

**Dr Sophia Hepple BVSc MRCVS DipWEL DipECAWBM(AWSEL) PhD NSch  
RCVS Specialist Animal Welfare Science Ethics & Law**  
Veterinary Adviser (Animal Welfare)  
Animal Welfare Team  
Animal & Plant Health Agency



Opinion on: Platts Agriculture Limited: Case for Appeal against deemed refusal by NRW for an environmental permit for production of cattle animal bedding, recycled from waste wood feedstock.

**EXPERT’S DECLARATION OF UNDERSTANDING**

I DR SOPHIA HEPPLE DECLARE THAT:

1. I understand that my duty is to help the court to achieve the overriding objective by giving independent assistance by way of objective, unbiased opinion on matters within my expertise, both in preparing reports and giving oral evidence. I understand that this duty overrides any obligation to the party by whom I am engaged or the person who has paid or is liable to pay me. I confirm that I have complied with and will continue to comply with that duty.
2. I confirm that I have not entered into any arrangement where the amount or payment of my fees is in any way dependent on the outcome of the case.
3. I know of no conflict of interest of any kind, other than any which I have disclosed in my report.
4. I do not consider that any interest which I have disclosed affects my suitability as an expert witness on any issues on which I have given evidence.
5. I will advise the party by whom I am instructed if, between the date of my report and the trial, there is any change in circumstances which affect my answers to points 3 and 4 above.
6. I have shown the sources of all information I have used.
7. I have exercised reasonable care and skill in order to be accurate and complete in preparing this report.

8. I have endeavoured to include in my report those matters, of which I have knowledge or of which I have been made aware, that might adversely affect the validity of my opinion. I have clearly stated any qualifications to my opinion.

9. I have not, without forming an independent view, included or excluded anything which has been suggested to me by others including my instructing lawyers.

10. I will notify those instructing me immediately and confirm in writing if for any reason my existing report requires any correction or qualification.

11. I understand that:

(a) my report will form the evidence to be given under oath or affirmation;

(b) the court may at any stage direct a discussion to take place between experts;

(c) the court may direct that, following a discussion between the experts, a statement should be prepared showing those issues which are agreed and those issues which are not agreed, together with the reasons;

(d) I may be required to attend court to be cross-examined on my report by a cross-examiner assisted by an expert.

(e) I am likely to be the subject of public adverse criticism by the judge if the Court concludes that I have not taken reasonable care in trying to meet the standards set out above.

12. I have read Part 19 of the Criminal Procedure Rules and I have complied with its requirements.

13. I confirm that I have acted in accordance with the code of practice or conduct for experts of my discipline, namely [identify the code]

14. I confirm that I have read guidance contained in a booklet known as Disclosure: Experts' Evidence and Unused Material which details my role and documents my responsibilities, in relation to revelation as an expert witness. I have followed the guidance and recognise the continuing nature of my responsibilities of disclosure. In accordance with my duties of disclosure, as documented in the guidance booklet, I confirm that:

(a) I have complied with my duties to record, retain and reveal material in accordance with the Criminal Procedure and Investigations Act 1996, as amended;

(b) I have compiled an Index of all material. I will ensure that the Index is updated in the event I am provided with or generate additional material;

(c) in the event my opinion changes on any material issue, I will inform the investigating officer, as soon as reasonably practicable and give reasons.

### **Expert witness qualifications and experience**

I have been a member of the Royal College of Veterinary Surgeons (RCVS) since 1995. I am one of ten recognised RCVS Specialists in Animal Welfare Science, Ethics and Law. In order to be included on the List of Recognised Specialists by the RCVS, an individual must: possess an RCVS, or RCVS-approved diploma, or other relevant postgraduate qualification (for example a European diploma in the specialist subject) and must additionally satisfy the RCVS that they make an active contribution to their specialty, have national and international acclaim and publish widely in their field. They need to be acknowledged by peers, in the area of specialisation; maintain acceptable continuing professional development (CPD), for example, through publication, teaching, reviewing, examining, attending and participating in national and international meetings within the specialised field; be available for referral by other veterinary colleagues; be a current active practitioner within the specialised field.

I have been employed as a veterinary adviser for animal welfare in the Animal & Plant Health Agency (APHA) since its creation in 2014 and prior to this as part of the Animal Health and Veterinary Laboratories Agency (AHVLA) since 2011. I performed a similar role as part of the Animal Welfare Team, Department for the Environment, Food and Rural Affairs (DEFRA) since January 2006, specialising in farmed animal welfare. Prior to this I was employed as a veterinary inspector, since January 2002, by the State Veterinary Service (DEFRA) appointed under the Animal Health Act 1981 and specialised in farm animal welfare and poultry health during this time. Prior to this I lectured at Bristol University, teaching veterinary parasitology, farm animal welfare, preventative medicine, epidemiology and basic animal husbandry in farm animals to veterinary students between 1996 and 2002. I am also a Doctor of Philosophy in neonatal nutrition and gastrointestinal (gut) disease of pigs. I have previously worked in large and mixed animal veterinary practice.

My current day to day work includes providing specialist knowledge on animal welfare to APHA (including field staff and senior management), DEFRA, Ministers, Government press offices, other delivery agencies, stakeholders, non-government public bodies and until recently, the European Commission. I developed cross compliance welfare standards and defined animal welfare breaches under the basic payment scheme across Great Britain in accordance with cross compliance rules and still continue to do this for Wales and Scotland since the scheme ended in England. I run APHA's welfare inspection programme, including provision of formal instructions and training to APHA staff and other Government / Agency partners, including local authorities, involved in enforcing animal welfare. I ensure APHA staff monitor and report on farmed animal welfare, during transport, at markets and during slaughter on farm, as well as liaise with local authorities to ensure proportionate enforcement in these areas. I also work with the Food Standards Agency (FSA), Food Standards Scotland (FSS) and local authorities/trading standards representative in improving responses to welfare referrals from slaughterhouses.

Between 2006 and 2014 I was the main veterinary adviser to the Farm Animal Welfare Committee (FAWC) (previously known as the Farm Animal Welfare Council, also FAWC and now known as the Animal Welfare Committee (AWC), an expert committee which provides advice to DEFRA and the Devolved Administrations in Scotland and Wales on the welfare of animals, including farmed animals and farmed fish, animals at market, in transit and at the place of killing. I was the veterinary adviser assigned to overseeing the following FAWC reports and opinions:

Opinion on Lameness in Sheep (2011)

Economics and Farm animal welfare (2011)

Education, Communication and Knowledge application in relation to farm animal welfare (2011)

Fam animal welfare: health & disease (2012)

Opinion on the welfare of farmed and park deer (2013)

FAWC advice on space and headroom allowances for the transport of farmed animals (2013)

Evidence and welfare of farmed animals Part 1: the Evidence base (2014)

Opinion on the welfare implications of nutritional management strategies for artificially-reared calves from birth to weaning (2015)

Opinion on the welfare of cattle kept for beef production (2019)

My contributions to each FAWC publication are acknowledged at the end of each report. I continue to review and provide feedback on draft FAWC reports prior to publication, most recently on beef cattle welfare (2019). I have been responsible for the initial re-drafting of DEFRA's most recent welfare codes for England: the laying hens code (2018), meat chickens (2018) and pigs (2020) prior to wider consultation and subsequent drafting details up to final publication, as well as providing advice and commentary of the Welsh and Scottish codes. I am currently working with my peers on revisions to the English cattle code. I also provide guidance / feedback to devolved Governments on interpretation of code and guidance content as well as to private assurance scheme guidance, for example Red Tractor and Quality Mark Scotland, to ensure their guidance and inspector assessments comply with relevant UK legislation and aligns wherever possible with Government welfare codes / guidance.

I lecture on animal welfare at national and international levels to vets, vet and agricultural students, farmers and other stakeholders. Since 2008 (to UK Exit) I was a recognized national expert in animal welfare for the Technical Assistance and Information Exchange (TAIEX) instrument managed by the Directorate-General Enlargement of the European Commission. TAIEX supports partner countries with regard to the approximation, application and enforcement of EU legislation. It is largely demand driven and facilitates the delivery of appropriate tailor-made expertise to member and accession countries. This work has included delivery of training to Government inspectors in Romania and Serbia. I have been an examiner for the RCVS certificate and diploma animal welfare science, ethics & law. I am a committee member of the Animal Welfare Science, Ethics and Law Veterinary Association. I have been a member of the European College of Animal Welfare and Behavioural Medicine (ECAWBM) since 2016, am a member of the European College board's education committee and communications team (animal behaviour and welfare).

As a result of my responsibilities on data surveillance in relation to farm welfare, markets, transport, slaughterhouse referrals and my responsibility for ensuring correct farm selections for inspection under cross compliance, I also work with APHA and other Government agency / department data specialists, such as the Food Standards Agency (FSA) and Food Standards Scotland (FSS) on the systems that record and identify trends indicating welfare problems and issues with specific livestock rearing sectors including farms, markets and slaughterhouses.

As part of my lead role in overseeing farmed animal welfare in APHA, I am responsible for providing advice and support to APHA field inspectors, local authorities, other Government agencies and where appropriate non-governmental organisations (NGOs) and private welfare scheme providers on individual welfare cases. This includes assessment and guidance to individuals intending on introducing novel production systems / equipment, or management processes in the UK that may impact on animal welfare. This includes being a member on various committees and steering groups. I am one of the longest standing members of the Dairy Cattle Mobility Steering Group (DCMSG), organised by the Agricultural and Horticultural Development Board (AHDB), I have advised on the content of training material for accredited training of foot trimmers, artificial insemination, embryo transfer and poultry welfare, to support UKAS approval of such training schemes to minimum national standards and was in the original steering group before that, which agreed the cattle lameness mobility scoring system devised by AHDB and now widely adopted by most of the UK farming sector. I also regularly advise the Ruminant Health and Welfare Group and other species sector groups as part of the Animal Health and Welfare Board for England.

### **Expert witness report**

1. I have been asked by **Cyfoeth Naturiol Cymru (Natural Resources Wales- NRW)** to provide an expert opinion on the appeal by **Platts Agriculture Limited** (referred from now as **PAL** in this document) in respect to **NRW's** refusal to approve an environmental permit for production of cattle animal bedding, recycled from waste wood feedstock.
2. I have been provided with the following:

**2.1. ECL Ref PLAT.01.02.NTS (Non Technical Summary)**

**2.2. ECL Ref PLAT.02.01EPTR**

**2.4. ECL Ref PLAT.01.02FPP**

**2.5. ECL Ref PLAT.01.02DMP**

**2.6. ECL Ref PLAT.01.02.NMP**

**3. ECL Ref PLAT.01.02SCR**

**3.1. ECL Ref PLAT.01.02EoW**

**Enclosure 1 - PLATTS Statement of Case - Platts - Served 03 04 23**

**Enclosure 2 - NATURAL RESOURCES WALES Statement of Case - Served 03 04 23**

**Enclosure 3 - Platts Non Technical Summary Issue 1**

**Enclosure 4 - Platts End of Waste Justification Issue 1**

**Enclosure 5 - Analysis of 'EoW Justification Annex V'**

**Submission statement**

**The Report of Dr George Fischer PhD**

**The Report of Dr Ivan Vance CEng FICHEM CSi CChem MRSC**

**The Report of Dr Owen Atkinson MRCVS RCVS**

**NRW Final Comments – Consultation response from APHA 2023 05 05\_Redacted**

On the 18<sup>th</sup> March 2024, I was sent further enclosures and due to other commitments this week, have only been able to review them at short notice on 21<sup>st</sup> March 2024, considering the requirement for this report to be completed by Saturday March 23<sup>rd</sup> 2024:

**Signed statement of common ground**

**AGR PO13 Incoming Material Procedure**

**Platts Phenols**

**Platts sample data**

**Clean results by supplier i2lab – excel spreadsheet**

**Copy of Copy of results Platts Agriculture – excel spreadsheet**

## **PEDW REF-CAS-02313-Z1D6V\$ NRW assessment**

On the basis of the shortness of notice to review this information, a short addendum is added at the end of this report in view of any additional information this may provide.

3. I can confirm that I have been consulted earlier on in this case regarding the risks associated with recycled products used as part of livestock husbandry systems, chiefly as bedding or incorporated into bedding, for animals. This comprises part of my day-to-day advice to Government departments, Ministers, European / International colleagues, non-Governmental organisations and other stakeholders on principally farmed animal welfare issues. My previous comments are therefore likely to comprise part of this expert report in response to the appeal documents.
4. I have been asked specifically to consider any new documents since I was last consulted on this appeal. The latest document supplied to me is that of Dr Owen Atkinson and I will consider that in the context of the existing documents provided to me. Some of the documents listed above may not have elements relevant to animal welfare and will not be discussed further in this report.

### **The Issue**

5. PAL have been producing what they describe as a “**cubicle conditioner**” from waste wood which is *“both ‘treated’ with veneers, glues, varnishes and stains, and ‘clean’, virgin timber, timber from the arboriculture sector, packing waste, kiln dried scrap pallets, and off cuts from the manufacture of untreated wood products”*.
6. This product has been used as an application of the product onto cubicle mattresses. Cubicles are free access lying areas for cattle, principally dairy cows but may also include pregnant growing heifers (young cows that are yet to give birth).
7. APHA is familiar with the use of untreated recycled wood products to produce bedding for animals, principally as shavings for poultry, horses and small animals and woodchips for cattle. The bedding product may be subject to further treatment, for example dust extraction methods due to recognised

issues with respiratory conditions in animals exposed to small particulate matter commonly associated with bedding and feed substrates.

8. APHA has never advised the use of treated wood as a bedding product for animals, unless that treatment can be shown to have no deleterious effect on the animals' health and welfare.
9. The welfare codes of recommendation for cattle (England or Wales) for example states in relation to the areas of buildings that cattle come into contact with:

*"If you are going to treat these surfaces, use paints or wood preservatives that are safe to use with animals. There is a risk of lead poisoning from old paintwork, especially if you use second-hand building materials" (England, 2003)*

*"80. Any treated surfaces should only have paints or wood preservatives that are safe for use with animals. There is a risk of lead poisoning from old paintwork, especially if second-hand building materials are used." (Wales , 2010)*

It therefore makes no sense to allow various treated woods of unknown provenance and toxicity, to be used for a product that the cow's skin comes directly in contact with AND, if the teats are still open, potentially contact with the teat canal mucosa.

10. The welfare codes of recommendation; meat chickens, for example states:

*"The material that is used as litter must be selected to ensure that it is of an appropriate quality. It must be suitable to provide a dry bedding material and must not contain anything that could be toxic or cause injury to the chickens."*

This infers a full knowledge of the content of the litter if it must not contain anything that could be toxic or cause injury to the animal.

11. Similarly the codes of recommendations for laying hens and pullets states:

*“The litter material should be of an appropriate quality, suitable for providing dry dustbathing or scratching material and **must not contain anything that could be toxic or cause injury to the hens.** Litter must be friable (loose) and should be dry on the surface.”*

### **The legislation for animals relating to bedding and their environment in the UK**

Rules on **“Bedding”** requirements for different livestock

12. By law, all lactating and calving dairy cows (i.e. cows producing milk or due to calve/have calved) must have access to a well-drained and bedded lying area at all times in the UK (other than Scotland) under the Welfare of Farmed Animals (England, Wales) Regulations 2007, (Northern Ireland) Regulations 2012; these regulations are, bar one word, the same for each country:

*“Where lactating dairy cows or calving cows are kept in a building, they **shall/must** have access at all times to a well-drained and bedded lying area.”*

For all other livestock, the regulations for all England and Wales requires:

*“Where any animals (other than poultry) are kept in a building they must be kept on, or have access at all times to, a lying area which either has well-maintained dry bedding or is well-drained.”*

For Northern Ireland:

*“Where any animals (other than poultry) are kept in a building they shall be kept on, or have access at all times to, a lying area which is well drained or well maintained with dry bedding.”*

For Scotland:

*“Where any animals (other than laying hens kept in the systems referred to in Parts 3, 4 and 5 of Schedule 3) are kept in a building they must be kept on, or have access at all times to, a lying area which is well maintained with dry bedding or litter or a well-drained area for resting.”*

For poultry the requirements vary according to system for laying hens but for commercially cventially reared reared meat chickens:

*“All chickens must have permanent access to litter which is dry and friable on the surface.”*

Calves have specific requirements in relation to bedding (Wales, England, Northern Ireland):

*“All calves must be provided with appropriate bedding.*

*(2) All calves must be kept on, or at all times have access to, a lying area which is clean, comfortable and adequately drained and which does not adversely affect the calves.*

*(3) All housed calves and calves kept in hutches or temporary structures must be kept on, or at all times have access to, a lying area which is well-maintained with dry bedding.”*

For Scotland:

*“All calves must be provided with appropriate well-maintained bedding.*

*(2)All calves must be kept on, or at all times have access to, a lying area which is clean, comfortable and does not adversely affect the calves and is well drained.*

*(3) All housed calves and calves kept in temporary structures must be kept on, or at all times have access to, a lying area which is well-maintained with dry bedding.”*

13. Therefore, in most instances, other than those systems utilising slatted systems for specific livestock where there is not a compulsory requirement for bedding, the majority of farmed livestock that are kept in buildings have access to some sort of bedded environment.

