Powys County Council

ABERMULE BUSINESS PARK AND RECYCLING BULKING FACILITY

Noise impact assessment

70032991-NV1-02-R1
JUNE 2018

PUBLIC

Powys County **Council**

ABERMULE BUSINESS PARK AND RECYCLING BULKING FACILITY

Noise impact assessment

PRE-APPLICATION SUMMARY REPORT (VERSION 1) PUBLIC

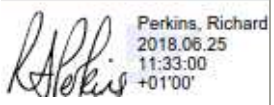
PROJECT NO. 70032991
OUR REF. NO. 70032991-NV1-02-R1

DATE: JUNE 2018

WSP
Kings Orchard
1 Queen Street
Bristol
BS2 0HQ
Phone: +44 117 930 2000

WSP.com

QUALITY CONTROL

Issue/revision	First issue	Revision 1	Revision 2	Revision 3
Remarks	Version 1	Version 2		
Date	11/06/2018	22/06/2018		
Prepared by	Michael Lotinga	Michael Lotinga		
Signature				
Checked by	Pete Bushell	Pete Bushell		
Signature				
Authorised by	Richard Perkins	Richard Perkins		
Signature				
Project number	70032991	70032991		
Report number	70032991-NV1-02	70032991-NV1-02-R1		

LIMITATIONS TO THIS REPORT

This report has been prepared for the titled project or named part thereof and should not be used in whole or part and relied upon for any other project without the written authorisation of WSP UK Limited. WSP UK Limited accepts no responsibility or liability for the consequences of this document if it is used for a purpose other than that for which it was commissioned. Persons wishing to use or rely upon this report for other purposes must seek written authority to do so from the owner of this report and/ or WSP UK Limited and agree to indemnify WSP UK Limited for any and all loss or damage resulting therefrom. WSP UK Limited accepts no responsibility or liability for this document to any other party other than the person by whom it was commissioned.

The findings and opinions expressed are relevant to the dates of the site works and should not be relied upon to represent conditions at substantially later dates. Opinions included therein are based on information gathered during the study and from our experience. If additional information becomes available which may affect our comments, conclusions or recommendations WSP UK Limited reserve the right to review the information, reassess any new potential concerns and modify our opinions accordingly.

CONTENTS

TABLES

FIGURES

APPENDICES

EXECUTIVE SUMMARY

This report documents the assessment of potential noise impact and acoustic mitigation design measures for the proposed Recycling Bulking Facility and business units at Abermule Business Park.

The assessment addresses the following environmental issues associated with the proposal:

- Noise emissions from the commercial operation of the site, as developed according to the application, affecting existing off-site noise-sensitive receptors located nearby
- Noise from existing road and railway sources affecting the intended use of the proposed business units
- Noise emissions from the proposed recycling facility affecting the intended use of the proposed business units
- Vibration from the existing railway affecting the intended use of the proposed business units

The following recommended noise mitigation measures have been included in the assessment of the Recycling Bulking Facility design:

Measure	Details
Restriction on bay door opening	Two of the five doors will be kept shut during operation
Sound absorptive materials to be added to processing shed interior	1092m^2 Class A sound absorptive panels to be installed; acoustic performance specified in Table 17.
Relocation of glass deposit	Moved approx. 25 m southeast further away from Bryn-y-Maes
Installation of local noise barrier at Bryn-y-Maes	2.8 m high, minimum surface mass 10 kgm^{-2}, location and extent shown in Figure 7. Powys Council ownership of the Bryn-y-Maes property enables this measure to be included in the mitigation scheme.

Adoption of the above mitigation measures is expected to minimise the risk of any adverse effects at off-site receptors generated by noise from the Facility.

The potential impact of noise from the business units to off-site receptors could be controlled via planning condition under the reserved matters consent. A suitable condition would require a further noise impact assessment and design to include consideration of the combined impact of noise from the units and the Recycling Bulking Facility. The information in this report could be used to inform such assessments – recommendations have been provided in section 4.2 for possible noise limit strategies that could be used to ensure the overall noise is controlled to acceptable levels.

