads have been used successfully for calving, but this relies on low stocking rates and good pad management.

Woodchip pads for beef cattle

Woodchip pads are particularly suitable for growing cattle and dry and lactating suckler cows.

Research in Ireland has shown that overwintering on woodchip pads improves daily liveweight gain and feed conversion in cattle, compared to those accommodated in conventional housing systems.

Table 5: Effect of wintering system on finishing cattle performance

	OWP	OWP + slats[1]	Slats	Straw
Space allowance (m^2/head)	18.0	17.5	2.5	4.0
Feed intake (kg DM/day)	10.88	10.58	9.50	9.79
Liveweight gain (kg/day)	1.40	1.33	1.01	1.10
Feed conversion (kg DM/kg LW)	7.77	7.95	9.41	8.90

Notes: [1]Slats at 2.5 m^2/cow with free access to OWP at 15 m^2/cow.
Source: P. French, TEAGASC, Moorepark Research Centre, Fermoy.

Woodchip pads for sheep

Little work has been done with sheep. Indoor tests on woodchip bedding show that a clean surface reduces the risk of infection to new-born lambs. However, the sheep were sensitive to feet bruising from irregular sharp chips. Experience in Scotland suggests an area requirement on woodchip pads of 3m^2/animal for adult sheep.

Well managed woodchip pads provide an environment in which cattle thrive and health and welfare can be better than in other types of accommodation. Consequently production is often as good as, or better than for conventionally housed cattle.

Research work in Ireland has consistently demonstrated that when given a choice, cattle prefer to be outside on a woodchip pad than in an enclosed building. However, it has also been observed that previously housed cattle bedded on different material such as straw, do require some time to acclimatise to the woodchip and may become dirty in the initial phase.

Trials in Ireland with dairy and beef cattle over the past six years, have shown a marked reduction in the incidence of respiratory problems such as pneumonia as well as foot problems and lameness.

Managing potential health issues

Whilst woodchip pads appear to reduce lameness, mastitis problems may increase due to the increased time spent lying on poorly managed, wet, soiled pads (Table 6).

Feeding is best managed off the pad, based around a feed barrier and concrete standing which can be easily cleaned. This will ensure animals are not exposed to excessive amounts of wet manure, which can make them dirty and induce dermatitis and heel erosion.

Scientific studies in Ireland have demonstrated that cattle on woodchip pads do not become environmentally stressed. This is because they are able to maintain body temperature through the activity in their rumen - as long as they are well grown and fed appropriately for the conditions they are experiencing.

The main animal performance data summarised in Table 7 show a consistent trend towards increasing daily liveweight and carcass gain, as space allowance increases for animals wintered outside. There was further marginal improvement when there was wind shelter.

Among the animals on the OWP there was no significant effect of stocking density or provision of shelter on growth rate, carcass traits or feed efficiency. However, the cattle on the OWP's had higher liveweight and carcass gains than those in the slatted floor shed, as well as better feed conversion efficiency and lower fat scores.

Within this research, climatic energy demand (CED), or the energy animals require to keep them warm, was estimated based on meteorological data, animal core body temperature, hair length and subcutaneous fat depth.

Wind speed was significantly reduced by the provision of shelter, but this reduction did not influence the estimated CED values, which were higher for animals out-wintered on OWPs, when compared with their counterparts indoors.

On no occasion did the CED exceed the energy released due to feed digestion over the period from mid-December to mid-March. Animals retained outside showed some level of adaptation to the higher energy demand by increasing hair length – 1.11cm and 1.36cm for indoors and outdoors respectively. There was no effect of shelter on mean hair length.

Table 6: Do's and do not regarding lameness and mastitis on OWPs

	Do not	Do
Lameness	Do not use very large chip sizes 50 mm across Do not expose cattle to excessive amounts of wet manure, which can cause dermatitis and heel erosion	Ensure that the feed area is scraped regularly and has an inner and outer kerb/lip to minimise muck spreading into the pad or onto the feed Allow cattle previously housed on other systems time to acclimatise
Mastitis	Do not let muck accumulate on the pads to an extent that cattle are unacceptably dirty	Regularly replace the top layer of chips to ensure cows do not get their udders excessively dirty

Table 7: Animal performance, carcass characteristics and feed efficiency of finishing steers (474kg initial liveweight) out-wintered on woodchip pads at different stocking densities, with or without shelter, relative to indoor housing on slats