#### **Rules on requirements of accommodation and animals kept in buildings**

14. Under the Welfare of Farmed animals regulations (all countries):

*“Materials used for the construction of accommodation, and in particular for the construction of pens, cages, stalls and equipment with which the animals may come into contact, must not be harmful to them and must be capable of being thoroughly cleaned and disinfected.”* And:

*“Air circulation, dust levels, temperature, relative air humidity and gas concentrations must be kept within limits which are not harmful to the animals.”*

**Rules on animals with regards to meeting their needs (specifically the environment and protection from harm)**

15. Under the Animal Welfare (England & Wales) Act 2006, Animal Health and Welfare (Scotland) Act 2006 and Welfare of Animals Act (Northern Ireland) 2011:

***“Duty of person responsible for animal to ensure welfare***

*(1) A person commits an offence if he does not take such steps as are reasonable in all the circumstances to ensure that the needs of an animal for which he is responsible are met to the extent required by good practice.*

*(2) For the purposes of this Act, an animal's needs shall be taken to include—*

*(a) its need for a suitable environment,*

*(b) its need for a suitable diet,*

*(c) its need to be able to exhibit normal behaviour patterns,*

*(d) any need it has to be housed with, or apart from, other animals, and*

*(e) its need to be protected from pain, suffering, injury and disease.”*

16. They key rules here are relating to the environment to which the animal is subjected. All farmed animals must be kept in a suitable environment and they must be protected from pain suffering injury and disease. Therefore, in considering whether a novel bedding material, with which the animal will come in contact with, provides a suitable environment, it must ideally contribute to animal well-being and health AND at the very least not cause any adverse health effects on the animal. This is separate to any public health impacts associated with milk or meat production and separate to any environmental impacts of the use of such a product.

**Rules on housing and novel systems**

17. The UK (all countries) have ratified codes of recommendation on a variety of farmed animals. The **European Convention for the Protection of Animals kept for Farming Purposes (ETS No. 087)** was signed by the UK in 1976 and came into force in 1979:

*“The Convention applies to animals bred or kept for the production of food, wool, skin or fur or for other farming purposes. It concerns in particular animals in intensive stock-farming systems.*

*The protection guaranteed by the Convention aims to avoid unnecessary suffering or injury, having regard to the condition of housing, food or administered care. To preserve well-being of animals, the Convention imposes on Parties the obligations to inspect the condition and state of health of animals and the technical equipment used in intensive stock-farming systems.” And:*

*“Article 3*

*Animals shall be housed and provided with food, water and care in a manner which – having regard to their species and to their degree of development, adaptation and domestication – is appropriate to their physiological and ethological needs in accordance with established experience and scientific knowledge.”*

18. This was followed by detailed protocol amendments for different species and livestock types. The UK signed and ratified all of the farmed livestock protocols that are currently in force. The cattle convention for example requires the following:

*“Parties should consider the possibilities of making arrangements for:*

- a. improved or new methods of cattle husbandry or equipment to be tested and possibly approved from the point of view of animal health and welfare before their introduction into commercial use;*
- b. advice on health and welfare aspects to be sought when new buildings are to be constructed or existing buildings modified.” And*

*“The accommodation for cattle should be kept so that the ambient temperature, the air velocity, the relative humidity, the levels of toxic gases and dust as well as other atmospheric conditions do not affect adversely the health and welfare of the animals.”*

19. This places obligations on the people developing new husbandry methods to ensure that animal health and welfare is not compromised. It also places obligations on the competent authority or delegated competent authority, such as APHA, to give advice on novel husbandry systems. UK countries do not have a formalised approval system for novel husbandry methods or livestock systems but their

relevant competent authority veterinary advisers do provide advice when requested on the suitability / legality of novel systems. On this basis, APHA has regularly provided advice on and assessed new systems before they are put into use.

20. Clarification was given to what established experience and scientific knowledge meant in Article 3 of the primary (1976) Convention and this was described in 2001:

**“Established experience”:**

*Knowledge that is put beyond doubt and that is gained through direct participation in animal husbandry or clinical veterinary practice.*

**« Scientific knowledge » :**

*Results published after peer review in internationally well-known and respected journals, or by an internationally well known and respected scientific body.”*

This is an important clarification because “established experience” allows for farming practices currently in use, for which there is not necessarily peer-reviewed evidence because that practice has been carried out as routine for many years without issues or concerns. This does not mean that a routine practice cannot be challenged and stopped through regulation or recommendations, but it is expected that any such change in husbandry practices should be achieved using results from peer-reviewed published sources to support such a change.

Similarly, this means novel husbandry methods must be supported by the scientific evidence that assures that animal health and welfare will not be negatively impacted. Therefore, when new husbandry methods are used, for example the use of novel bedding substrates for animals, it is expected that there is sufficient evidence to show that these do not negatively impact on animal health and welfare before competent authorities can accept these as reasonable husbandry practices. On this basis the Scientific Committee for Animal Health and Welfare (SCAWHAW), later incorporated into the work carried out by the European Food Safety Authority (EFSA) proceeded to publish regularly on peer-reviewed evidence suggesting a need for changes or minimum standards in livestock husbandry.

21. Application of the UK statutory regulations, European Conventions and codes to novel bedding materials means that the relevant competent authority permitting its use, needs to be satisfied that this new bedding material:
  - a) complies with current regulations (for example recycled manure is not permitted to be used for bedding calves because this specifically breaks rules on calf rearing that is applicable in all UK countries has); AND
  - b) ideally improves animal health and welfare but at the minimum does not pose a risk to health and welfare of the animal(s) for which it is proposed being used.
22. If there are concerns about health and welfare risks, and the company or sector proposing its use has not carried out appropriate testing to confirm its safety, then it cannot be considered suitable for use.
23. Since this is a novel bedding substrate, any testing of such a material must be carried out under the relevant animal research rules for the country. If a method, housing system or environmental practice is novel, it is not a common agricultural practice and therefore rules on animal testing means that such a novel material does get caught by the Animals (Scientific Procedures) Act 1986. Any testing of novel materials, for which there is a genuine perceived animal health and welfare risk, must be carried out under a Home Office licence. It is against the law to trial such products on animals without such a licence.

#### **Bedding in cubicle systems**

24. Traditional loose housing of dairy cows during late autumn / winter / early spring i.e. bedding large groups in straw pens/courts, has been increasingly replaced in the UK dairy industry by individual laying access “cubicles”, with a variety of bedding types. This includes “mattresses” which often includes a small quantity of traditional bedding material on it. An increasing number of dairy systems opt to house some or all of their cows in cubicle systems all-year round.
25. Cubicle housing for dairy cows carries inherent risks associated with it, including a ten-fold risks of leg and foot disorders when compared to straw and pasture-based systems (EFSA, 2009a), but can also

lead to reduced disease risks including environmental mastitis (EFSA 2009b) when the bedding hygiene is optimum and cubicle design is large enough to suit the cow.

26. The bedded environment and cubicle design is crucial in ensuring cow comfort (EFSA, 2023). Where cubicles are used for dairy cows, deep bedded cubicles, with a minimum design size and bedding depth now recommended to optimise comfort, reduce locomotor disorders and lameness and maintain dry hygienic bedding. Further Welsh and English cattle codes describe the expectations around cubicle bedding:

*“Cubicles should be designed to encourage cows to lie down and stand up easily without injuring themselves. There should be enough bedding to:*

- *keep the cows comfortable;*
- *prevent them from getting contact or pressure sores (from always lying in the same or cramped positions); and*
- *keep the cows’ teats, udders and flanks clean.” (Wales, 2010)*

*“Cubicles should be designed to encourage cows to lie down and stand up easily without injuring themselves. You need to have enough bedding to:*

- *keep the cows comfortable;*
- *prevent them from getting contact or pressure sores (from always lying in the same or cramped positions); and*
- *keep the cows’ teats, udders and flanks clean.*

*You must never use a bare, solid base in the cubicles.” (England, 2003)*

27. Therefore, current guidance based on scientific evidence and expert recommendation is that dry, soft and deformable lying surfaces, preferably deep bedding, should be provided because they allow longer lying time and ease of lying down and rising up movements. When using bare concrete, bedding

of at least 30 cm thickness should be provided. When using mats and mattresses, a bedding with a minimum depth of 5 cm of compressed material (i.e., compressed because of the animal lying on it) should be provided. For instance, this corresponds to 3 kg of straw per day to be provided per cubicle space (EFSA, 2023). This in effect does not permit mattresses to be used alone as the only form of “bedding” and requires a minimum depth to achieve optimum cow comfort and reduced injury / disease risks.

28. Therefore, in considering the cubicle “conditioner” suitability, aside from any potential toxicity / skin sensitivity issues, it needs to be evaluated as part of the current recommendations on suitable bedding depth for cubicles. Any novel system suggesting reduced quantities of bedding use per cubicle space, will not support the requirements for cow comfort and cannot be recommended or supported.
29. Having set the scene regarding what the minimum rules are on bedding and specifically the current recommendations on what should be acceptable bedding for dairy cows kept in housed cubicle systems I will now go on and assess the evidence provided as part of this appeal.

### 2.1. ECL Ref PLAT.01.02.NTS (Non Technical Summary)

30. This document describes the process involved, principally in relation to the collection, storage and processing of the product. This mentioned that the untreated wood sources would be dealt with separately to the treated wood sources.
31. It lists in Table 1 of this document a proposed waste code:

**Table 1: Proposed Waste Code to be Accepted**

Code	Description
<b>03</b>	<b>WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, PULP, PAPER AND CARDBOARD</b>
03 01	Wastes from wood processing and the production of panels and furniture
03 01 05	Sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 0 4

It is not clear to me what is excluded as 03 01 04 is not listed. However, my understanding from gov.uk guidance on waste descriptors is that 03 01 05 is refers to untreated sawdust, shavings,

cuttings, wood, and biodegradable veneer other than those in 03 01 04\* which are “sawdust shavings, cuttings, wood, particle board and veneer containing hazardous substances.”

However, the document further lists the wood sources:

*“waste wood which is both ‘treated’ with veneers, glues, varnishes and stains, and ‘clean’, virgin timber, timber from the arboriculture sector, packing waste, kiln dried scrap pallets, and off cuts from the manufacture of untreated wood products.”*

This is quite a wide-ranging number of treated wood sources, the specific treatment types of which are not listed. The Environment Agency guidance (gov.uk, 2023) list examples of typical risks associated with wastes like this:

- *“material containing old fencing and waste wood may include preservative chemicals such as pentachlorophenol, lindane or copper chrome arsenate*
- *timber yard by-products may contain persistent preservative chemicals which have dangerous or hazardous substances – this could cause metal contamination*
- *panel board manufacturing involves the use of resins and bonding agents; these can contain contaminants, depending on the type and quantity of the bonding agent”*

It should be noted that these waste sources and guidance by the Environment Agency refers to use of such waste products for landspreading, and not any risks if such products were used for direct contact with animal skin and teat mucosa.

32. In mitigation, the document states that:

*“regular sampling will be undertaken assessing a range of substances which may be present in the waste wood streams. The sampling will ensure that substance concentrations are sufficiently low so as not to pose a risk to the environment, human health, or animal welfare.”*

However, it is not clear what the testing in relation to animal welfare will be and what specific hazardous elements have been considered.

33. The report also records the justification for use:

*“The production of cubicle conditioner (animal bedding) for use in livestock cubicles fitted*

*with rubber mats/mattresses as opposed to other bedding material (e.g., straw and virgin sawdust) has a number of benefits including, improving animal welfare, improving air quality in cubicles, and waste minimisation. As the cubicle conditioner (animal bedding) is highly absorbent, only a small amount is required (one cup per mat/mattress), consequently it is more energy efficient to transport than other animal bedding materials. Alternative bedding material is also required to be changed more frequently as its greater moisture content increases the likelihood of bedding fermentation, requiring the bedding to be changed and hence producing more waste.”*

34. This actually does not describe any tangible welfare benefits for the dairy cow. A cup full (cup size not defined) of this cow conditioners is insufficient to meet recommended bedding requirements for animal welfare purposes, even when a cubicle mattress is used. The argument for air quality is not clear either, but this may become clear in later documents, because actually the high dust content of the products described does raise concerns about air quality. The appellants do refer to fine chopped straw having similar fine dust content issues for livestock, so I agree that there are other bedding substrates which can carry a high dust content, but this does not necessarily mean we would regard this as good animal welfare practice for using such products and in particular applying such products when animals are in the building and some bedding types for livestock are dust-extracted products because of the known issues with bedding that has a high dust content.
35. This bedding conditioner could not be used alone since it is such a small amount and so even if support of this conditioner was given, additional bedding would be required to deliver the level of acceptable comfort and to avoid leg and locomotor disorders and injuries, according to current recommendations (EFSA, 2023). This then negates the other considered benefits suggested regarding reduced volume of bedding use, reduced waste overall etc.

## **2.2. ECL Ref PLAT.02.01EPTR document**

36. This document describes the ENVIRONMENTAL PERMITTING TECHNICAL REQUIREMENTS (EPTR)

The overview states that the untreated waste wood is used for animal bedding and that the treated wood product will be used for producing a “conditioner”. This makes no sense since the conditioner clearly constitutes part of the animal bedding and therefore has been produced and marketed a part of the animal bedding that is provided to cattle in cubicles.

37. This document states:

*“Animal bedding products will be produced from clean, uncoated, and untreated waste wood only. Waste wood which has been previously coated will not be used to produce animal bedding and therefore the two waste wood types will not be mixed.”*

This is in line with current recommendations on the use of waste wood for animal bedding purposes.

38. This document states:

*“Any treated waste wood will be stored entirely separately from the clean, uncoated, and untreated waste wood and will be pulverised to produce a cubicle conditioner (animal bedding) for use in the agricultural livestock sector. The cubicle conditioner (animal bedding) is important for animal welfare, acting to control moisture levels and keep animals clean and hygienic through application of a limited quantity (1 large cup) to the mat or mattress.”*

I have difficulty with this statement because this automatically uses treated wood to produce a bedding for the animals. Irrespective of the quantity of said conditioner, this constitutes part of the bedding environment, which the cow is exposed to. This again makes reference to animal welfare by stating it keeps the animals clean and hygienic but the evidence at this point is not clear.

39. This document describes the two products produced using treated waste wood in animal bedding:

Fine Bed® and Powder Bed.

**FineBed®** - *“ FineBed cubicle conditioner is designed to be used sparingly on the mat or mattress, to control moisture and keep cattle clean and hygienic. Since its fine and up to 100% dry, only 1 large cup of product is required per cow mat – meaning a bag covers up to 50 cubicles!”*

**Powder Bed** - *“Powder Bed was developed by Platts to provide a hygienic and comfortable cubicle drying solution for your dairy cows, using a unique, super-fine consistency of softwood sawdust to ensure a dry and clean environment.”*

The second product does not describe application method.