The ingress of noise generated by the Recycling Bulking Facility and the existing road and railway sources nearby to the business units has been assessed. Recommendations have been provided in section 4.2 for minimum building envelope sound insulation performances expected to achieve suitable indoor levels in office spaces. As a primarily commercial concern, it is not considered necessary to control this aspect via condition, but the information in this report could be used to develop a suitable design.

An assessment of the potential for tactile vibration from the railway line to adversely affect use of the business units indicates the risk is negligible.

The noise impact and acoustic design of the development has been assessed and recommendations made to ensure suitability. Subject to the recommendations in this report, the proposed development is considered acceptable with regards to acoustics, noise and vibration.

1 INTRODUCTION

1.1 DOCUMENT SCOPE

1.1.1. This report documents the assessment of potential noise impact and acoustic mitigation design measures for the proposed Business Park and Recycling Bulking Facility at the site near Abermule. A glossary of acoustical terminology is included in Appendix A.

1.2 DEVELOPMENT DESCRIPTION

1.2.1. The development proposal comprises two different uses:

1. A recycling bulking facility for kerbside collections, including vehicle washdown, refuelling, manoeuvring and parking areas with space for 32 staff vehicles – hours of operation 0600-1800hrs Mon-Fri (activity hours 0630-1615hrs Mon-Fri)
2. Business/employment units to accommodate office and/or light industrial uses, including parking and delivery areas – expected hours 0600-2000hrs Mon-Sun.

1.2.2. The recycling facility is considered primarily a noise-generating activity, while the business units can be considered both noise-generating (servicing plant, vehicles) and noise-sensitive in work areas requiring a degree of concentration, such as offices.

1.3 ASSESSMENT SCOPE AND LIMITATIONS

1.3.1. This assessment addresses the following potential environmental issues associated with the proposal:

- Noise emissions from the commercial operation of the site, as developed according to the application, affecting existing noise-sensitive receptors located nearby
- Noise from existing road and railway sources affecting the intended use of the proposed business units
- Noise emissions from the proposed recycling facility affecting the intended use of the proposed business units
- Vibration from the existing railway affecting the intended use of the proposed business units

1.3.2. We are advised this hybrid application is for full planning consent for the Recycling Bulking Facility, and for reserved matters consent on the business/employment units. This assessment is based on the design information provided to us during the pre-application stage and does not take account of any subsequent design development or amendments that may affect noise impact.

1.3.3. Since specific intended uses have not yet been assigned for the business/employment units, control of noise impact from the units is considered by identifying suitable operational noise limits. The noise impact from the business/employment uses would be expected to be adequately controllable via planning conditions requiring submission of further noise impact assessment information when the specific uses are proposed and noise sources known. Elevation heights of the proposed business units are assumed to be two-storey for the purpose of this assessment (ie ~7 m).

1.3.4. The scheme is intended to be constructed on a phased basis, as set out in the Development Phasing Plan submitted within the application. This assessment addresses the long term noise impact expected when the site is fully developed.

1.4 SITE DESCRIPTION

1.4.1. Annotated satellite photography of the site is shown in Figure 1. The site is situated in an area of predominantly agricultural and rural land on the outskirts of Abermule. The site is bounded to the northwest by the A483, from which the B4386 branches and forms the boundary for the central north section of the site perimeter. The south of the site is bounded by the Cambrian Line railway between Newtown and Shrewsbury. The nearest residential/noise-sensitive receptors are the farmhouses of Bryn-y-Maes and Maesderwen, and the dwellings on Court Close. It is noted that the Bryn-y-Maes and Maesderwen properties are owned by Powys Council.