Conditions	Exposed OWP			Sheltered OWP			Slatted house
Space allowance (m^2)	6	12	18	6	12	18	3
Liveweight gain (kg/day)	1.17	1.17	1.22	1.17	1.14	1.23	0.99
Carcass gain (kg/day)	0.69	0.70	0.71	0.66	0.66	0.73	0.62
Feed intake (kg DM/day)	9.92	10.01	10.22	9.85	10.08	10.06	9.64
Feed efficiency (g carcass gain/kg DM intake)	57.7	57.7	57.3	54.3	53.3	60.7	51.3

Recent research data, including the results from the recent LINK project, suggest that well designed and managed woodchip pads can help reduce the environmental emissions associated with cattle production.

Woodchip effluent

The Water Resources (Control of Pollution) (Silage, Slurry and Agriculture Fuel Oil) Regulations 2010 (commonly referred to as "SSAFO Regulations"), classify effluent generated from woodchip pads as slurry, with significant implications regarding storage.

Any new, substantially reconstructed, or substantially enlarged slurry storage facilities must comply with the SSAFO requirements and in conjunction with any other storage, provide four months slurry storage capacity on the farm.

The Environment Agency must be notified in writing about such a store at least 14 days before it is first used. However it is advisable to seek advice from the Environment Agency at an early stage of pad design to ensure what is proposed will meet the required construction standards.

If the farm is in an NVZ then a minimum five months storage capacity is required for cattle slurry, and producers must follow strict land spreading rules.

The results of the LINK research showed that effluent is consistent with, or of lower polluting potential than the published analyses of typical 'dirty water', and far below those expected in slurries (Table 8).

The analyses and measured depth and bulk density of the soiled, surface layers of woodchips indicate that more than 90% of the input N and P is retained within the solids built up on the top of the OWP. The analysis of this material is similar to that of FYM (Table 9). This means that management and spreading practices similar to FYM would be appropriate, following periodic removal of the dirty surface layers, as required for good pad management.

Table 8: Flow-weighed average nutrient content of effluent collected from woodchip pads at Lower Porthamel Farm, Brecon and from High Tor Farm, Coalville, Leics. Also comparison with typical analysis data for dirty water and slurry

Site or Source	No. of observations	Tot.N (mg/l)	Amm.N (mg/l)	Tot.P (mg/l)	Tot.K (mg/l)	COD (mg/l)	DM (mg/l)
Brecon							
FW Average	(13)	94.8	33.2	36.0	457	2682	2786
Coalville							
FW Average	(25)	134.2	58.5	33.9	559	3083	4279
Dirty water [1]		500	300	44	913	-	5000
Dirty water [2]		825	457	135		13500	10700
Beef cattle slurry		4300	1890	916	5065	-	87000

Notes: COD - Chemical Oxygen Demand – a simple measure of the organic polluting potential of effluent.

Source data: [1]Chambers & Nicholson, 2004; [2]Cumby et al., 1999.

Table 9: Nutrient content of the soiled woodchip from the two woodchip pads compared with analysis of soiled woodchip used for animal bedding (ADAS Pwllpeiran) and with typical nutrient content of cattle farmyard manure

	Samples (n)	DM %	Total N (kg/t)	NH_4-N (kg/t)	P_2O_5 (kg/t)	K_2O (kg/t)	Bulk density (t/m^3)
Brecon	(4)	31.6	2.6	0.03	0.6	1.2	0.87
Coalville	(9)	31.4	1.9	0.24	2.2	1.3	0.97
Bedding chip (Pwllpeiran)[1]	(3)	36.6	1.2	0.04	1.6	4.5	-
Cattle FYM[2]	-	25.0	6.0	0.6-1.2	3.2	8.0	0.7[3]

Source data: [1]Aldwyn Clarke, ADAS, personal communication; [2]RB209, 2010; [3]Smith, 2005

Detailed monitoring of effluent flow and rainfall at the research sites, also allowed the hydrological balance to be assessed. This demonstrated the significant surface evaporative losses and absorptive capacity of the woodchip, both of which significantly reduced the volume of effluent draining from the pads.