40. The document states that it will not accept wood waste that has been subject to pressure treatment with preservatives. It states that it will obtain a representative sample from each waste supplier and subject to a chemical analysis, including for heavy metals.
41. The document refers to the testing process that is used for processing waste used for bedding. However, the PAS111 guidance refers specifically to the testing of untreated wood (that would normal be used for producing bedding) and not to treated wood that is the subject of this appeal.
42. The document describes that biological and moisture testing is being carried out for waste materials intended for use as animal bedding but then states: *“biological testing is not undertaken for the cubicle conditioner (animal bedding) as it would not be within the cubicle long enough to pose a risk to animal health.”*

If the cubicle conditioner is placed on a mattress, then the cow will come in contact with it, unless Platts are suggesting that the conditioner is added, then removed after soaking up water and then the area is cleansed and disinfected before the cow uses the mattress. This argument makes no biological sense whatsoever. Further, since the biological testing is not being carried out for the treated waste wood used in the “conditioner” it is not even conforming with the PAS111 requirements for untreated wood, which would be the expected minimum of tests in addition to testing for likely products associated with the addition of glues, veneers, solvents etc.

43. The document states: *“analytical suites covering metals, VOC’s, Phenols and PAH’s have been developed to assess the wide range of substances that may be present in the wood waste streams to ensure that substance concentrations are sufficiently low so as not to be deemed either a risk to the environment, human health, or animal welfare.”*

I presume a VOC means volatile organic compound and PAH is a polycyclic aromatic hydrocarbon, but this is only an assumption since these acronyms are not explained in the glossary and why these would be of particular interest in these wood waste derived products and is beyond my expertise.

44. The document describes how 10 of the suppliers are tested weekly, which comprises 60% of the supply. This suggest that 40% of the suppliers are not tested weekly, and from Dr Atkinson's report there are a total of 50 suppliers of wood waste. It does not explain whether these are tests carried out by the supplier of the wood waste products or carried out by themselves. However, the document does not describe the frequency of tests on the final product.
45. The future recommended sampling approach includes random sampling of suppliers. This may catch some of the 40% of the treated waste wood supply not tested weekly, however there is still no description of any tests on the final product to demonstrate the chemical content of what they have produced from the waste and that this is consistently produced and poses no risk to animal health and welfare.
46. The document describes a vague visual assessment of the wood waste on arrival at the processing plant. I would expect there to be clear process of visual assessment of specific wood waste types to confirm the wood waste type being accepted. I would also challenge how non-conforming waste is evaluated. How is pressure-treated preserved wood visually separated from non-pressure treated on this type of visual assessment? I think this would be impossible.
47. On page 28 of this document the benefits of the "cubicle conditioner" are reiterated with no clear reference to evidence for this. As has been explained, the use of a cupful of cubicle conditioner on top of a mattress are not considered acceptable levels of bedding substrates and therefore the benefits outlined regarding volume. The document further states:  
*"The cubicle conditioner (animal bedding) is highly absorbent, it aids in the maintenance of the sanitary conditions in livestock cubicles that are fitted with rubber mats/mattresses. The cubicle conditioner (animal bedding) keeps cows clean and dry. The theory is that by keeping the mat dry with no moisture*

*then this aids in the control of environmental mastitis, prevents hock rubbing and increases lying time, resulting in increased milk yields and improved Somatic Cell Counts (“SCC”).”*

However, I have seen no peer-reviewed evidence to demonstrate this, particularly considering the small amounts that are being used. Further, there is no consideration of interactions with the cattle urine and faeces. For example, in the meat chicken industry there is plenty of peer-reviewed evidence that helps tell us the better litter substrates (including amounts used and best processed forms of substrate), for rearing meat chickens, what typical sources are used, which perform better and which lead to less skin impacts such as hock burn, breast blisters and pododermatitis. There is no scientific peer-reviewed evidence presented here about the two types of cubicle conditioner being marketed by the appellants. This is because there is no final testing of the final product, we only have chemical testing of some of the wood waste sources supplied by 60% of the waste suppliers used to make the final product.

48. The document details issues with badly managed bedding in cubicles, all of which would be an unacceptable situation for the bedding of dairy cows and describes bedding in cubicles that would be non-compliant with legislation (please see earlier sections on what the law requires). Obvious sequelae due to bad bedding management are described. Farmers should not be managing bedding in that way because it's a point of law and should be ensuring sufficient bedding is provided to each cow cubicle and that it is frequently replaced.
49. The document then goes on to state that the moisture-absorbing properties of the product are superior to other products in use (where is the evidence for this?) and do not cause the same problems as some other products used to absorb moisture:

*“The cubicle conditioner (animal bedding) is non-abrasive to the skin and hocks of cattle, unlike other bedding products such as lime or calcium hypochlorate which can cause cracking of hooves and skin, burning of the udder, as well as becoming slippery when wet.”*

This describes the effects of these other products directly contacting cow skin and feet. These products are similarly of concern, I am not familiar calcium hypochlorate, presume they mean calcium

hypochlorite (essentially a bleach-based product in a dry form) or some other chemical but again this is not something that is recommended because of potential impacts on the skin of the animals. None of these are suitable bedding materials, just as a conditioner is not suitable if we basically have no idea what the final chemical constituents may be in the product. There is no welfare guidance that supports cattle skin contact with powders/products that cause chemical burns on direct contact and farmers using the other products in this way should not be.

50. The Appendix III is essentially a questionnaire for the people supplying the wood waste product. This is the only way that the product is assessed for evidence of pressure treated timber / wood products.
51. The AGR P010 describes the visual checks made during daylight and night delivery hours and requires a sample from the centre of the load only to be taken only if visual contamination is seen. The visual check involves looking for gross contamination such as plastic. There is no assessment of the colour or smell of the waste wood for example, that may give an indication that non-compliant treated wood has been included in the waste supply.
52. PAS 111 states that only grade A (i.e. untreated) wood waste can be used for animal bedding, as per APHA / DEFRA's current position on wastes used for bedding. The cubicle conditioner is essentially part of the bedding which can come into contact with the animal. The properties of the conditioner are to carry out part of the role of the bedding i.e. to absorb any moisture content. Its small volume of use means it cannot meet the requirements of an acceptable bedding alone. Therefore, cubicle conditioner is part of the bedding and therefore its source needs to come from untreated wood. Further, I struggle with the checks on processed waste that arrives at Platts that prevents excluded wood waste from entering the final product. As a bedding material this "conditioner" would need to pass all the PAS 111 tests once the final product is completed and include any tests for known products that may have an injurious effect on the animals, both before and after mixing with animal urine/faeces.
53. Due to the nature of the wood waste supply, there will be variations in chemical content. The impurities and contaminants considerably vary with wood waste origin and therefore wood waste

should not be considered as a single type of material, but rather be managed as a complex and variable flow of material (Faraca et al., 2019). Since the end product is made of variable inputs (different wastes that have been subject to different treatments from different suppliers), it is likely that the final product is not going to be consistent. With the lack of product testing at the end I cannot see how it can possibly be guaranteed to not cause harm when used as part of animal bedding material.

54. Table 6 of this document states at point 8:

*“No wastes should be accepted at the Facility without sampling, checking and testing being carried out. Reliance solely on the written information supplied is not acceptable, and physical verification and analytical confirmation are required. All wastes, whether for on-site treatment or simply storage, must be sampled and undergo verification and compliance testing.”*

From the documents provided it is not clear to me that this is actually carried out on every load. Testing is only carried out on those loads that do not pass a cursory visual inspection of one shovelful of waste wood material. Analytical checks are only done if the visual check is failed.

55. Table 6 of this document states at point 9:

*“The Operator should ensure that waste delivered to the Facility is accompanied by a written description of the waste describing:*

- *the physical and chemical composition;*
- *hazard characteristics and handling precautions;*
- *compatibility issues; and*
- *information specifying the original waste producer and process.”*

In reading the Appendix III written AGR F068 questionnaire it is not clear that this is achieved. For example :

4 Are chemicals used in the manufacturing process which may be found in the by-product?

--

5 Does the process change at all, frequency, duration etc. which may affect the by-product?

5 Please provide tonnes of product available per month

7 Is this the same throughout the year or do amounts per month differ? Please explain below.

Does this expect a YES or NO or expect full details of chemicals that are used and likely quantities in relation to total wood waste. They should have details on the volume / mass of chemicals they use per certain throughput of wood and make it clear what process is followed that is used with the chemical. This small amount of space on one of the most important aspects of this in relation to treated wood, for which one supplier may have several chemical processes e.g. use of solvents, addition of veneer (including what process was used to produce the veneer etc).

There is a question on chemical analysis:

4 Has a sample chemical analysis of the product been completed and made available to Platts staff?  
 YES  NO

5 Has a physical sample of the product been given to our Platts representative for analysis?  
 YES  NO

6 Has a WM3 (Waste Management) Assessment been undertaken on the product?  
 YES  NO

This is only a YES/NO and does not describe what actually has been done, for example what stage of wood waste production was analysis carried out and what they have actually measured. It may be that the appellant has examples of what is provided by each of the suppliers that make up total supply used for the “conditioner” products.

4 Can you confirm that the product does not exceed the maximum levels of heavy metals permitted under PAS 111 Standard?			
Sample within PAS 111 limits	<input type="checkbox"/>	Sample exceeds PAS 111 limits	<input type="checkbox"/>

The only confirmation check is in relation to heavy metals being withing PAS111 limits. As mentioned before, these are treated woods and so the issue of concern (and which is different to the PAS 111 associated tests / recommendations for UNTREATED wood) goes beyond the recommended testing for PAS 111. The testing for PAS 111 should be the minimum for any wood being used for bedding. What I would want to know is what tests have been carried out in relation to the chemicals being used

in the wood processing activities of the supplier. These are the elements that make this wood different to the untreated wood.

### 3.1. ECL Ref PLAT.01.02EoW document

56. This document details evidence to demonstrate that the processed wood meets “end of waste” criteria.

57. On page 5 the appellants raise concerns about lack of risk associated with untreated wood:

*“The regulators’ interpretation that clean or untreated wood is free of contamination and therefore suitable for use as animal bedding is not correct and is not in accordance with the rWFD, or the Precautionary Principle.”*

I have not seen the specific responses of NRW to the appellants, but I agree that of course there is risk associated with untreated woods, particularly where other products have the potential to be incorporated (metal, plastic, glass, concrete etc) at the supply site and of course in relation to any storage process by the supply site that could lead to fungal contamination as well as microbial contamination. These are known risks associated with bedding from natural sources. This is one of the reasons that there are recommendations in the PAS 111 with regards to assessment and processing of untreated wood to protect animals as far as possible from known avoidable risks. This is also the reason untreated wood is currently regarded as being not acceptable for animal bedding. The precautionary principle is in relation to dealing with unknown risks, not known risks. We may not know what the woods are treated with / how the wood is treated in that process and what impact this has on the health and welfare of animals (in relation to chemical treatments / applications) and how this affects the properties of the wood and how this interacts with the environment of the animal – both direct skin contact, the interactions with urine , moisture and faeces and how this then impacts on the animals. We can overcome the precautionary principle by allowing proper testing of the products in relation to what chemicals have been added / what physical and chemical properties of the product have been altered and, if it is considered that there is no obvious risk to animals, then evaluate what

happens during a controlled testing procedure with that material that is done in a way that meets concerns regarding risks to animal health and welfare. None of these evaluations have been carried out, only anecdotal feedback from those that have already used the product.

58. On page 5 it is acknowledged that visual assessment alone cannot differentiate treated from untreated wood. It is also stated that:

*“Through analysis, it has been demonstrated that the materials are more than 99.9% wood, therefore, the potential for harm to be caused may be deemed negligible. Nevertheless, a veterinary expert (Dr Owen Atkinson), a risk assessment expert (Dr Ivan Vince), and a soil expert (Dr George Fisher) have all been asked for their expert opinion on the risks posed by the materials as informed by their respective expertise. All have confirmed there is negligible risk of harm.”*

Clearly, the elements that constitute wood, are changed through processing. The product coming out at the end is soft and non-abrasive according to the appellants. The physical and chemical properties of the final product will have been changed by both the activities at the supply sources and by the pulverisation process described by the appellants. The appellants state that the “conditioner” has a much higher dry matter content than say, traditional unprocessed sawdust so I presume that at some point in the process the product is being dried out or this happens as a consequence of whatever the appellants are doing to the waste wood. However, it is the 0.1% that we are particularly interested in, that makes it different to the untreated wood and which causes us concern. 0.1% is equivalent to 1000mg per kg of product and there are plenty of things that can be injurious to animals at less than 1000 mg/kg, particularly when in direct contact with the skin and the potential to be in contact with the teat mucosa and which may produce gases when mixed with urine/faeces. It is the fact of not knowing what this 0.1% is that is the issue here.

59. On page 5 its is stated: *“The substance concentrations within the waste woods received by Platts are not at a level that would cause harm to animals or humans if they came into contact with the processed materials.”*

Again, it is not clear to me how this has been assessed. Platts state only 60% of the wood waste from 10 suppliers is tested (and for what I do not know) and the other 40% there is no test information. Further, there is no testing of the final products which may clearly vary in content from batch to batch. From the EPTR document (Appendix III) it only details a non-compliance procedure (if visual assessment fails) and follows PAS 111 requirements only (for untreated wood)

60. On page 5 it is stated: *“The substance concentrations within the processed materials are sufficiently low that if cows ate the material at any conceivable amount (cows do not eat wood) it would not cause them harm due to the substance concentrations within the wood.”*

This is incorrect, cows will chew on and imbibe wood and wood products. I don't believe they would seek to positively eat wood products when other more palatable products are available but, yes they will eat it and if it smells or feels different to other things they may well investigate it further and taste it. However, I think this is less of a concern compared to what the final product does when interacting in the environment of the cubicle with moisture / urine / faeces etc. and how this impact's the cow's skin and immediate environment.

61. On page 6 it is stated: *“Every supply site is subject to pre-acceptance checks to ensure that the material that will be received from the supply site is suitable for processing and passing on. Samples are analysed and the results reviewed prior to any material being accepted from a supplier. If deemed acceptable, through chemical analysis, then supplies are received with on-going sampling and analysis undertaken. Results are stored and checked against individual supply sites and therefore on a case-by-case basis.”*

This does not align with what the other documentation states. This states that analysis results are available from 60% of the supply from 10 suppliers. The rest is not tested prior to supply to the appellants. Further, samples are not collected from every single batch of wood supply for testing. A shovel full is assessed to check for visual contamination for things such as bits of plastic, if that passes this visual check, no sample is taken. If it fails the visual check a sample is taken, but there is no indication of what tests are actually carried out on the sample.

However, the key issues here, is a lack of quality control over the final product. There is limited sampling of sourced supplies, there is no testing of the final product to provide any certainty as to what the final product contains, which by their own admission contains treated wood as far as the “cubicle conditioner” is concerned. If there is no discernible difference between untreated wood and treated wood, why is one used as a main bedding source and the other used as a conditioner – i.e. a bedding with a different name used in smaller volumes which the appellants argue will not be around long enough to impact animal health?

62. On Page 6 it is stated: *“It is acknowledged that median figures were used in Platts’ original submission. This is recognised now to have been an incorrect approach, the key data being mean concentrations, ignoring short-term fluctuations.”* This is not correct. What type of average someone uses in describing data is fully dependant on the data distribution. If the data is parametric i.e. normally distributed, then the mean values should be used. If the data is non-parametric i.e. it is not normally distributed, then the median values should be used.

63. On page 7 it is stated: *“In reference to NRW SoC Paragraph 6 above, based on the regulator’s own evidence, it can be confirmed that the materials passed on by Platts potentially pose a lesser risk of harm to the environment, human health, and animal health than the straw comparator.”*

The concern here is the unknowns, what chemicals / varnishes / stains /solvents have been used on wood, and has this increased health / welfare risks?

64. On page 7 it is stated: *“Platts undertake sampling and analysis for all individual supplier waste wood, both at pre-acceptance stage and as an ongoing basis to ensure materials received remain fit for purpose.”* This is not what is stated in the earlier documentation. Clarification is needed on what Platts actually do with respect to testing incoming materials, what tests from the source supplier they rely on only and what tests they complete on the final product. People who buy this product need to know what is actually contained within it, particularly since Platts make specific claims associated with the benefits of using such a product.