1.4.2. The stretch of the A483 adjacent to the site is a busy single-carriageway road; Department for Transport traffic count figures for 2016 indicate an Annual Average Daily Traffic (AADT) flow of 11,207 vehicles, 9% of which are classified as heavy vehicles[1]. As described in section 3 and the associated site survey information, traffic noise from the A483 dominates the daytime sound environment around Bryn-y-Maes and the western portion of the development site. In the eastern portion of the site towards Maesderwen and Court Close, the sound climate is less affected by the A483 road noise and instead is punctuated by local traffic on the B4386, occasional trains on the Cambrian Line, irregular aircraft movements, agricultural industrial activity, typical neighbourhood activity noises (such as domestic animals and machinery), and natural ambient sounds such as birdsong and wind/vegetation interaction.

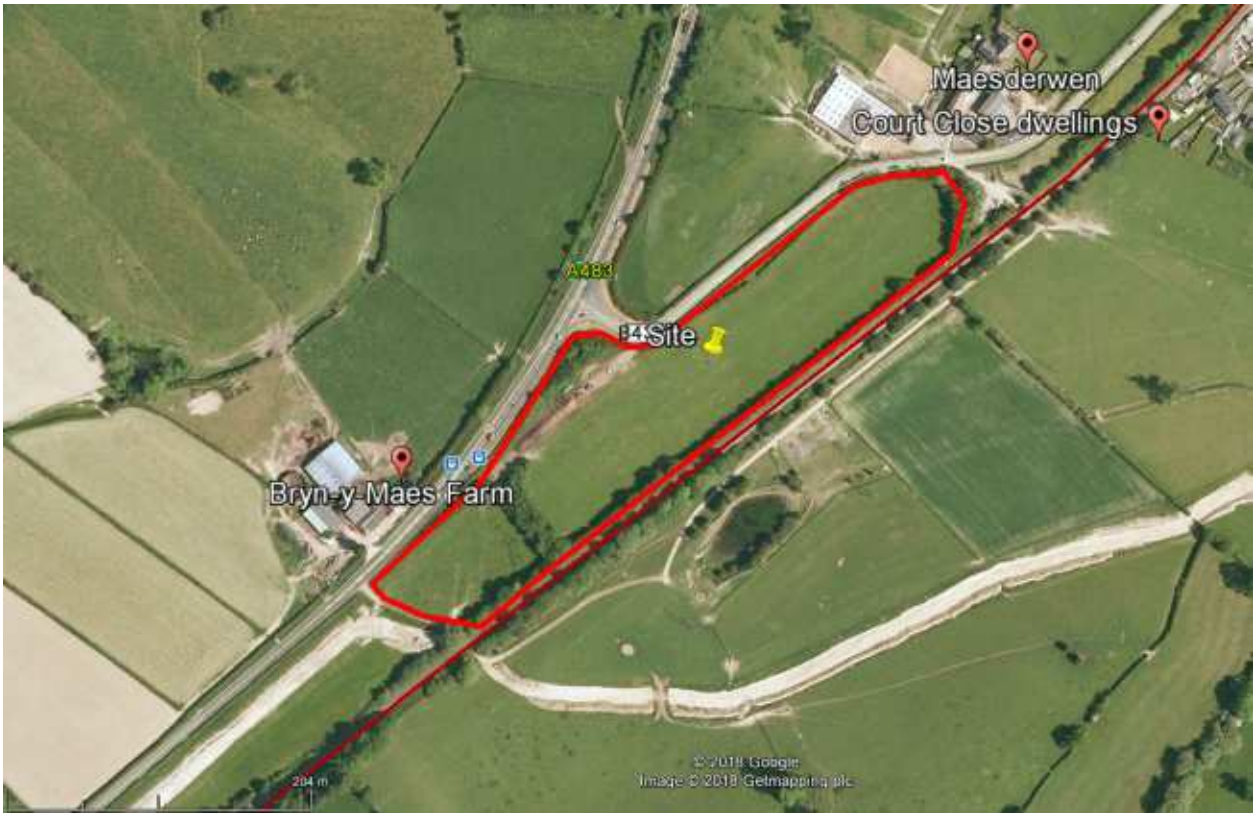


Figure 1: Annotated satellite photo of development site (red line: boundary; brown line: Cambrian railway)

1.5 STAKEHOLDER ENGAGEMENT

1.5.1. Powys Council Environmental Health has been consulted on the approach to the assessment and survey methodology, which is described below.