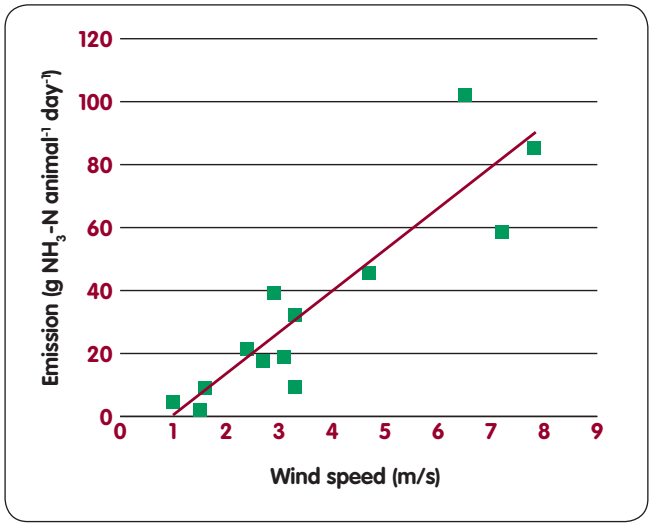
Ammonia emissions

Ammonia emission rates from the farm sites and the North Wyke experimental OWPs, were generally of similar magnitude to those reported in Defra's annual UK Ammonia Emissions Inventory for beef cattle housed on concrete yards.

It is possible that reductions in emissions compared with concrete surfaces may not be as great as anticipated, due to retention of urine in an absorbent surface layer of soiled woodchips.

The results also showed a marked impact of wind speed on ammonia emissions (Figure 11). Median emissions per head of cattle were about 40% lower than current ammonia inventory values for livestock housing with slurry-based management systems.

Figure 11: Relationship between measured ammonia emission and wind speed on the experimental OWPs at Rowden Farm, North Wyke



It follows that emissions from woodchip pads could be reduced by erecting shelter, using fencing with windbreak material, or hedging around exposed sites subject to high winds. The shelter effect could also provide welfare benefit to the animals on more exposed sites, but may cause trampling hotspots.

Figure 12: Outwintering on woodchip pads can reduce damage to grassland

Potential environmental benefits of woodchip pads

+ Reduced ammonia emissions
+ Reduced volumes of effluent compared to yards
+ Effluent quality similar to dirty water rather than slurry, therefore potentially less risk of environmental pollution
+ Protection of grassland from poaching damage due to grazing activity during wet periods

Limited research conducted in the project showed there to be no negative effects on grass growth following the application of soiled woodchip residue directly after removal from the pad.

However, the high carbon-to-nitrogen (C:N) ratio of soiled woodchip can sometimes result in N immobilisation, especially with very fine chip/sawdust. In this case, some benefit from composting prior to spreading on the land might be expected.

Direct spreading (no composting)

Soiled woodchip of 1-2cm grade and sawdust were removed from the surface layers of an OWP and applied to grassland at different rates, the highest one supplying 160 kg/ha N.

Within three weeks of application, the soiled woodchip was barely evident having been rapidly incorporated within the sward and topsoil (Figure 13 and Figure 14).

However, larger woodchip chunks of 5-10cm scraped up from the base layer with the surface woodchip, remained in the sward, with no effective sward/soil incorporation.

Figure 13: Application of 20t/ha soiled woodchip, supplying 160kg/ha N

Figure 14: Grass sward three weeks after application

Grass yields from both soiled woodchip treatments (1-2cm size and sawdust), were similar to those from fertiliser applications of 30 and 60 kg/ha N. No negative effects on grass dry matter (DM) yield were observed from the application of untreated soiled woodchip.

Figure 15: Experimental grass plots to assess yield response to soiled woodchip applications and fertiliser N

Composting before spreading

Composting soiled woodchip is an alternative management strategy to direct land spreading. Where waste wood has been chipped for use on the pad in accordance with a "U8 exemption", the Environment Agency has a regulatory position on their composting and use.

Composting works well for finer grades of woodchip <2cm in size. Coarser grade woodchip is generally unsuited to grassland application as large chunks will persist even after composting. Coarse woodchip therefore requires different management such as incorporation into arable soils, or ploughed in before a grass re-seed.

Composting during storage can be undertaken outdoors where rainfall will replenish water losses caused by evaporation from the heap. This maintains the composting process for a longer period from eight to 24 months. Among the benefits of composting are reduction in weed seed and pathogen viability. However, it may also result in ammonia emissions and loss of nutrients, particularly N.