65. On page 8 it is stated: *“With sample analysis results confirming that the mean concentrations of both the clean and ‘treated’ woods being below 0.1% (1000mg/kg) total concentrations for all substances analysed (based on a wide analysis suite of substances likely to potentially be present), it is argued that the materials are of very similar composition.”*

The tests are what exactly? The test will be for wood to give the more than 99.9% wood factor. The test applied are based to the treated wood are less than those carried out on untreated waste wood. The difficulty here is that one set of wood has been treated with various treatments including solvents. Clearly one would expect tests to be relevant for the solvents / treatments used. If there was confidence in knowing what this 0.1% comprises then I think we could be more comfortable in accepting there is little difference between the two products.

66. On page 9 it is stated: *“The selection process involves a technical assessment of the source materials to ensure that they are suitable for processing and the ultimate use.”* However, this just appears to be a questionnaire completion based on responses from the supplier and a visual examination of just one shovel full of wood waste from the middle of a truck which looks for visual contaminants (Appendix III AGR P010 Visual Quality Testing Procedure):

**Visual Inspection – During daylight hours the operator should take the sample and thoroughly inspect it for contaminants. At night inspect a shovelful in the back shed under a light. Contaminants that should not be in the sample include metal, plastic, microplastics, general rubbish, laminate, stones, shells, large pieces of wood or other inappropriate materials.**

It also relies on testing carried out from 60% of the source suppliers, without actually clarifying what these tests are and when and with what frequency they are done and whether these tests are relevant to any of the chemicals / products being used in their wood processing activities.

67. On page 9 it is stated *“there are no quality criteria or product standards applicable. However, Platts have set their own standard based around the PAS111 ‘protocol’ and minimal substance concentration content from source selected supply sites and confirmed through extensive sampling and analysis.”*

This is not correct. Platts have applied the PAS111 protocol to the bedding materials produced from untreated wood only and have not applied the same testing to the conditioner – which we have

established is also bedding, made from treated wood. The assessment for content appears to be based on checking for heavy metal concentrations. I would have thought that the checks should be associated with whatever chemical has been used in the wood processing activities and that an understanding of the chemicals used should direct the appellant to the appropriate testing protocols.

68. On page 9 it is stated: *“In addition, the waste wood is put through two further utilization steps, (as cubicle conditioner (animal bedding), and as a component of the slurry that is then spread to land) improving its life cycle, without harm.”*

No peer-reviewed evaluation of the substance when used as a conditioner i.e. part of the bedding and when it finally ends up in slurry is available, so there is no evidence either way as to whether it causes harm or not. All we have is limited evidence from people that have been sold the product, even though at the time it was sold to them it would have not been lawful to use the product as part of the animal bedding, without a Home Office licence being used to evaluate the product experimentally.

69. On page 10 it is stated: *“Cows do not eat wood, therefore a potential effect on the food chain through cows ingesting the conditioner materials is highly unlikely. The conditioner material is placed at the rear of the cubicle to soak up urine and faeces produced by the cow and keep the cubicle as dry and comfortable as possible. There is a potential for the wood dust to be transferred to cows’ udders but it is considered virtually all of the contaminants would remain bound to the dust particles and be filtered out. Any small fraction passed on in the milk would make a negligible contribution to substances of concern”*

As has been mentioned, cows do eat wood although its not a preferred substrate we don’t know how the processed treated wood “conditioner” will present to the cow palatability-wise as it has not been tested for palatability. In fact there has been no formal testing of the final product and no formal testing of what happens with the product when mixed with urine and faeces. There has also been no testing of milk for cows that have been constantly exposed to this product. The only way this could be demonstrated is through experimental comparison in identical environment, under a Home Office licence, exposing half the cows to the product and half not and measuring impacts on bedding

suitability, cow cleanliness, udder hygiene, health, skin evaluation, milk evaluation, slurry evaluation etc. I am not convinced that contaminants would remain bound to dust and in all fairness any type of hydration whether milk, urine or faeces is more likely to create bonds with any contaminants in the “dust”. The bottom line is we just don’t know because that testing has not been carried out.

70. I will not refer to potential land contamination via the slurry. The appellant has not tested the effect of the product in slurry and so is unable to compare the use of the product in slurry with other products. This again is something that should be evaluated in formal trials of the product to show its equivalence or better than other bedding substances when added to slurry.

71. Page 19 it is stated: *“The material has an established use, is considered to contribute to improving animal welfare, is a suitable alternative to traditional materials and has no greater risk or impact than those materials.”*

This is incorrect. There is not an established use of a product which is not permitted by law to be used for animal bedding currently. There is no scientific study yet carried out to demonstrate its safety for its use as part of animal bedding or that it improves animal welfare.

72. Overall, the further arguments / justification for use of this material as part of dairy cows’ bedding have made me more concerned, not less concerned. The fact that the final product is never tested for consistency of content and then it also has not been properly evaluated in the field under controlled conditions raises significant concerns about its use. I am not against the changes to approvals processes, if experimental works shows status quo or improved health / welfare, but this has to be carried out properly under licence to prove its efficacy and safety. So far, all tests have been on input sources, not on the final product and there have been no reported scientific evaluation of its impacts when used in practice. Further, from a marketing perspective I would have thought the final product would require regular batch testing, in order for the manufacturer/ seller to attest as to its content type. The appellant argues that they are merely screening it and pulverising it but this can still lead to changes in the final product – clearly there are changes since the appellant states that the final product has a much higher dry matter content than, say, normal sawdust.

## Submission statement

73. This gives some more information on the background to this company and describes how the cubicle “conditioner” has been used since the early 1990s. If this is the case, I am really surprised there is no peer-reviewed published literature on the use of this product anywhere that I can find. However, I have searched across academic search engines and there is nothing.

74. The appellants state: *“This belief in turn informs its ‘regulatory position’ that “treated” wood cannot possibly be used in any form of animal bedding.”*

This is not strictly correct. If scientific evidence in the form of peer-reviewed published literature establishes minimal or comparable risk to other bedding substrates with regards to animal health and welfare, then I think it could be considered. We do not have that evidence, we have not even been provided with details on the specific treatments that wood has been subject to and what tests have demonstrated that their levels in the final product are insignificant to animal health and welfare.

The onus is not on the regulator to evaluate novel husbandry methods, including novel bedding substrates, but for those marketing their products to have carried out experimental work with the proposed substrates to demonstrate that they do not pose a risk.

75. The appellants states: *“If NRW were correct, then dairy farmers would run into a serious shortage of supply of the products that are currently relied on by a substantial section of the market. Farmers could not buy the Platts’ (or presumably other suppliers’) conditioners, the risk then being that dairy cows would be subject to the use of other materials as bedding which would be less comfortable, more likely to result in mastitis and worse for the wider environment”*

Use of the “conditioner” alone on cow mattresses is considered unacceptable for cow comfort. The design of cow mattresses is such that they cannot possibly meet the requirements for a dry bedded environment without intervention to deal with non-draining urine and faeces. The dairy industry has addressed this failing, by fixing it with the application of various products with a high dry matter content to absorb moisture. None of these products should be in direct contact with cattle skin and

therefore use of such products necessitates additional bedding to ensure skin contact does not occur or is minimised.

76. The appellants state: *“Those products can be used in the same way as other products intended to keep cows dry and comfortable and indeed they provide better results in various ways, in particular in terms of the absorbency of animal waste, resulting in increased comfort and the reduced risk of the growth of mastitis-causing pathogens. The conditioner products produced by Platts have no worse environmental effects than any comparable products (indeed their effects are better).”*

We have no peer-reviewed published scientific evidence of this unfortunately.

77. The appellants state: *“Platts does not need to be concerned with “potentially harmful substances” because it has analysed and knows what those substances are. These analyses confirm that the concentrations are so low that they are harmless.”*

We have no details on the types of treatments the wood sources have previously had applied to them. It is stated they are analysed for these substances but if we have not seen any details of these analyses then it is a challenge to consider whether these are a conceivable risk or not.

78. The appellants state *“Further, the material making up the non-hazardous waste wood (classification 03 01 05) which Platts processes is consistent. Furniture manufacturers do not suddenly change or alter the materials which they process, and Platts knows its clients.”*

This is not correct according to documents provided. The documents state that they have analyses from 10 of their suppliers comprising 60% of their waste intake. We still have not been provided with a clear list of what treatments are used on these wood sources.

79. The appellants state: *“MDF, fibreboard, chipboard and plywood products are currently the most prevalent bedding material type used on dairy farms throughout the United Kingdom. Currently, about 30-50% of dairy cows, when housed, are likely to be kept on rubber mats / mattresses with an additional sawdust substrate, the majority of which is sawdust which is not from pure softwood or virgin sources. That amounts to about 450,000-750,000 animals on about 2,500-4,000 dairy farm holdings. For many years there has been a plethora of suppliers of the same product, the larger*

*suppliers who are competitors to Platts being based in England. Platts have been supplying its conditioner products as additional bedding substrate within this market since 1973.”*

An earlier statement from this document (in the introduction) suggest this product has been supplied since the early 1990s, not since 1973. As previously mentioned, I can find no peer-reviewed published evidence on the use of such a product. It would be useful for the appellants to quote their sources regarding the sawdust substrate sources that they refer to. The WRA (2021) stated that of the 3.8 million tonnes of waste wood processed in 2020, only 350,000 tonnes were processed into “animal bedding, equine surfacing, reuse and other recycling” substrates.

80. The appellants state: *“Whilst farmers make their own choices in respect of bedding material, sawdust is preferred because of its cost, absorbency properties when dry (providing good hygiene with benefits for udder health and milk quality), availability, compatibility with slurry systems and ease of use (since a bedding substrate such as sawdust governs the ease by which beds can be brushed clean).”* AND *“National baseline standards exist in the form of the Red Tractor Farm Assurance Standards. In summary, these are that dairy cows’ bedding should be non-injurious, non-toxic and absorptive. It should provide for good comfort (to ensure adequate lying times and cleanliness of the animals). These standards are met by the Platts’ conditioners.”*

As already mentioned, we do not have clear evidence of the type of substances that have been used and potential toxicity. This is exactly why APHA have raised concerns with Government departments regarding the use of certain novel substrates in recent years. For example, the use of recycled manure solids was an area of contention and required detailed scientific evaluation before we were able to advise on the appropriateness of its use for different livestock types and what level of processing was required for these products to be considered suitable for some livestock and not others. I produce the document on RMS – APHA guidance, where you can clearly see the requirements that APHA have determined from the available scientific evidence (**RMS- APHA guidance**). This is the type of guidance I would expect to see developed in respect to the use of untreated and treated wood sources, where the type of treatment is known and the final product has known quantities of various substances that

can be properly quantified and their risk assessed. This then means it can be reasonably marketed as a suitable bedding substrate for farmed livestock that are used in food production and would then comply with the law and code guidance, if the standards for a U8 exemption were to be changed in future. Red Tractor standards (a private assurance scheme) merely reflects legislative standards and the cattle welfare codes. Red Tractor issues a position statement on the use of bedding substrates in 2021 (see attached document) and it specifically lists treated wood as unacceptable. This, therefore, by definition means that the two products marketed by Platts Agriculture must not be used on Red Tractor Assured farms and should be recorded as a non-conformance where this is found. I do have concerns that the “conditioner” does not clearly state that the wood sources are from non-Grade-A sources and therefore are being illegally marketed as a product for use for animals when this is not permitted. This will need to be passed on to Trading Standards Wales, to investigate under the Unfair Trading Regulations 2008.

81. The appellants state: *“It is worth reflecting at this point on the absurdity of NRW’s objection to the grant of a waste permit on the basis that an end-of-waste justification cannot be made out because of a ‘regulatory position’ that “treated” wood cannot be used with dairy cows. On the contrary, this is an ideal opportunity for a permit to be granted, as NRW first intended, the terms of which can be replicated as a harmonised standard throughout the United Kingdom for the rest of the animal bedding industry and the benefit of farmers and their dairy cattle.”*

I agree that moves could be made to consider what non-hazardous treatments could be considered acceptable and low risk; as I said before, there needs to be a clear evidence base for what is acceptable and is not acceptable and the waste recycling industries need to provide clear evidence of what their exactly their waste sources, what treatments have been used in the production of such wood waste and then what processing of these wastes results in as a final product. The Wood Recyclers Association (WRA) in 2021 produced a position document on exactly this. However, the current position and the current exemption process only allows for Grade A wood to be used as animal bedding; there is not enough evidence available to demonstrate the level of risk or safety associated with different treated

wood sources. However, it does not need to stay this way if those wanting to make use of waste can produce the evidence to show that the final product is suitable and safe to use as part of animal bedding.

#### **Report of George Fisher PhD**

82. Dr Fisher's expert report focuses on heavy metal levels in slurry and is not relevant to the animal health welfare aspect.

#### **Report of Dr Ivan Vince CEng FICHEM CSci CChem MRSC FEI**

83. Paragraph 11, Dr Vince relies on anecdotal feedback regarding use of the product(s) by a number of farmers. This does not form an acceptable evidence base, does not account for all the other various risk factors that are associated with mastitis and cannot be accepted as peer-reviewed published evidence of efficacy / improved health / welfare and/or reduced harm (see previous comments).
84. Dr Vince states: *"Decades of experience, together with a large volume of testimonials, confirm that skin contact with the cubicle conditioner is, if anything, beneficial to cows."*

We have no details "over the years" of what wood sources were being used, whether these started out as the equivalent to grade A wood products, as seems to be suggested by the appellants in their summary document, who discuss issues with normal sawdust and developing the "conditioner":

*"Platts is run by Caroline Platt, the daughter of parents whose family were farmers and who found that fresh sawdust was too coarse and too moist for use with rubber mattresses as a common means for housing dairy cattle. The conditioner product which is at the centre of this application was developed by the early 1990s and it has not substantially changed since then."*

As previously stated, no comprehensive testing of this product in relation to animal health and welfare has been carried out.

85. Dr Vince states: *"Again, the quantity of contaminants in the conditioner that can credibly enter the blood of a cow via an open wound before the wound is discovered and treated is negligible, bearing in mind not only the very low concentration, but also the general lack of mobility, of the contaminants –*

*since substances soluble in water (and thus in blood) are necessarily avoided in surface coatings and adhesives applied in furniture manufacture.”*

We do not know what the contaminants are, the final product has not been tested for the known contaminants that Platts are aware of, let alone the contaminants they do not know about from 40% of their supply chain. We do not know, therefore, whether any of the contaminants can be absorbed through intact skin, let alone via the teat mucosa at the time of milk leakage or via wounds. We basically do not know the risk.

86. Dr Vince re-iterates Dr Atkinson’s erroneous comment: *“According to Dr Atkinson, it is unlikely that even a hungry cow would ingest any of the cubicle conditioner”.*

See previous comments. Cattle can and do eat wood, and when hungry will eat all aspects of their bedding material they may consider a potential food source. Welfare cases I have been involved with where food has been withheld, records large quantities of sawdust in the rumen of calves and cattle at post-mortem, so yes, they will eat wood when hungry. We don’t know the palatability of the “conditioner” either in its dry or hydrated form and therefore this is an assumption made by both Dr Atkinson and Dr Vince that is incorrect.

87. Dr Vince states: *“ECL’s review of the industry sector identified a wide range of potential contaminants for chemical analysis by a laboratory with suitably accredited test methods. I have reviewed the spreadsheets containing chemical analysis results of samples from furniture manufacturers supplying Platts. The concentrations are all orders of magnitude below any possibility of acute toxicity from possible ingestion. Any potential hazard can only be from chronic exposure.”*

I cannot comment on this because I have not seen the full data set from all the furniture manufacturers that carry out chemical analysis (891 samples). However, again I should reiterate that samples are only available from 10 suppliers, comprising 60% of the waste wood intake to Platts Agriculture and therefore, since the final product is not analysed, we have no idea what the constituents of this final conditioner product contain, nor whether these levels are consistent from batch to batch. Further, the appellants have already that the conditioner products have a much higher dry matter content than

the wood sources that are supplied to them. This would concentrate any contaminants within those products, hence the need to know the analysis of the “conditioner” as a product that is used in animal bedding. This has nothing to do with end of waste activities, this is about providing the consumer i.e. the purchaser of the “conditioner” with details about what the product is and what it contains. Further, we have already been told that this conditioner product is in constant use by those that purchase it and therefore an understanding of chronic exposure is extremely important.