1.5.2. The tenants occupying Bryn-y-Maes and Maesderwen were consulted on the local siting of measurement equipment. The occupant of Bryn-y-Maes has also been consulted by Powys Council on potential noise mitigation measures.

[1] https://www.dft.gov.uk/traffic-counts/cp.php?la=Powys#30557

2 METHODOLOGY

2.1 RELEVANT POLICY AND GUIDANCE

2.1.1. In developing the adopted methodology, the following policy and guidance has been considered.

NATIONAL POLICIES

2.1.2. Planning Policy Wales (Welsh Government, 2016) sets out current national policy for development plans and decisions. Section 12.5 sets out specific policy guidance concerning waste management development proposals, while management of general environmental noise pollution is addressed in Chapter 13.

2.1.3. Planning Policy Wales (PPW) also advises reference to supplementary Technical Advice Notes (TANs); relevant TANs include TAN 11: Noise and TAN 21: Waste (discussed below).

2.1.4. TAN 11 (Welsh Government, 1997) gives specific guidance on both noise-generating and noise-sensitive developments. TAN 11 advises that noise from industrial or commercial development can be assessed using the method in BS 4142 (discussed below). It also suggests reference to BS 8233 and BS 6472 (also discussed below) with regards to ensuring suitable levels of noise and vibration, respectively.

2.1.5. TAN 21 (Welsh Government, 2014) provides guidance on development planning for waste management and includes advice on control of noise. TAN 21 states that noise assessments should be undertaken in accordance with BS 4142, and BS 5228-2 as appropriate. TAN21 also confirms that the setting of noise limits can be used to control impacts, and limits should be set at sensitive receptor locations.

LOCAL POLICIES

2.1.6. The adopted Powys Local Development Plan (LDP) 2011-2026 (Powys County Council, 2018) includes under Policy DM13, 'Design and Resources', the statement that developments will be permitted where they comply with (amongst other things) clause 11:

> *The amenities enjoyed by the occupants or users of nearby or proposed properties shall not be unacceptably affected by levels of noise, dust, air pollution, litter, odour, hours of operation, overlooking or any other planning matter.*

2.1.7. The LDP also includes under Policy W2, 'Waste Management Proposals', the statement that waste management developments will be permitted where they comply with (amongst other things) clause 3:

> *There would be no adverse impact on amenity, human health or the environment due to noise, dust, odour or air quality.*

TECHNICAL STANDARDS

2.1.8. BS 4142:2014 (BSI, 2014a) defines a method for rating and assessing the noise impact of industrial or commercial noise sources. The assessment is undertaken by comparing the noise level emitted by a specific source to the background sound level at a receptor location. Depending on the characteristics of the source, penalty adjustments can be applied to represent the subjective prominence of the noise at the receptor location. This 'rating level' is compared to the background sound level at the receptor in the absence of the source operation. An initial estimate of the impact of the noise source is obtained by determining the arithmetic difference between the rating and background levels, as shown in Table 1.

Table 1: BS 4142:2014 Criteria for description of noise impact estimate

Level difference, rating level minus background level	Impact estimate
Around 10 dB or more	Likely to be an indication of a significant adverse impact, depending on the context.
Around 5 dB	Likely to be an indication of an adverse impact, depending on the context.
Around 0 dB (similar levels)	An indication of the specific sound source having a low impact, depending on the context.

2.1.9. Contextual factors that are considered relevant to a BS 4142 assessment include: the absolute level of the noise, the character and level of the existing ambient sound, the expected sensitivity of receptors and available mitigation.

2.1.10. BS 8233:2014 (BSI, 2014b) provides guidance on the design of buildings with respect to controlling noise transmission and ensuring a suitable internal acoustic environment. In relation to offices, BS 8233 advises indoor noise level design ranges as shown in Table 2.