The application of composted woodchip to grassland does not appear to confer any advantage over spreading soiled, finer grade woodchip, directly from the pad.

Figure 16: Composting soiled woodchip

Active aeration for example by turning the heap, is not necessary. Application to grassland of actively aerated compost gave similar results and DM yield to those from static heaps.

Top Ten Tips for OWPs

1 Specialist advice

+ Seek professional advice at an early stage to meet all regulatory requirements and minimise risks of pad failure and/or environmental problems

2 Site selection

+ Locate pad away from public view. A gently sloping, south facing site is ideal, with easy access to off-pad area where stock can go if necessary.

3 Proximity to water courses

+ Site pad at least 50m away from a watercourse or ditch and avoid sensitive groundwater areas

4 Pad drainage system

+ Perforated plastic piping is recommended for drainage. External access to the pipes via capped extensions, allows easy access for jetting and clearance of blockages

5 Effluent volume

+ Estimate effluent volume, taking pad area, rainfall and animal numbers into account. Allow for the amount absorbed by the woodchip and lost to the air

6 Woodchip size

+ Use coarse chips (fist size >5-10cm) to encourage rapid drainage and a clean pad surface. However, finer chips (1-2cm) are better for animal welfare and retain more slurry solids
+ Compromise with a 30cm base layer of coarse chip, with a 20cm surface layer of fine chip, which will need removing at least once a year

7 Pad management

+ Active management is essential. Heavy soiling of the surface chip can occur in dry or freezing conditions, when followed by wet weather.
+ Remove heavily soiled chip and replace with a few centimetres of clean chip

8 Dealing with dirty woodchip

+ Close off the affected pad area when removing woodchip, avoiding the need to remove stock completely
+ Use of cultivators has met with little practical success. Physical removal of the affected layers and replacement with clean chip is best

9 Application of dirty woodchip to grassland

+ Apply dirty woodchip to grassland direct to make best use of available N content. Fine chip is incorporated into the topsoil within a few weeks. Coarse chip persists and is not suitable for spreading on the surface

10 Feeding and watering

+ Locate feed fences and water troughs outside the pad area. The concrete feed stance should have sufficient area to accommodate all animals at once
+ A raised kerb at the base of the feed barrier prevents contamination of the feed with slurry. Bury water pipes and protect against frost

Research consortium

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Project consortium/partners:

+ Alan Cottle Woodchips

+ Dave Simmons Contracting

+ SW Forest

Livestock production levy organisations

Further information and advice is available from:

AHDB Dairy

Tel: 024 7647 8702; E-mail: info.dairy@ahdb.org.uk
Web: **dairy.ahdb.org.uk**

AHDB Beef & lamb

Tel: 024 7647 8834; E-mail: brp@ahdb.org.uk
Web: **beefandlamb.ahdb.org.uk**

Hybu Cig Cymru (HCC)

Tel: 01970 625050; E-mail: info@hccmpw.org.uk
Web: **www.hccmpw.org.uk**

Further reading

Planning information

The 'Planning Portal' (**www.planningportal.gov.uk**) is the best source for general advice on how the planning system works.

Specialist agricultural advice with respect to meeting planning policy is available from:

Environment Agency

Whether through prior notification or full planning application, including for storage systems, farmers considering building an OWP should consider seeking direct advice from the Environment Agency.

The Agency will provide help and guidance on complying with regulations such as SSAFO, NVZ, EPR 2010, and other ways of reducing and preventing pollution, on a site specific basis. Given the potential for costly mistakes, it is sensible to contact the Agency before building commences.

Tel: 03708 506 506

Web: **www.environment-agency.gov.uk**

Published guidelines

Detailed guidelines on construction of 'Out-wintering Pads' already published in Scotland and Ireland, are available via the following weblinks:

A set of detailed fact sheets on NVZ issues is available to supplement the general guidance provided in this publication:

www.environment-agency.gov.uk/business/sectors/108825.aspx

Wood-chipping suppliers

There are a number of producers and suppliers of high grade quality wood chip suitable for out-wintering pads, which can be found via an internet search.

For more information:

For more information contact:
Better Returns Programme
AHDB Beef & Lamb
Stoneleigh Park
Kenilworth
Warwickshire
CV8 2TL

Tel: 024 7647 8834
Email: brp@ahdb.org.uk
beefandlamb.ahdb.org.uk

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