88. Having had assurances from Dr Atkinson, and DR Vince based on Dr Atkinson’s report, that cattle do not eat wood they then go on to calculate likely ingested amounts of the conditioner.
89. Dr Vince determines likely amounts of the heavy metals potentially in the conditioner product that may be ingested or enter the milk based on some figures provided by Dr Atkinson. He then summarises by stating: *“Risks from the application of cubicle conditioner can therefore be considered to have been screened out: to require no statistical or other detailed assessment, nor any management measures apart from the important one of monitoring to ensure the current situation does not deteriorate.”*

This, however, is based on waste source input values from a proportion of the wood source suppliers, unless there is an additional document that shows analysis of the conditioner product that I have not seen. The calculations are based on rather arbitrary determinants of ingestion / passage into milk and I would say that myself, Dr Vince and Dr Atkinson actually have no idea how much of the conditioner is likely to be ingested or enter into milk.

90. Dr Vince comments the testing regime used by Platts is in excess of that required for compost processing. Compost is not recommended for use in livestock bedding because of its many animal health risks. Therefore, if something is being used for livestock bedding there is an expectation that more rigorous tests will be applied than waste used to produce compost. I therefore am not surprised the tests made on untreated wood sources are more rigorous. This also follows that tests on any products produced from treated wood sources should be even more rigorous.
91. Dr Vince then makes a number of statements in conclusion, firstly (para 40, p 16):

*“NRW appears to be misapplying the precautionary principle, in effect viewing any risk as intolerable unless proved otherwise. However, a cursory examination of the risks presented by the Platts cubicle conditioner strongly suggests that they are insignificant and can be “screened out”, on the basis of conservative assumptions.”*

This is incorrect. Everything can have a risk, depending on what is being examined. For example, the appellants have made it quite clear that there are clear risks associated with the use of untreated wood and there are mitigations in place during their processing to manage these risks but their evaluation and processing protocols for untreated wood sources may not completely remove all known risks but will have done sufficient to be considered as acceptable. On this basis there is an exemption to use untreated waste wood to produce livestock bedding, despite these clear risks.

92. There are identified additional risks associated with treated wood because specific chemicals, solvents, other products have been added to the wood as part of the manufacturing process. Platts have stated that they are familiar with all the manufacturing processes used in their wood sources, that they know exactly how much of different elements are used in the manufacturing process and show evidence of asking the questions. What I would want to know is the detail of exactly what these solvents, chemicals, veneers and varnishes are and how much is used for every batch of wood manufacturing. Platts supply the skips which collect the waste that will get filled over a defined period of manufacture for each supplier. Therefore, for each skip that is filled with treated wood dust and offcuts / shavings, the suppliers will be able to describe exactly how much wood they have used and how much of a certain treatment has been used during that period of time.

As a consumer / purchaser I would want to know exactly what treatments have been used for that wood supply, particularly if they are going to come in contact with my animals.

Whilst Platts have stated that manufacturing processes have not changed over the years, they most definitely have. Let us just consider **a single example**, the use of **adhesives** in wood bonding.

### **Adhesive use in wood manufacturing.**

93. 80% of wood-based products use adhesives (Raydan et al, 2021). Wood bonding has been practiced for thousands of years, with adhesives initially produced from plant and animal protein sources. In the late 19<sup>th</sup> and early 20<sup>th</sup> century, the main adhesive source in the wood manufacturing industries was based on animal proteins, including collagen, blood, casein, fish, starch, and other animal-based sources such as keratin. It was not until the 1930s that fossil fuel sources were used to create synthetic adhesives (Gadhavé et al, 2017) which were not only lower in cost, they had superior bonding strength and moisture resistance when compared with traditional bio-adhesives.
94. Today, the majority (90-95%) of global industrial wood adhesives are produced from fossil fuel sources (Raydan et al, 2017) consisting of phenol-formaldehyde (PF), urea-formaldehyde (UF), melamine-formaldehyde (MF) and polymeric diphenylmethane diisocyanate (pMDI). UF-based adhesives are used for producing interior wood-based materials, such as chipboard (particleboard) or medium-density fibreboards (MDF). The development of phenol-resorcinol-formaldehyde (PRF) and resorcinol-formaldehyde (RF) resins have enabled the production of high-performance glue-laminated timber in major structures and can be used in boat building and external wood furniture due to their high-water resistance. However, increasing concerns about urea-formaldehyde, during and after production, due to unreacted formaldehyde and hydrolysis of the adhesive under hot/humid conditions have led to restrictions associated with its use. Free formaldehyde exposure, greater than 0.1 parts per million (ppm), can result in eye irritation, nasal and throat congestion, respiratory tract irritation and skin sensitization (Golden et al, 2011, Salthammer et al, 2010) and is a group 1 carcinogen associated with cancer of the nasopharynx (back of the nose, roof of the mouth) and leukaemia. This has led to limits being set for free formaldehyde exposure, with the World Health Organisation (WHO) setting indoor exposure limits at 0.1mg per cubic metre (0.08 ppm) for 30 minutes to avoid sensory irritation (WHO, 2010). Cancer risks associated with long term exposure are considered to be in the range of 0.2mg per cubic metre (WHO, 2010).

95. The risks associated with formaldehyde and the fact that fossil fuels have been the source of all synthetic adhesives has led to a renewed interest and uptake of creating bio-adhesives from renewable plant and animal proteins (Gonçalves et al, 2021). The greatest uptake of these alternatives to formaldehyde based wood adhesives is in Europe and North America (Hussin et al, 2022). Examples include all of the protein sources that were used in the previous centuries with additional sources of low value animal proteins, for example spent hens (Wang & Wu, 2012). Methods of processing and combining different protein sources (such as soy and chicken feather) using less hazardous chemicals have been developed to improve properties of bio-adhesives, particularly with respect to bonding strength (Zhou et al, 2021, Li et al, 2021)
96. This is another reason that it is necessary to know the type of products being used from every single wood manufacturing source because any wood products using certain animal protein sources in adhesives would not be permitted for use in animal bedding. Further, certain plant bio-adhesive sources could be particularly toxic for animals – such as a rapeseed-based bio-adhesives (Frihart et al, 2017).
97. Further, whilst a bio-adhesive may be suitable for use in human buildings and considered a non-hazardous wood treatment, as far as human exposure is concerned, this is because the product would have been used with a specific outcome – to create wood panels that may be coated with veneers and which there is no expectation that a human or animal is likely to peel off the veneer and start eating the adhesive. However, once the wood source becomes waste, and it is then reduced to a fine powder, and forms part of the bedding, the adhesive components i.e. the plant or animal based proteins will be exposed. It may also be far more palatable than we might expect once reduced to a fine powder and mixed with a bit of leaked milk from the udder.
98. Therefore, in summary wood manufacturing will have changed since the early 1990s and very much changed since 1973. Not only is there a change in the types of adhesives and wood processing techniques used in basic bonding and manufacture, there is also the development and increased use of wood-plastic composite (WPC) technology (Gardner et al, 2015) incorporating polymers such as

polyethylene and polyvinylchloride, and for example the extensive use of products such melamine and polyurethane as coatings for kitchen furniture, rather than varnished wood or wood veneers. So, I cannot agree that the wood wastes that are coming from various sources are pretty much the same thing now as they have always been, following similar processes that carry equal risks.

99. If we do not know what the wood source has been treated with, we then do not know what to look for, with regards to animal health and welfare risks and would therefore what might constitute a hazard. The appellants and experts seem to have focussed purely on the levels of heavy metals, which yes are important, and microbiological testing is also important, but these are for tests associated with untreated wood. We are not expecting there to be rapeseed protein, rabbit skin, chicken feathers, formaldehyde, polyurethane coatings or melamine in untreated wood, but there could be in treated wood.

100. The bottom line is that from the documents that I have seen, I have no idea what is going into the "conditioner" and so we have no idea what the components of the final product are and therefore what could pose a potential risk to the animals.

101. Dr Vince states (para 41, p17): "*Ceasing to use the conditioner is not risk free, but carries documented health risks to cows.*"

It is not clear to me what risks Dr Vince is referring to in ceasing to use the conditioner would result in. There are legal requirements about providing an appropriate environment for dairy cattle in cubicles and therefore if the bedding environment is considered not suitable without the conditioner, then it is the farmer's responsibility to use other bedding sources. As stated earlier, the latest scientifically evidence based and peer-reviewed recommendations on providing an ideal and comfortable environment that reduces risks associated with lameness, foot lesions, body cleanliness etc in cubicle systems require a reasonable depth of bedding – at least 5cm compressed material on top of a cubicle mattress (3kg straw per cubicle on a mattress by way of example).

102. There is no peer-reviewed evidence that demonstrates improved benefits with the use of the conditioner and indeed in relation to reducing mastitis pathogens, hydrated lime is the only one that

consistently shows this effect in peer-reviewed literature (Gleeson, 2013) but carries other risks such as a teat keratosis, petechial haemorrhages, gross haemorrhages, cracking and chapping of teat skin, particularly in association with using specific teat disinfection protocols post-milking and in cold weather. No such research has been carried out on the conditioner and therefore Dr Vince has no evidence of what this conditioner can do – either as a health benefit or as finite hazard.

103. Dr Vince states (para 42, p 17) : *“Inhalation exposure to the conditioner, to the extent that it occurs at all, is no more harmful, whether to cows or humans, than exposure to untreated wood dust. Skin exposure is actually beneficial to cows, in comparison with alternatives, in particular reducing mastitis”* and (para 42, p17): *“Potential chronic ingestion of the cubicle conditioner by cattle, while highly unlikely, is quantifiable, and thus a convenient means to demonstrate that the risk to cows is negligible. Based on conservative assumptions, informed by advice from the veterinary expert witness and a review of analysis results of a large number of product samples, I conclude that ingestion of cubicle conditioner, if it occurs at all, makes a negligible contribution to any toxic load inherent in the regular feed of dairy cows.*

and (para 44, page 17) *“There is negligible contamination of milk by conditioner transferred from udders.”*

There has been no testing of this cubicle conditioner with regards to its particle size and therefore the risks that it carries compared with other dust sources in the normal bedded environment for cattle. I will speak about this later. There is no testing for the impact of use of the cubicle conditioner in dairy cows, whether any or none gets ingested (I will speak on the use of wood flour in human and animal feeds later) and its likely entry into the milk. Therefore, there is no confidence in Dr Vince’s statements here.

#### **Wood Flour particle sizes in the cubicle “conditioner”**

104. I have attempted to understand from the documents what size the final dust particles are, but the appellants have not provided exact details about how much the wood sources are pulverised and what size particles they end up with. From my understanding, what Platts Agriculture is producing is a form

of what is understood in the wood industry as “wood flour”. Reineke (1966) describes wood flour: *“is applied somewhat loosely to wood reduced to finely divided particles approximating those of cereal flours in size, appearance, and texture”*. However, for practical purposes wood flour describes wood particles that can pass through an 850µm mesh size (0.85mm) (Clemons & Caufield, 2005). As I said, it is assumed that this “conditioner” is a form of wood flour, based on the physical and visual description, but as, there is no details from Platts Agriculture on particle size of the final product this is of course an assumption based on the description of the process that Platt’s Agriculture carry out on the wood sources to produce the cubicle conditioner.

### **Wood Flour uses**

105. Wood flour has been in use at least since the early 1900s and has been added to soil / compost, used in glues, as a component in producing explosives and as a wood plastic composite (WPC) (Clemens & Caufield, 2005). One of its earliest uses in a WPC called “Bakelite” that was used in electrical equipment manufacture.
106. Wood has also been used as a natural fibre source in both human and animal feeds, but it is important that when wood sources are used in human and animal feeds that such wood sources come from untreated, virgin timber sources. Therefore, contrary to Dr Vince’s and Dr Owen Atkinson’s comments wood flour (the same as the cubicle conditioner in its production) is used in animal and human feeds and clearly would be considered edible, as would most bedding constituents provided to animals.

### **Legislation using wood sources in feedstuff and food contact materials**

107. There is legislation that covers the use of wood sources in feed stuffs (human and animal). Transferred EU REGULATION (EU) No 68/2013 - Catalogue of feed materials. describes the acceptable form of wood that may be used as a crude fibre source as *“chemically untreated wood or wood fibres”* in food stuffs.
108. The Agriculture Act 1970 describes what a “feeding stuff” means with respect to animals:  
*“(a) a product of vegetable or animal origin in its natural state (whether fresh or preserved);*  
*(b) a product derived from the industrial processing of such a product; or*

*(c)an organic or inorganic substance, used singly or in a mixture (and whether or not containing additives);*

*for oral feeding to pet animals and such descriptions of animals as may be prescribed being animals which, or kinds of which, are commonly kept for the production of food, wool, skins or fur or for the purpose of their use in the farming of land”*

And for the purposes of the Act this includes any bird, insect or fish (including shellfish).

109. Regulation (EC) No 767/2009 Annex III describes what elements are prohibited from animal feedstuffs and includes:

*“Wood, including sawdust or other materials derived from wood, which has been treated with wood preservatives as defined in Annex V of [EU regulation 528/2012] of the European Parliament and of the Council of 16 February 1998 concerning the placing of biocidal products on the market”*

Annex 5 of 518/2012 lists wood as a potential risk in the following way:

*“Wood preservatives*

*Products used for the preservation of wood, from and including the saw-mill stage, or wood products by the control of wood-destroying or wood-disfiguring organisms, including insects.*

*This product-type includes both preventive and curative products.”*

Article 3 of 528/2012 describes not only known biocidal components but hazardous, dangerous and other substances that we don't know the risks.

110. Commission Regulation EU 68/2013 describes specific feed materials that includes wood sources that are permitted as feed materials in animal foodstuffs:

*“Lignocellulose - Product obtained by means of mechanical processing of raw natural dried wood and which predominantly consists of lignocellulose. The natural content of trace elements shall be taken into account*

*Powdercellulose - Product obtained by decomposition, separation of lignin and further cleaning as cellulose from vegetable fibre of untreated wood and which is modified by mechanical processing only.*

*Neutral detergent fibre (NDF) minimum 87 %*

*Wood - Chemically untreated wood or wood fibres*

*Xylose - Sugar extracted from wood*

*Starch hydrolysates cake - Product from starch hydrolysis liquor filtration which consists of the following: protein, starch, polysaccharides, fat, oil and filter aid (e.g. diatomaceous earth, wood fibre)."*

All of these are for crude fibre constituents of feed except for the starch hydrolysates cake.

111. For Wales, The Animal Feed (Wales) Regulations 2010 and The Animal Feed (Composition, Marketing and Use) (Wales) Regulations 2016 covers key elements of regulation and enforcement in relation to these various pieces of EU transferred legislation and compliance with the Agriculture Act 1970.
112. Regulation (EC) No 1935/2004, is the transferred EU legislation applicable to what materials are considered suitable contact with human food material and, for wood, is listed as "*wood flour and fibres, untreated*".
113. However, there has been increasing concern about the use of wood sources, described as "natural" and fully biodegradable in materials that come in contact with food material, when in fact they may be a high wood percentage wood plastic composite (WPC), and that such wood sources maybe entering either animal or human feedstuffs when they are contaminated with high risk / hazardous substances.
114. This concern has been extended to the composition of "food contact materials" when considering risks and in relation to the cubicle conditioner this concern could be similarly extended when considering Dr Vance's and Dr Atkinsons suggestion that small amounts of cubicle conditioner may enter milk, means that the cubicle conditioner does fall under the same concerns raised by EFSA (2019) when considering additions of wood flour to make WPC that may come into contact with food materials. Further, it has been determined that in fact untreated "virgin" wood, which can contain a various levels of different substances, according to wood species, which could be considered toxic. On this basis EFSA(2019) determined that wood sources must be further evaluated before being considered safe as constituents of feed contact material (Let alone feedstuff itself) and that each wood species used must be considered on a case by case basis. This is because certain wood sources and

their constituent elements e.g. bark, leaves are in themselves poisonous and not considered acceptable in the production of WPCs associated not only with food material contact e.g. milk but for example prohibited from production in WPCs associated with human contact e.g materials used in childrens' playgrounds (Presumably on the basis that adults are not expected to chew on such materials used in indoor wood furniture manufacture but that children might chew on it in a playground) and include yew, cherry, cypress (cedar), oak , walnut, yew and sandalwood.