Table 2: 8233:2014 Criteria for indoor noise in offices

Room type	Noise level design range
Open plan shared	45 to 50 dB $L_{Aeq,T}$
Meeting room	35 to 45 dB $L_{Aeq,T}$
Executive office	35 to 40 dB $L_{Aeq,T}$

2.1.11. BS 8233 also advises that guidance for office acoustic design can be obtained from the British Council for Offices (discussed below).

2.1.12. BS 6472-1:2008 (BSI, 2008) provides a method for assessing the potential impact of whole-body tactile vibration for typical sources, including railways. The standard advises on vibration dose values (VDVs) expected to correspond with a given probability of 'adverse comment' (ie subjective disturbance); the guidelines for offices are shown in Table 3.

Table 3: BS 6472-1:2008 Vibration dose value ranges for probability of adverse comment in offices

Place and time	Low Probability	Adverse comment possible	Adverse comment Probable
Offices, daytime period 0700-2300hrs	0.4 to 0.8 $ms^{-1.75}$	0.8 to 0.16 $ms^{-1.75}$	0.16 to 3.2 $ms^{-1.75}$

2.1.13. BS 7445-1:2003 (BSI, 2003) and BS 7445-2:1991 (BSI, 1991) provide general guidance on environmental noise measurements and surveying practice.

FURTHER GUIDANCE

Engagement with Powys Council Environmental Health

2.1.14. Engagement activity with Powys Council Environmental Health Department indicated that a noise impact rating level of no more than 5 dB above the background level should be considered as the limit of acceptability.

2.1.15. Further consultation with Powys Environmental Officers has indicated that predicted noise emissions could also be compared with World Health Organisation guideline threshold values for noise, which are found in the current Guidelines for Community Noise (WHO, 1999) and the Night Noise Guidelines for Europe (WHO, 2009). These guidelines are based on reviews of the evidence for adverse health effects from noise exposure, and propose threshold values for a range of potential effects, including annoyance and sleep disturbance.

2.1.16. For noise affecting outdoor residential areas used for amenity, the 1999 Guidelines suggest that noise limited to levels of no more than 50 dB $L_{Aeq,T}$ may protect the majority of people from *moderate* annoyance, while limits of up to 55 dB $L_{Aeq,T}$ might protect the majority from *serious* annoyance. It should be noted that much of the research evidence underpinning the guidelines relating to annoyance responses elicited in residential areas is from studies that primarily investigated the effects of transportation noise sources, and extension of these values to commercial and industrial noise must be viewed with some caution.

2.1.17. Similarly, a range of threshold values for potential adverse effects of noise on sleep are provided in both the 1999 Guidelines and the 2009 Night Noise Guidelines (NNG). The 1999 Guidelines propose a limit of 30 dB $L_{Aeq,8h}$ *inside* sleeping areas at night to avoid negative effects on sleep, while the 2009 NNG suggest that average annual levels *outside* dwellings during night-time should be limited to 40 dB $L_{Aeq,8h(yr\ mean)}$ to protect public health.

2.1.18. It should be noted that the above WHO guideline values are considered as effects onset thresholds, ie values at which specified effects may begin to become noticeable in some people; they should not be interpreted as 'trigger' values. The guidelines also reflect the state of knowledge and study data available at the time of the reviews of the evidence on which they are based. A revised set of Environmental Noise Guidelines for the European Region is expected to be published in 2018, and the evidence reviews supporting this revision have already been published[2].

2.1.19. Exposure-response relationships (ERRs) for annoyance related to industrial noise have been derived from study data gathered in the Netherlands and analysed in research published more recently than the 1999 WHO Guidelines (Miedema & Vos, 2004). Comparison of the relationship between the proportions of people expected to be 'highly annoyed' due to exposure to a range of industrial noise sources[3] indicates that this is very similar to the ERR for aircraft noise derived in recent research conducted on behalf of the Department for Transport (CAA, 2017). These relationships are compared in Figure 2[4], which illustrates that around 6% of people might be expected to be highly annoyed by industrial noise levels of 50 dB $L_{Aeq,16h}$, increasing to around 11% of people at 55 dB $L_{Aeq,16h}$.