115. Therefore, considering the range of concerns raised around wood sources, including even sources of “contact” material, then I do struggle with both Dr Vince and Dr Atkinson’s assumptions that there are little or no risks associated with use of the cubicle conditioner and milk contamination, about which we have no knowledge of its wood species composition or its contaminants including various treatments / adhesives used during manufacturing processes. We come back again to the fact that there has been no comprehensive testing of the final product for the constituents that may have been used in wood treatments during the various manufacturing processes that the wood sources come from.

#### **Physical and chemical composition of wood, wood flour and associated risks**

116. Wood is composed of hollow, spindle-shaped cells (fibres) that are arranged parallel to each other along the trunk of the tree. The centre of the cells contains deposits such as resin or gum. Softwood wood fibres are typically 3-8mm long, whilst hardwood wood fibres are 1mm long. Their diameter is 15-45µm, so when considering the composition of wood flour it will consist of bundles of these wood fibres, which, when pulverised will break up differently according to how the specific wood species’ wood fibres are organised and the contents of the wood fibre.
117. The particle size achieved by pulverising is highly dependent on the wood source (Pokhrel et al 2021), which we have already established that Platts have not provided specific information on and is likely to be mixed wood sources. It is not just a difference of softwood vs hardwood but the chemical constituents, for example the content in the centre of the wood fibres that can influence the appearance and feel of the resulting wood flour. Therefore, even for untreated wood sources (so virgin

timber sources etc) the dust particle size achieved with pulverisation is affected by the wood species (Pokhrel et al 2021). The resulting particle sizes obtained through the hammermill process, for example, are affected by hammer speed, the extent of wear on the hammer and screen, screen area, air flow, method of discharge, kind of raw material and moisture content of the raw material (Pokhrel et al 2021). For example, in one study, using a 0.5mm screen, the resulting average fragment diameter by species varied from 0.18mm and 0.25mm with a geometric standard deviation of between 0.10mm and 0.13mm. Pulverizing produces a mixture of particles that contains both fibre bundles and fragments with a range of length to diameter ratios of 1:5 (Clemons & Caufield, 2005) or 2:3.5 (Pokhrel et al 2021).

118. The key chemical components of wood are lignin, cellulose and hemicellulose. Then, dependent on the species of wood, 3-10% of the dry wood may include fats, waxes, resins, proteins, gums, terpenes, and simple sugars, for example (Clemons & Caufield, 2005). The moisture content of the source wood and resulting wood flour produced is also affected by wood species source (Pokhrel et al 2021).
119. The pulverisation process does change the properties of the wood. The high “dust” content of pulverised wood that produces wood flour, results in a lower thermal stability and is a higher explosion risk than normal wood or shavings (Clemons & Caufield, 2005) and should be annotated when supplied and managed as such in the agricultural environment. Wood waste has a dust explosion risk where the mean particle size is less than 200 µm, and where as little as 10% of the mixture contains dust less than 80 µm in size. Only weak explosions are likely where the mean particle size exceeds 200 µm. Of course, we are not provided with this information because the final product is not tested for this. However, considering the limited evidence available, it is likely that conditioner in its final form is a significant explosion risk. All farmers caring for cattle must by law have access to the cattle welfare codes (DEFRA, 2003) and this details requirements for contingency planning in association with fire hazards. I would expect anyone using this product, in the absence of further data about its explosion risk, to treat it as a high explosion risk and ensure its safe storage and use is detailed in the farmer’s animal health and welfare plan.

120. Further, we know that the pulverisation process results in a much drier product, 54% less moisture than the source wood (Pokhrel et al 2021). Platts Agriculture also state that the pulverisation process to produce the cubicle conditioner produces a much drier product. So, the cubicle conditioner has a smaller particle size, producing a much larger surface area available for contact and reaction, is much drier (more than 50% drier) and clearly carries a much higher fire safety risk than “normal” shavings. It is very important to understand the risks of the cubicle conditioner during production and when in storage at an agricultural premises. I therefore cannot agree that the cubicle conditioner carries the same risks as normal bedding and associated dust, because the process is deliberately producing very fine particulate dust, with known very high explosive risks. The last fatalities associated with a wood mill explosion in Great Britain occurred in 2015, resulted in four deaths and multiple injuries; the owner received a £75,000 fine and suspended prison sentence for the wood mill owners in 2021 (BBC, 2021a) However, the most concerning issue regarding the trial was that the Wood Mill owners did not understand the significant explosion risks associated with the accumulation of wood dust (BBC, 2021b). I am sure farmers buying the wood conditioner product are equally unaware of the explosion risk associated with this fine wood flour.
121. Further, wood based composite materials used in manufacturing processes, another likely component of Platts’ Agriculture treated wood waste and therefore resulting cubicle conditioner, makes the product even more combustible when compared wood flour derived from untreated wood (Renner et al., 2021).
122. It is hoped that Platts Agriculture do understand the explosion risk associated with the wood sources that they use and the even higher explosion risk associated with wood flour products that they are producing as an end-product and fire hazard control processes in place to manage such risks. However, if they are supplying these products with high explosive risks to farmers, then I would expect these risks to be clearly stated somewhere on their marketing and labelling of such products. I find it concerning that in their Fire Prevention Plan (FPP) they state:

*“The FPP has been updated to address NRW’s Schedule 5 Notice II (dated 09/11/2022).”*

*However, it must be noted that the FPP guidance is applicable only to combustible waste.*

*Therefore, the FPP guidance is applicable only to the storage of incoming wood waste at the Facility.*

*However, to demonstrate Platts' commitment to robust environmental protection, the processed material is included within FPP document despite the material being considered to meet end-of-waste and therefore, it must be emphasised that it is not deemed to be formally subject to the FPP guidance."*

This concerns me because it seems to suggest that they think they do not need a Fire Prevention Plan associated with their business of processing the waste product or associated with their final product.

123. On page 20 of this Fire Prevention Document it does make a statement on explosion risk:

*"Due to the presence of sawdust, the processing area is covered by ATEX European Directives (Directive 99/92/EC – ATEX 137 and Directive 94/9/EC – ATEX 95) and only appropriately 'Ex' rated equipment is used; A Dangerous Substances and Explosive Atmospheres Regulations 2002 ("DSEAR") risk assessment is undertaken by a qualified person to zone the process areas; an annual site inspection takes place to ensure equipment meets the right specification for that zone and is conducted by a qualified ATEX company; and Any findings are actioned and documented"*

There is no mention of the final product being a known explosion risk hazard, and indeed a much higher explosion risk hazard than the wood source nor does it detail how they plan to implement the requirements associated with the safe processing of wood sources according to HSE requirements, including scavenging systems for dust in the production area and safety of the final conditioner product, which is more explosive than the original wood waste.

124. However, the requirements and guidance under dangerous explosive regulations states that:

*"For dusts, information on particle size and density will be needed, once it has been shown that a particular dust can form an explosive atmosphere. Often, relevant information is contained on a safety data sheet provided with the product."*

There is no indication that Platts Agriculture have recognised the risks associated with the products they are producing from the wood waste and that these carry a far higher explosion risk than the sawdust and wood waste sources at the start of processing.

We have not been told about the particle size of the cubicle conditioner, but it will be a higher risk than the wood waste.

#### **Human and animal health risks associated with wood dust**

125. The International Agency for Research on Cancer (IARC) listed wood dust as a group 1 carcinogen in 1995 (IARC, 1995). Wood dust is recognised as a risk for cancers of the nasal cavity and paranasal sinuses and nasopharynx (Straif et al., 2009) and for asthma. Hardwood dusts are specifically seen as a risk and are listed as a carcinogen in the Health and Safety Executive's (HSE) guidance on control of substances hazardous to health (2002). However, softwood dust has also been more recently associated with squamous cell carcinoma (Straif et al., 2009).
126. It is recognised that the latency between wood dust exposure and cancer diagnosis (up to 25 years later), means that the evidence associated between the exposure levels at the time was limited, which made it difficult to set exposure limits (Holm & Festa, 2019). Improvements in working conditions in Great Britain, following the reported cases in wood furniture workers, have been attributed to the HSE guidance associated with wood dust extraction to reduce human exposure as well as the explosive risks (HSE, 2023). There has been a marked reduction in the risks associated with working with wood dust since exposure levels were set since 1988 at 5mg/m<sup>3</sup> (Holm & Festa, 2019) and the requirements for dust scavenging that should avoid these exposure limits.
127. Unfortunately, the same cannot be said for farmers and farm workers. Livestock farming is associated with exposure to organic dust containing allergens and microbial matter, including living microorganisms including bacteria, viruses, fungi, endotoxins (Sigsgaard et al, 2020). This can be aggravated by exposure to disinfectants and ammonia. This type of exposure is associated with an increased risk of asthma, rhinitis, chronic bronchitis, Chronic Obstructive Pulmonary Disorder (COPD)

reduced forced expiratory volume (FEV) (Basinas et al, 2015). A review of recent studies on dust and endotoxin exposure in livestock farmers since (Sigsgaard et al, 2020) do not show a reduction in exposure over the last 30 years, suggesting that the farm workers continue to be over exposed and at increased risk of respiratory disease. The cubicle conditioner is clearly a significant dust risk and its use is clearly a higher risk than normal dusts associated with other beddings, due to the very small particle size of the product. Just because we have a problem with the farming sector not managing its dust exposure, does not mean it is then acceptable to add to the dust levels, saying its ok because it is dusty anyway.

128. The impacts of dust exposure on livestock, and specifically cattle are similar to that in human exposure. Exposure to dusty environments alone or in combination with other risks have resulted in acute interstitial pneumonia (AIP) in cattle (Woolums, 2015), bovine respiratory disease (BRD) (Urso et al., 2021) and can increase transmission of infectious diseases such as *Mycobacterium avium* subspecies paratuberculosis (MAP) (Johnes disease) (Eisenberg et al, 2013). Just as with humans, dust causes irritation in both the upper and lower respiratory tracts and creates bioaerosols which facilitate the transmission of bacteria, viruses, fungi and toxins that can result in bovine respiratory disease. Most studies however have focused on consequences of human exposure to dust in livestock environments. There are many factors that contribute to cattle morbidity and mortality in livestock accommodation where dust can be a contributory factor to this.
129. Again, we do not know the increased dust risk associated with the use of the product because it has not been tested and compared as I would expect with any novel substrate. We can hypothesise that there will be dust aerosols created that may cause symptoms similar to that seen in humans exposed to fine dust aerosols, but we just don't know. Clearly tumour development is less likely considered an important morbidity factor due to normal dairy cow longevity in the cattle sector being much shorter than the time taken for most cancers associated with dust exposure in humans, to develop in an equivalent manner in dairy cows.

## Report of Dr Owen Atkinson

130. I am familiar with Mr Owen Atkinson through work with stakeholders and through Nuffield Farming scholars. There are no conflicts of interest that I am aware of.
131. ref page 10 (3.4) I am surprised that Dr Owen Atkinson chooses to avoid discussing toxins associated with wood. Toxicology is part of the basic teaching in veterinary schools and vets need an understanding of toxicology to determine whether issues with animals are subject to poisons rather than infectious disease. In fact, farmers need to understand what things may be poisonous to their animals as part of basic animal husbandry. Further, paragraph 80, page 26 of Wales' Code of Practice for the Welfare of Livestock: Cattle (2010) states:
- “Any treated surfaces should only have paints or wood preservatives that are safe for use with animals. There is a risk of lead poisoning from old paintwork, especially if second-hand building materials are used.”*
132. ref page 17 (15) I have never heard of the term cubicle conditioner and in searching for it can only find reference to Platts Agriculture calling their products a cubicle conditioner. Therefore, Dr Atkinson is correct in saying that there is no definition of a cubicle conditioner because it is a term created by Platte Agriculture as far as I am concerned, in a way to suggest that the “conditioner” is not part of the bedding. We have already established and Platts now accept that this “conditioner” is part of the bedding and is referred to earlier. On page 18 (para 15) Dr Owen Atkinson concurs that there is no difference.
133. Dr Owen Atkinson discusses the relative differences between practices used for cubicle bedding management and on page 19 (Figure 10b) shows a picture of sawdust, claimed to be delivered from another recycling operator (not Platts). However, no details of the recycling operator are provided now are details of the source of the wood waste sawdust. The current guidance that we provide to the Environment Agency and other Government departments is that wood sources used in bedding must come from untreated wood sources.

134. Dr Owen Atkinson has determined from waste codes that particle board is not hazardous for use in animal bedding. I find this difficult to follow. However, if he followed that principle then the codes that he refers to includes a code listed as 03 01 01 – waste bark and cork – listed as AN absolutely non-hazardous. I presume therefore that Mr Atkinson would be absolutely fine with providing yew, walnut and cherry bark to livestock. Clearly, he has learnt about poisonous plants and of course would not support the use of such bark in the accommodation of livestock, whether as part of wood fittings or part of the bedding. Yet it is listed as non-hazardous. We therefore need to consider the context of these waste codes and what is defined as “hazardous”. This is because what Platts Agriculture do is take a waste product (irrespective of its sources and how well and easily it is can be separated into 03 01 04 or 03 01 05, which is essentially the same as 03 01 04 but is considered “not hazardous” and then create a product, the cubicle conditioner; this is most definitely, under Commission Decision 2000/532 and directive 2008/98 (as transposed into UK legislation), a hazardous substance under several of the hazard codes listed by this because it is – explosive (H1), carcinogenic (H7), irritant (H4), chronic or toxic health risks (H5, H6) because it is highly pulverised wood flour which carries the greatest of all the risks of wood dust (for explosiveness, flammability and health risks) due to its much reduced particulate size.
135. Putting aside lack of evidence as to what wood sources are hazardous or not, and how the 50 suppliers to Platts Agriculture determine whether their wood waste sits in the 03 01 04 category of the 03 01 05 category, the bottom line is that we (APHA, DEFRA) have always stated that animal bedding must come from untreated wood sources that have not been subject to any chemical processing, staining or procedure that could be poisonous to animals. This is because the law requires that we provide a suitable environment for them and do not expose them in their environment to substances that may cause them illness or injury. We do not have enough evidence that shows that the various treatments applied to wood fibre or wood are safe because they there is insufficient evidence to demonstrate safety, in a published peer-reviewed manner.

136. Page 23 (8) Dr Atkinson refers to the hazardous and non-hazardous treatments of wood and the difficulties with interpretation of “treated”. We have had no such difficulty in articulating that wood that can be used in animal bedding is that that has not been treated by stains, resins, glues, paints etc. This will include particle board / MDF because this requires resins to glue it all together under pressure!
137. Page 24 Dr Atkinson discusses some of the legal and guidance requirements around bedding. I have already discussed this in detail and will not reiterate. He also quotes the Red Tractor Standards which require bedding to be “non-injurious non-toxic and is absorptive”
138. Page 27 Dr Atkinson discusses the additional Red Tractor guidance which I have previously raised stating clearly that bedding substrates must not be sources from treated wood such as chip board or particle board / MDF. This is because this is the current guidance that APHA and DEFRA provide, since we have no peer-reviewed evidence to suggest that this type of wood source is non-injurious or non-toxic when used as a bedding substrate. In discussing welfare standards with Red Tractor Assurance at our most recent meetings this issue has not been raised. Usually when Red Tractor are seeking to clarify points of law and standards in their guidance, they will come to ourselves, in the welfare team at APHA, or to DEFRA or the respective devolved Governments who are then referred to our team, as the welfare veterinary advisers that provide advice and guidance on these subjects.
139. Dr Atkinson goes on to describe all of the various guidance notes that are currently available, most of which clearly state that any form of treated wood (and yes this includes chip/particle boards / MDF). They are pretty clear and so I am not sure why Dr Atkinson feels this is confusing. This has been the position for a long time.
140. Dr Atkinson’s statement (page 32) states: *“Platts Agriculture products, Powder Bed and Fine Bed are fine sawdust products and inherently have the potential to be dusty when applied to the beds”*. There is no “potential” doubt that these products are dusty because it is pulverised wood dust or wood flour that is being sold to farmers.