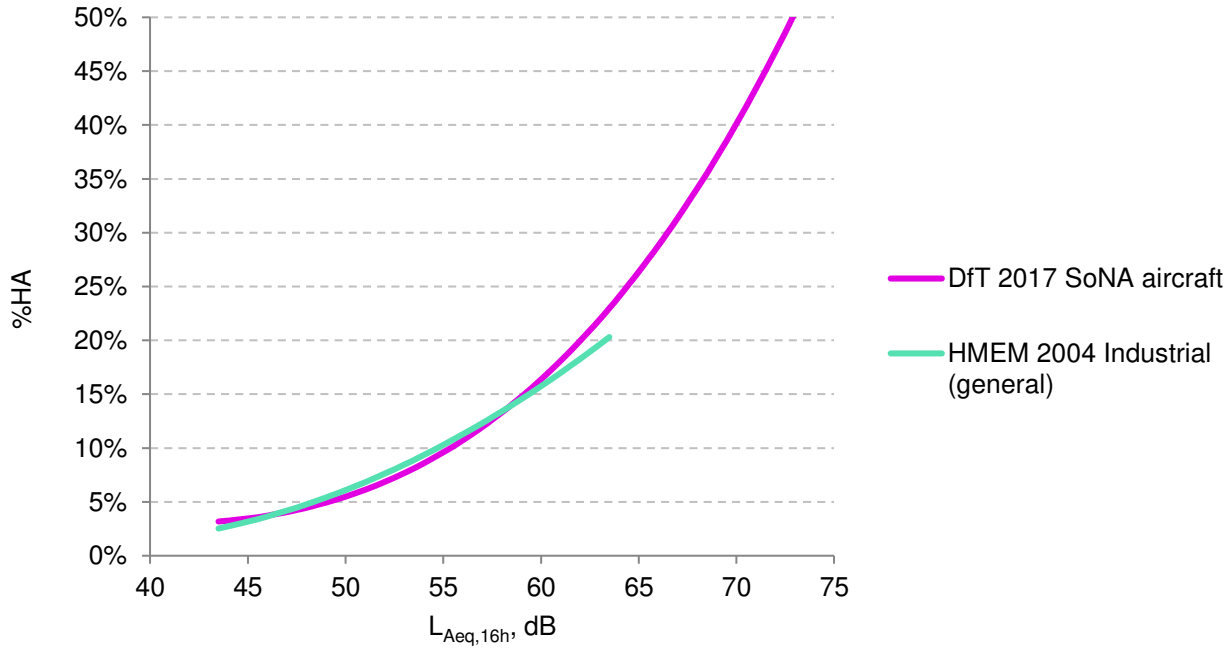


Figure 2: Exposure-response relationships for general industrial noise sources (Miedema & Vos, 2004) compared with UK aircraft noise (CAA, 2017)

British Council for Offices

2.1.20. The current British Council for Offices (BCO) Guide to Specification (BCO, 2014) provides further detailed guidance on suitable design specifications for offices, including levels of external noise and vibration intrusion indoors, as shown in Table 4, and levels of internally-generated building services noise, as shown in Table 5.

[2] http://www.mdpi.com/journal/ijerph/special_issues/WHO_reviews
[3] Mainly manufacturing facilities
[4] Figure 2 assumes the approximate difference between $L_{Aeq,16h}$ and L_{den} is $L_{Aeq,16h} \approx L_{den} - 1.5$, as indicated in the DfT study (CAA, 2017) – the actual relationship may vary depending on the noise source.

Table 4: BCO Guide to specification for levels of external noise intrusion to indoors

Building Type	Average Noise Levels	Maximum Airborne Noise Levels	Maximum Structure-borne Noise levels
Speculative offices (planning/design for category A)	General noise: - artificially ventilated space: NR38 ($L_{eq,T}$) - naturally ventilated space: NR43 ($L_{eq,T}$) Rain noise during heavy rainfall: 60 dB $L_{Aeq,T}$	55 dB L_{AFmax} (artificially ventilated) 60-65 dB L_{AFmax} (naturally ventilated)	45 to 50 dB L_{AFmax}

Table 5: BCO Guide to specification for levels of internal building services noise

Room Type	Average Noise Levels
Speculative offices (planning/design for category A)	NR38 ($L_{eq,T}$)

2.2 APPLICATION OF POLICY AND GUIDANCE

INDUSTRIAL AND COMMERCIAL NOISE IMPACT ASSESSMENT

2.2.1. The 2014 version of BS 4142 recognises that flexibility is necessary in applying the method and highlights the importance of 'context', advising that all pertinent factors should be taken into consideration, including (as mentioned above) absolute noise levels, the character and level of the existing sound climate at receptors, and the sensitivity of the receptor, as well as any attenuation measures that might exist at the receptor. These and any other relevant contextual factors have been taken into account in the impact assessment.

2.2.2. BS 4142:2014 defines assessment reference periods of 1 hour for the daytime (0700-2300hrs) and 15 minutes for night (2300-0700hrs). The BS 4142 assessment reference periods applied to the proposed recycling bulking operating hours mean that the early morning period 0600-0700hrs is classed as night-time (15-minute reference period), and the remaining hours as daytime (1-hour reference period).

2.2.3. In consultation with Powys Council Environmental Health department, it was established that a noise impact target rating level of no more than 5 dB above the background level should be considered in the design. This target has been applied during the design as the worst case benchmark for proposing additional mitigation to minimise noise impact, as far as is practicable due to the nature of the use.

2.2.4. Where relevant, absolute levels of noise emissions have been compared with available threshold values, subject to the limitations acknowledged in section 2.1.

BUSINESS UNITS INDOOR NOISE AND VIBRATION ASSESSMENT

2.2.5. The design of the internal commercial spaces inside the business units is considered against the noise criteria set out in BS 8233:2014 and the BCO Guide to specification, and against the vibration criteria set out in BS 6472-1:2008.

SOUND AND VIBRATION SURVEYS

2.2.6. A survey of existing sound and vibration levels affecting the site and surroundings was carried out over a week-long period from 11-18 May 2017 employing general principles from BS 7445-1:2003, BS 7445-2:1991 and BS 4142:2014 as appropriate. Sound measurement equipment employed conforms to the class 1 specification of BS EN 61672-1:2013 (BSI, 2013), and the calibration recommendations in BS 7445-1:2003.

2.2.7. A survey of indicative source noise levels has also been conducted at the existing Waste Transfer Station in Brecon. The Brecon site includes very similar equipment and process as are proposed for the Abermule site, and is considered a suitable source of representative data.

2.2.8. A description of the surveys and the corresponding results is included in section 3.

NOISE MODELLING

2.2.9. A computerised model of the site and surroundings has been developed using CadnaA 2018 software. The calculation algorithms of ISO 9613-2:1996 (ISO, 1996) are implemented to predict the propagation of noise

from the industrial activities on the site. Calculations of road and rail noise affecting the site are predicted using the propagation functions in the Calculation of Road Traffic Noise (Department of Transport, Welsh Office, 1988) and the Calculation of Railway Noise (Abbott, et al., 1995) methodologies. Key parameters adopted in the model are summarised in Appendix B.

2.2.10. The planning application drawings have been used to generate 3D representations of the proposed development buildings, and 2m resolution LiDAR data from the Natural Resources Wales dataset has been imported as base topography.

2.2.11. The Recycling Bulking Facility noise sources inserted in the model have been calibrated to be consistent with the source survey data acquired at the existing Brecon site. These noise sources are characterised using octave band data in the range 63-8000 Hz.