141. Ref page 32 (para 6) Dr Atkinson makes reference to contact with Dr Vanessa Swinson, lead of the cattle expert group in APHA. This is a group principally focussed on disease surveillance in cattle, rather than welfare specifically. However, Dr Swinson provided details of the risks of sawdust causing injury and illness in two cases, which clearly underlines the risks associated with wood sources for bedding.
142. Ref page 33 (para 7) Dr Atkinson refers to a short paper: “An outbreak of acute respiratory disease in an adult dairy herd due to dust inhalation” presented at the World Buiatrics Congress in September 2022, which reflects my earlier comments on the health risks associated with dust in cattle.
143. Ref page 33 (para 8) Dr Atkinson makes reference to the ingestion of bedding substrate. Clearly animals do ingest it, hence the case involving lead paint in sawdust, further I have already elaborated on the fact that wood flour is regularly used in both human and animal food production as a crude fibre additive.
144. Ref page 37 (para c) Dr Atkinson states that the milk filter socks will prevent milk contamination. This is based on the assumption that the fine dust particles in the cubicle conditioner are larger than the filter pores which are usually around 100-200µm. I have already described how different wood species produce different sizes of wood flour particles and it is highly likely that the cubicle conditioner will have some particle sizes that are below the filter pore sizes, This means that cubicle conditioner will be able to pass through these filters.

#### **Dr Owen Atkinson’s summary opinion in his report**

145. Dr Atkinson states that *“Sawdust bedding derived from waste wood sources, including panel boards, is commonplace on GB dairy farms. Nationwide surveillance data and my own professional experience gives evidence to the fact that the products are not harmful to cows”* We do not know how common place this is. Dr Atkinson said that most of the cattle expert panel members did not think waste wood was used this way in dairy units;
- “In experience of the group, poorer quality sawdust or waste wood chip materials are more likely to be used for beef cattle rather than dairy.*

*In experience of the group, in such cases, the product would not usually be marketed for use as bedding, and is often sourced locally by word of mouth. Local sourcing makes it difficult to regulate”*

Most guidance focuses on not using treated wood as a source of animal bedding and requires untreated wood only to comprise livestock bedding. It is not clear where Dr Atkinson gets this information that treated wood sources are in widespread use across GB farms.

146. Dr Atkinson acknowledges that harm has occurred to animals associated with using contaminated wood substrates but argues that none are associated with Platts’ product. He then discusses the case where animals were affected when a similar product was spread whilst cattle were in the building and blames farmer action, rather than the product being the cause of illness (i.e. spreading it whilst the cattle were in the building). Clearly there is evidence that wood flour is a hazard to cattle and if used (irrespective of what category waste it is assigned to) it carries a significant risk associated with human and cattle health when exposed to the dust when aerosolised.
147. Dr Atkinson makes clear qualifications about why he thinks the cubicle conditioner would be acceptable on the basis that it conformed to wood waste type 03 01 05 non-hazardous. However, when discussing hazards this is merely in relation to human handling and management of waste products. The waste directive actually refers to “hazardous” in the context of the hazard codes which clearly demonstrate all wood dust is hazardous once made into wood flour or wood dust, in the context of the human handling and management of this waste. This coding does not relate to risk associated with the product being used as bedding for animals or where it can potentially be ingested or enter the milk and therefore the food chain. I can only reiterate that we have no clear peer-reviewed evidence of this type of product being beneficial or neutral effect for animals. However, we do have evidence of such a product causing respiratory disease in 28 cattle in GB and as reported in 2022 and we do have evidence of contaminated wood waste causing illness and disease. This emphasises the need for such a product to carry the appropriate hazard warnings that I previously alluded to.

148. Further, I do not believe the procedures that Platts follows actually demonstrates that the wood types 03 01 05 are what they say they are if only a proportion of their sources have a guaranteed source content and they are essentially only checking for heavy metal contamination from the wood sources.

#### **Further concerns about the use of “treated” wood**

149. I am content that treated wood is exactly that, the opposite of untreated wood and that treatments include processes that add other products to wood fibres to make panel boards including particle (chip) board, plywood and medium density fibreboards. This is because our current guidance to Government colleagues such as NRW and the Environment Agency is that only untreated wood sources may be used in animal livestock bedding until as such time someone is able to prove that certain additives do not pose a risk to animals.

150. I have already alluded to examples such as adhesives used in the wood manufacturing industries but there are other “treatments” to wood that give cause to concern for animal welfare. And will refer to some of these.

#### **Lead**

151. Any painted wood products from buildings built prior to 1992 in the United Kingdom are likely to have lead-based contamination and there is extensive literature regarding lead toxicity in animals including cattle. However, despite this, lead toxicity is still one of the most common reported poisoning incidents picked up in passive surveillance (Payne & Livesey, 2010). Certain anti-corrosive treatments for metal may still contain lead. It should be noted that Platts Agriculture process for screening for and removing metals with magnetic trapping will not work for lead since lead is diamagnetic in its metal form, and not only is not attracted to magnets, but is actively repulsed from magnets when in its solid metal form.

152. APHA’s passive surveillance has picked up lead poisoning associated with the use of sawdust, as commented on by Dr Atkinson. Payne et al (2010) raised concerns about the risks of recycled treated

wood products where animal death was associated with high lead levels in bedding provided for cattle and poultry. It should be noted that the levels recorded in some carcasses were above the threshold for a human health risk in the offal and meat so this also becomes a significant food safety issue.

### **Phthalates**

153. Any modern painted products or veneered chipboards, typically used for indoor storage (eg kitchen / bedroom cabinets) are likely to contain PVC plasticisers which contain phthalates. Phthalates are esters of 1,2 benzenedicarboxylic (or phthalic) acid. Humans and animals are exposed to these compounds through ingestion, inhalation, and dermal exposure for their whole lifetime, including in utero before birth (Latini, 2004). Phthalates are animal carcinogens and can cause foetal death, malformations, testicular injury, liver injury, anti-androgenic activity, teratogenicity, peroxisome proliferation and especially reproductive toxicity, with the greatest concern relating to the hepatocarcinogenic effect and the developmental and reproductive effects (Latini, 2005). For this reason, they are banned in the production of childrens' toys, who are likely to put such objects in their mouths.
154. Di (Bis)-(2-ethylhexyl)-phthalate (DEHP) is the most commonly used plasticizer in PVC formulations for a wide variety of applications including building materials such as wallpaper and flooring; other uses includes non-polymer materials such as lacquers, paints, adhesives, fillers and printing inks (European Chemicals Bureau (ECB), 2008). Contamination from the environment of the dairy farm is suggested by the ECB (2008) as a possible source for contamination in dairy products. This is therefore a very real risk for their presence in the cubicle conditioner. Acceptable levels have been set at 0.05mg/kg in milk by some countries. Milk contamination is specific concern for children since 58% of their risk for DEHP exposure comes from dairy products, whereas for adults it is 24% (ECB, 2008).
155. Phthalates on the whole are perceived to have low toxicity associated with short-term acute exposure, except for some of the lower molecular weight phthalates such as diethyl phthalate (DEP) which can cause mild ear, nose and throat irritation (Olkowska et al., 2022).

156. However, it is chronic exposure that causes greatest concern, coupled with the fact that phthalates can be ingested, inhaled and, for the smaller phthalates, absorbed across the skin. Phthalates are described as Endocrine Disrupting Chemicals (EDCs). An EDC is an exogenous compound that affects particular aspects of the endocrine (hormonal) systems in wildlife and humans, inhibiting or stimulating synthesis, secretion, transport, metabolism, activity and elimination of endogenous hormones (Olkowska et al., 2022).
157. The impact of EDCs can result in obesity, diabetes, kidney and liver disorders, female and male reproductive system impairment, hormone sensitive cancers, thyroid and prostate gland disorders, neuro-developmental, neuro-endocrine and immunological effects (Lauretta et al., 2019). They are of even greater concern to humans and apex predators because the EDCs are lipophilic and accumulate in adipose tissue, this means that lifelong exposure to different EDCs can have additive or synergistic effects.
158. There is a high likelihood that the wood sources use will have phthalates in them, yet no tests are carried out on the final product. It is not mentioned by either Dr George Fisher or Dr Ivan Vince as an important contaminant.

### **Formaldehyde**

159. Formaldehyde, combined with urea to create a urea-formaldehyde resin, has been typically used to produce particleboards, including medium density fibreboard (MDF) and plywood. MDF for example, is a timber product made from hardwood and softwood fibres bonded with wax and a resin adhesive containing around 82% wood fibre 9% urea-formaldehyde, 8% water and 1% paraffin wax (Kozłowski & Helwig, 1996); however, some MDFs are now available that are considered low formaldehyde or no added formaldehyde (Cavallo et al., 2022). Other uses for formaldehyde are in paper production, coatings including in wood production but also for example in cosmetics and nail hardening products. Chip board or particle board typically may contain formaldehyde, carbon monoxide, hydrogen cyanide or phenol, content depending on the type of resin used during production.

160. Formaldehyde in solution is known as formalin and is used at approximately 5% strength as a disinfectant on farms and in footbaths; it is also used as a fumigant. It should be noted that formalin is not approved for use as a veterinary medicine and its use in footbaths is as biocide only.
161. Formaldehyde's toxic effects are mostly carcinogenic (Nielsen et al, 2017, Doung et al, 2011) as well as allergenic and increased obstructive respiratory conditions. There has also been an association with early embryonic death when exposed prior to mating, spontaneous abortion, increased foetal anomalies (i.e., cryptochordism and aberrant ossification centres), decreased concentrations of ascorbic acid in neonate, and abnormalities in enzymes of mitochondria, lysosomes, and the endoplasmic reticulum when rats were exposed to formaldehyde (Thrasher & Kilburn, 2001). Studies have shown impacts on fertility and foetal death / abnormalities in both humans and animals ( Duong et al, 2011)
162. Despite significant confounding of many earlier studies where exposure to wood dust and formaldehyde occurred concurrently, the latest reviews conclude that formaldehyde is carcinogenic to both humans and animals (IARC, 2012) and that in humans formaldehyde causes cancer of the nasopharynx and leukaemia. There is also a positive association between formaldehyde exposure and sinonasal cancer (IARC 2012). It can also cause breathing issues for people with conditions such as asthma and chronic obstructive pulmonary disease (COPD). Since January 1<sup>st</sup> 2016, formaldehyde has been classified as a group 1B carcinogen, meaning there are restrictions on its use and sale. It is only for professional use and can only be marketed by a registered supplier.

**Additional documents assessed on 21<sup>st</sup> March 2024**

**PEDW REF-CAS-02313-Z1D6V\$ NRW assessment**

163. This reiterates some of the issues I have already raised around sample evaluations and concerns around Fire Hazard management.

**Signed statement of common ground**

164. This summarises the issues at hand and does not change my opinion provided thus far.

### **AGR P013 Incoming Material Procedure**

165. This reiterates the inspection process on arrival. This does not change my position In respect to my concerns regarding lack of evaluation of the incoming wood sources and lack of evaluation of the final product and its various risks to animals and humans.

### **Platts Phenols etc / Platts sample data / Clean results by supplier i2lab – excel spreadsheet /Copy of Copy of results Platts Agriculture – excel spreadsheet**

166. I have only briefly looked at this due to time limits on this report to be produced and when I was provided with these documents at such late notice, I cannot fully assess potential risks. Whilst I would prefer more time to look at this and consider this carefully, ultimately these test result are meaningless in relation to the final product and its potential impact on the animals and humans coming into contact with it. I note Styrene was detected which does cause concern considering its toxic effect on animals causes acute respiratory tract irritation and central nervous system depression in addition to other identified issues such as reduced testicular function in males (GOV.UK, 2024)

167. As mentioned previously, a set of tests on some of the wood treated sources, and not others, that are carried out prior to any processing of the waste that is carried out by Platts' Agriculture, means we still do not know what the contaminant levels are in the final product. Platts' themselves state their process to produce the "conditioner", results in a much higher dry matter end-product and therefore we can expect the levels of these contaminants to be higher, once moisture has been removed.

168. Phenols obviously feature in much of the tests, because of the environmental impacts caused by phenols and concern around their discharge into the environment, including watercourses. Phenols (encompassing the whole range of phenolic compounds) have different properties according to their type.

169. Obviously, there are certain woods that produce high levels of phenols naturally, including pine and cedar (the smell we associate with pine is down to the phenolic compounds in these woods). The extracts have various uses, including in disinfectants. There are requirements associated with processing the original wood to reduce phenolic content. Therefore, even untreated wood sources

may have a high phenol content and have anecdotally been associated with irritation and skin conditions in small companion animals, including hamsters and rabbits for example. However, some phenols are used as food additives. Therefore, the knowledge base on phenols and their contrasting negative and positive impacts on animal health and welfare is limited and our understanding around their uses, from an animal health and welfare perspective, is still growing.

## Summary

170. I have provided just some examples of potential issues with the cubicle conditioner produced by Platts Agriculture and the potential risks to animals, to farmers working with the cubicle conditioner and potential issues with both milk and meat contamination, including the effects of acute/chronic exposure to contaminants as well as acute exposure to the dust (humans and animals) and the fire hazard risk. These examples are just examples, without a full understanding of ALL the treatment processes and products that are used by the primary suppliers of the wood then I cannot possibly cover all possible risks to animals with these various unknowns.
171. The key issue is that Platts Agriculture are marketing a product based on wood sources that have received various treatments, that these treatments are not documented anywhere as far as I have been made aware, and that these substances have the potential to cause illness and death to the animals they come in contact with and that there is no indication of this risk on the product they are selling to the livestock industry.
172. The contaminants also have the potential to enter the milk and meat from these animals and therefore there is an additional human food safety issue. As an authorised inspector for the Secretary of State (England, Wales and Scotland) I will be duly obliged to report these concerns to both the local authority in regards to any regulatory action that may need to be taken in relation to how Platts Agriculture are advertising and selling certain products and to the Food Standards Agency regarding the food safety concerns, especially if large numbers of dairy farmers are using this and similar

products being marketed and sold across Great Britain to the farming sector, and specifically to dairy farms, as Platts Agriculture have stated.

173. The risk associated with exposure to the various toxins is increased when the wood source products are broken down - which is exactly what is done when creating the “conditioner”. The appellants describe pulverisation and collection of all the product, including the dust, for use as the cubicle conditioner. They describe no other process to purify the product / extract toxins and indeed the inclusion of the minute dust particles in the “conditioner” poses a significant health risk to animals and humans alike when used (Thetkathuek et al, 2021, Murphy, 2011)
174. Platts Agriculture are carrying out no analysis of the final product, which is likely to have a 50% higher dry matter content than the source waste which will concentrate levels of any wood treatments, which means that they could potentially be marketing products that are neither safe to the animals nor safe to the farmers working with it. This means any partial testing of source materials really has no bearing on what is actually in the final product.
175. On this basis, I believe that the conditioner carries significant risks directly in relation to animal and human health and indirectly with regards to food safety (milk and meat) and must not be used as in the food producing or any other associated animal industry (e.g. equine, poultry, small animal etc) until it can be demonstrated that such a product is safe to use. The variation in treated wood sources carries significant concern, because it means that one batch of conditioner may have quite different contaminants to another, which means rigorous quality assurance process would be required to assure any purchaser or retailer that the product is safe.

## References

APHA (2017) Conditions of Use in Relation to the Use of Recycled Manure Solids as Bedding for Dairy Cattle. Produced by the Animal and Plant Health Agency (APHA) Available from:

-  
[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/5852](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/5852)

[81/guid-](#)

[ab143.pdf#:~:text=Unless%20TB%20is%20advanced%20in%20an%20animal%2C%20there,reachin%20this%20stage%20of%20infectivity%20are%20much%20reduced.](#) [Accessed 20th September 2023]

Akter, S., Rahman, M.A., Naher, J., Majumder, MWR, Alam, AKMN Fish glue from tilapia scale and skin and its physical and chemical characters Int. J. Fish. Aquat. Stud. (2017), pp. 255-257

Basinas I, Sigsgaard T, Kromhout H, Heederik D, Wouters IM, Schlunssen V. A comprehensive review of levels and determinants of personal exposure to dust and endotoxin in livestock farming. J Exposure Sci Environ Epidemiol. 2015;25(2):123–37.

BBC (2021a) Bosley Mill: Fine for owner over explosion which killed four people BBC On line. Available from: <https://www.bbc.co.uk/news/uk-england-stoke-staffordshire-57528427> [Accessed 2<sup>nd</sup> October 2023]

BBC (2021b) Bosley Mill bosses 'may not have understood blast risk' BBC online. Available from: <https://www.bbc.co.uk/news/uk-england-55824015> [Accessed 2<sup>nd</sup> October 2023]

Cavallo D, Fresegha AM, Ciervo A, Ursini CL, Maiello R, Del Frate V, Ferrante R, Mabilia R, Pizzo B, Grossi B, Ciccio P, Ciccio P, Iavicoli S. New formaldehyde-free adhesives for wood manufacturing: In vitro evaluation of potential toxicity of fine dust collected during wood sawing using a new experimental model to simulate occupational inhalation exposure. Toxicology. 2022 Jan 30;466:153085.

Clemons, C. M. & Caufield, D.F. Chapter 15 Wood Flour. (2005) In: Functional Fillers for Plastics; Edited by Marino Xantho. WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim

DEFRA (2003) The Codes of Recommendation for the Welfare of Livestock: Cattle Available from:

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/69368/pb7949-cattle-code-030407.pdf?msckid=ca7cb622cf9911ecbb00da8b1ff8fe2a](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/69368/pb7949-cattle-code-030407.pdf?msckid=ca7cb622cf9911ecbb00da8b1ff8fe2a)

[Accessed 1<sup>st</sup> October 2023]

Duong A, Steinmaus C, McHale CM, Vaughan CP, Zhang L. Reproductive and developmental toxicity of formaldehyde: a systematic review. *Mutat Res.* 2011 Nov-Dec;728(3):118-38

EFSA (2009a) Scientific opinion on welfare of dairy cows in relation to leg and locomotion problems based on a risk assessment with special reference to the impact of housing, feeding, management and genetic selection Scientific Opinion of the Panel on Animal Health and Animal Welfare (Question No EFSA-Q-2008-337) Adopted on 05 June 2009, *The EFSA Journal* (2009) 1142, 1-57

EFSA (2009b) Scientific opinion on welfare of dairy cows in relation to udder problems based on a risk assessment with special reference to the impact of housing, feeding, management and genetic selection. Scientific Opinion of the Panel on Animal Health and Animal Welfare (Question No EFSA-Q-2008-338) Adopted on 05 June 2009. *The EFSA Journal* (2009) 1141, 1-60

EFSA (2019) Update of the risk assessment of 'wood flour and fibres, untreated' (FCM No 96) for use in food contact materials, and criteria for future applications of materials from plant origin as additives for plastic food contact materials. *EFSA Journal* 2019;17(11):5902.

EFSA (2023) EFSA Panel on Animal Health and Animal Welfare (AHAW), Welfare of Dairy cows. *EFSA Journal* 2023; 21(5):7993

Eisenberg SW, Chuchaisangrat R, Nielen M, Koets AP. Relationship between presence of cows with milk positive for *Mycobacterium avium* subsp. *paratuberculosis*-specific antibody by enzyme-linked

immunosorbent assay and viable *M. avium* subsp. *paratuberculosis* in dust in cattle barns. *Appl Environ Microbiol.* 2013 Sep;79(18):5458-64.

European Chemicals Bureau (2008) European Union Risk Assessment Report: bis(2-ethylhexyl)phthalate (DEHP) CAS No: 117-81-7 EINECS No: 204-211-0

Faraca G., Boldrin A., Astrup T. Resource Quality of Wood Waste: The Importance of Physical and Chemical Impurities in Wood Waste for Recycling. *Waste Manag.* 2019;87:135–147.

Filazi A, Sireli UT, Ekici H, Can HY, Karagoz A. Determination of melamine in milk and dairy products by high performance liquid chromatography. *J Dairy Sci.* 2012 Feb;95(2):602-8.

Fischer, W.J. & Schilter, Benoit & Tritscher, Angelika & Stadler, Richard. (2011). Contaminants of Milk and Dairy Products: Contamination Resulting from Farm and Dairy Practices. *Encyclopedia of Dairy Sciences.* 887-897. 10.1016/B978-0-12-374407-4.00104-7.

Frihart, C.R.; Lorenz, L.F. Protein adhesives. In *Handbook of Adhesive Technology*, 3rd ed.; CRC Press: Boca Raton, FL, USA, 2017; pp. 145–176.

Freeman, L.E.B.; Blair, A.A.; Lubin, J.H.; Stewart, P.A.; Hayes, R.B.; Hoover, R.N.; Hauptmann, M. Mortality From Solid Tumors Among Workers in Formaldehyde Industries: An Update of the NCI Cohort. *Am. J. Ind. Med.* 2013, 56, 1015–1026.

Gadhav R.V., Mahanwar P.A., Gadekar P.T. Starch-Based Adhesives for Wood/Wood Composite Bonding: Review. *Open J. Polym. Chem.* 2017;7:19–32. doi: 10.4236/ojpcem.2017.72002.

Gardner, DJ., Han, Y., Wang, L. (2015) Wood–Plastic Composite Technology in Wood structure and function ( S Hizoroglu section editor) *Curr Forestry Rep* (2015) 1:139–150

Golden, R. Identifying an indoor air exposure limit for formaldehyde considering both irritation and cancer hazards. *Crit. Rev. Toxicol.* 2011, 41, 672–721.

GOV.UK (2024) Styrene . Toxicological Overview. Available from:

[https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment\\_data/file/338268/HPA\\_STYRENE\\_Toxicological\\_Overview\\_v1.pdf](https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/338268/HPA_STYRENE_Toxicological_Overview_v1.pdf) Accessed 22nd March 2024

Gleeson, D. (2013) Evaluation of hydrated lime as a cubicle bedding material on the microbial count on teat skin and new intramammary infection. *Irish Journal of Agricultural and Food Research* 52: 159–171, 2013

Gonçalves D, Bordado JM, Marques AC, Galhano Dos Santos R. Non-Formaldehyde, Bio-Based Adhesives for Use in Wood-Based Panel Manufacturing Industry-A Review. *Polymers (Basel)*. 2021 Nov 24;13(23):4086.

GOV.UK (2023) Landspreading: benefits and risks of the waste types you can use. Available from:

<https://www.gov.uk/guidance/landspreading-benefits-and-risks-of-the-waste-types-you-can-use/03-waste-codes> [Accessed 15th September 2023]

Giuliani A, Zuccarini M, Cichelli A, Khan H, Reale M. Critical Review on the Presence of Phthalates in Food and Evidence of Their Biological Impact. *Int J Environ Res Public Health*. 2020 Aug 5;17(16):5655.

Health and Safety Executive (2023) Safe collection of wood waste: Prevention of fire and explosion HSE leaflet . Available from: <https://www.hse.gov.uk/pubns/wis32.pdf> [Accessed 1st October 2023]

Health & Safety Executive. Control of substances hazardous to health. The Control of Substances Hazardous to Health Regulations 2002 (as amended) Available from: <https://www.hse.gov.uk/pubns/priced/l5.pdf>  
[Accessed 1st October 2023]

Holm SE, Festa JL. A Review of Wood Dust Longitudinal Health Studies: Implications for an Occupational Limit Value. Dose Response. 2019 Feb 28;17(1):1559325819827464.

Hussin, MH., Latif, NHA, Hamidon, TS., Idris, NN., Hashim, R., Appaturi, JN., Brosse, N., Ziegler-Devin, I., Chrusiel, L., Fatriasari, W., Syamani, FA., Iswanto, AH., Hua, LS., Edrus, SSAOA, Lum, WC., Antov, P., Savov, V., Lubis, MAR., Kristak, L., Reh, R., Sedliačik, J. (2022) Latest advancements in high-performance bio-based wood adhesives: A critical review, Journal of Materials Research and Technology, Volume 21, 2022, Pages 3909-3946, ISSN 2238-7854

International Agency for Research on Cancer (IARC) IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol. 62. Wood dust and Formaldehyde. Lyon, France: IARC (International Agency for Research on Cancer; ); 1995.

International Agency for Research on Cancer (IARC) Chemical agents and related occupations volume 100 F A review of human carcinogens. IARC monographs on the evaluation of carcinogenic risks to humans IARC, Lyon, France: IARC (International Agency for Research on Cancer; ) 2012

Kalo D, Hadas R, Furman O, Ben-Ari J, Maor Y, Patterson DG, Tomey C, Roth Z. Carryover Effects of Acute DEHP Exposure on Ovarian Function and Oocyte Developmental Competence in Lactating Cows. PLoS One. 2015 Jul 8;10(7):e0130896.

Kingsley E. Residues Becoming a Problem for Northeastern Mills. Available from: <https://www.forest2market.com/blog/residues-becoming-a-problem-for-northeastern-mills> [Accessed on 21st September 2023]

Kozłowski, R., and M. Helwig, (1996), Critical Look on Cellulose Modification. Proc. of the Intern. Symposium on Cellulose Modification. December, Honolulu, USA

Latini G, De Felice C, Verrotti A. Plasticizers, infant nutrition and reproductive health. *Reprod Toxicol.* 2004 Nov;19(1):27-33.

Latini G. Monitoring phthalate exposure in humans. *Clin Chim Acta.* 2005 Nov;361(1-2):20-9.

Lauretta, R., Sansone, A., Sansone, M., Romanelli, F., & Appetecchia, M. (2019). Endocrine disrupting chemicals: effects on endocrine glands. *Frontiers in endocrinology*, 10, 178.

Li, X.; Zhou, Y.; Li, J.; Li, K.; Li, J. Perm-Inspired High-Performance Soy Protein Isolate and Chicken Feather Keratin-Based Wood Adhesive without External Crosslinker. *Macromol. Mater. Eng.* 2021, 1–8.

Murphy TW The effects of individual and combinations of airborne pollutants on feed intake, immune function and physiology of the pig Thesis for Dr of Philosophy Decmebr 2011, University of Adelaide

Nielsen GD, Larsen ST, Wolkoff P. Re-evaluation of the WHO (2010) formaldehyde indoor air quality guideline for cancer risk assessment. *Arch Toxicol.* 2017 Jan;91(1):35-61.

Olkowska E, Gržinić G. Skin models for dermal exposure assessment of phthalates. *Chemosphere.* 2022 May;295:133909.

Payne, J., Otter, A., Cranwell, M., Jones, J., Wessels, M. and Whitaker, K. (2008), Lead poisoning associated with recycled wood products. *Veterinary Record*, 162: 191-192.

Payne, J. and Livesey, C. (2010), Lead poisoning in cattle and sheep. *In Practice*, 32: 64-69

Pokhrel G, Han Y, Gardner DJ. Comparative Study of the Properties of Wood Flour and Wood Pellets Manufactured from Secondary Processing Mill Residues. *Polymers (Basel)*. 2021 Jul 28;13(15):2487.

Raydan, NDV, Leroyer L, Charrier B, Robles E. Recent Advances on the Development of Protein-Based Adhesives for Wood Composite Materials-A Review. *Molecules*. 2021 Dec 15;26(24):7617.

Reineke, L. H., Wood Flour, U.S. Forest Service Research Note FPL-0113, USDA Forest Service, Forest Products Laboratory, Madison, WI, USA, 1966, 13 pages.

Red Tractor (2021) Cattle and Sheep Bedding Materials (Dairy, Beef and Lamb). Available from: <https://redtractorassurance.org.uk/wp-content/uploads/2021/08/Cattle-and-Sheep-Bedding-Materials.pdf>  
[Accessed 20th September 2023]

Pokhrel G, Han Y, Gardner DJ. Comparative Study of the Properties of Wood Flour and Wood Pellets Manufactured from Secondary Processing Mill Residues. *Polymers (Basel)*. 2021 Jul 28;13(15):2487.

Sigsgaard, T., Basinas, I., Doekes, G. et al. Respiratory diseases and allergy in farmers working with livestock: a EAACI position paper. *Clin Transl Allergy* 10, 29 (2020).

Straif, K., Lamia Benbrahim-Tallaa, L., Baan, R., Grosse, Y., Secretan, B., El Ghissassi, F., Bouvard, V., Guha, N., Freeman, C., Galichet, L., Coglianò, V. (2009) Special Report: Policy A review of human carcinogens—Part C: metals, arsenic, dusts, and fibres. *The Lancet / oncology*. Volume 10 (2009) p 453-454.

Thetkathuek A, Yingratanasuk T, Ekburanawat W, Jaidee W, Sa-Ngiamsak T. The risk factors for occupational contact dermatitis among workers in a medium density fiberboard furniture factory in Eastern Thailand. *Arch Environ Occup Health*. 2021;76(5):255-265.

Thrasher, J.D., & Kilburn, K.H. (2001) Embryo Toxicity and Teratogenicity of Formaldehyde, *Archives of Environmental Health: An International Journal*, 56:4, 300-311

Trading Standards Wales (2023) Unfair Trading Practices Available from: <https://tradingstandards.gov.wales/en/consumer-advice/detail/InDispute/322634/Unfair-trading-practices/#:~:text=The%20Regulations%20include%20a%20list%20of%20commercial%20practices,sets%20out%20the%20banned%20practices%20in%20more%20detail>. [Accessed 20th September 2023]

Urso, P.M., Turgeon, A., Ribeiro, F.R.B., Smith, Z.K., Johnson, B.J. (2021) Review: the effects of dust on feedlot health and production of beef cattle, *Journal of Applied Animal Research*, 49:1, 133-138

Welsh Government Code of Practice for the Welfare of Livestock: Cattle (2010) Available from: <https://www.gov.wales/sites/default/files/publications/2020-11/welfare-of-cattle-code-of-practice.pdf> [Accessed 20<sup>th</sup> September 2023]

Woolums AR. Feedlot Acute Interstitial Pneumonia. *Vet Clin North Am Food Anim Pract*. 2015 Nov;31(3):381-9, vi.

World Health Organization (WHO) (2010) WHO Guidelines for indoor air quality: selected pollutants. [online] Available from: <https://www.who.int/publications/i/item/9789289002134> [Accessed 20th September 2023]

WRA (2021) Waste Wood Assessment Guidance for the UK

Waste Wood Industry Available from: <https://woodrecyclers.org/wp-content/uploads/WRA-Waste-Wood-Assessment-Guidance-July-2021-V1.pdf> [Accessed 20th September 2023]

Wang, CC., Wu, JP. (2012) Preparation and characterization of adhesive from spent hen proteins

Int J Adhesion Adhes, 36 (2012), pp. 8-14

Zhou, Y.; Zeng, G.; Zhang, F.; Luo, J.; Li, X.; Li, J.; Fang, Z. Toward Utilization of Agricultural Wastes: Development of a Novel Keratin Reinforced Soybean Meal-based Adhesive. ACS Sustain. Chem. Eng. 2021, 9, 22.

I confirm that the contents of this report are true to the best of my knowledge and belief and that I make this report knowing that, if it is tendered in evidence, I would be liable to prosecution if I have wilfully stated anything which I know to be false or that I do not believe to be true.

SIGNED

A solid black rectangular box used to redact the signature of the author.

DR SOPHA HEPPLÉ

DATE: 22<sup>nd</sup> March 2023