2.2.12. In addition, noise generated by access movements of the waste collection/distribution vehicles has also been included in the model. Anticipated vehicle count data has been provided by the design team, as included in Appendix C.

2.2.13. Vehicle noise source levels have been adapted from measurement data acquired at another similar waste processing facility in Ebbw Vale, as reported in a noise assessment submitted to discharge noise conditions attached to planning consent ref 01032/I/P1[5] (Applied Acoustic Design, 2017) and provided as indicative by the intended equipment supplier for the Abermule Facility. The adaptations applied take into account small differences in the number of vehicles represented. These noise sources are also characterised using octave band data in the range 63-8000 Hz.

2.2.14. All the Recycling Bulking Facility noise source data input to the model is documented in Appendix B.

2.2.15. The road and railway sources have been calibrated to be consistent with the survey measurements made at the Abermule development site. It is noted that the CRTN and CRN methods used for predictions of road and rail noise propagation are conducted using overall A-weighted levels. Therefore, for the purpose of assessing noise intrusion to any office spaces on the development site, these predicted levels can only be combined with the overall A-weighted levels of noise from the industrial and commercial sources. The calibrated transportation noise levels calculated in and around the development site are shown in Figure 3 below (NB. all noise maps presented in this assessment have been calculated at a height of 1.5 m).

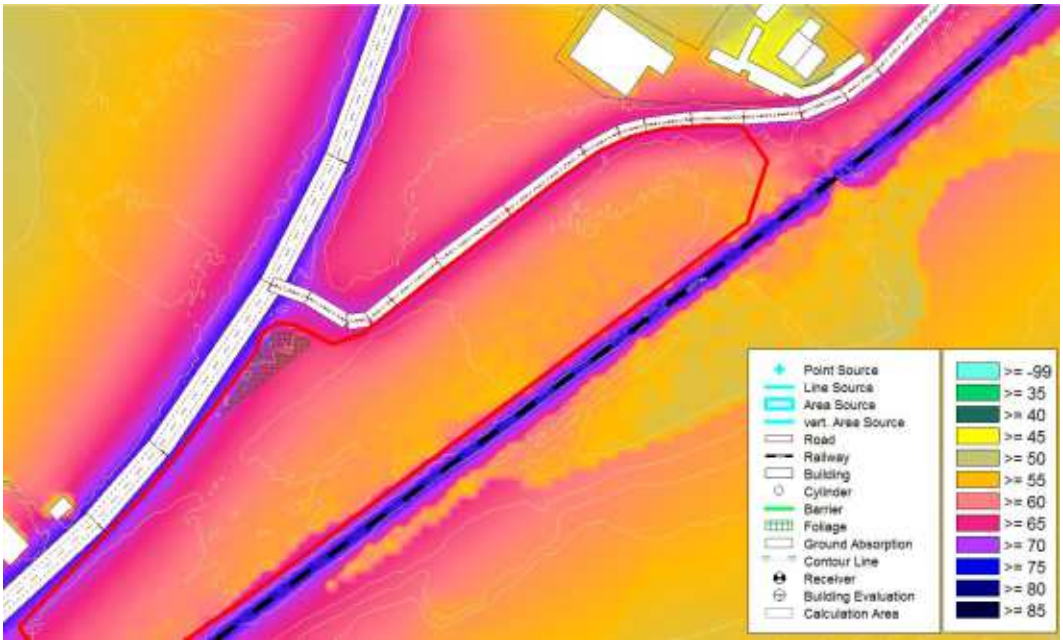


Figure 3: Calculated noise map of existing typical daytime average transportation noise levels ($L_{Aeq,T}$ dB), calibrated to survey data (red line: development site boundary)

[5] http://planning.hounslow.gov.uk/Planning_CaseNo.aspx?strCASENO=P/2017/2667

3 SOUND AND VIBRATION SURVEYS

3.1 AMBIENT SOUND AND VIBRATION

3.1.1. Full details of weather conditions, equipment, results and analysis of the survey data can be found in Appendix D. Automated measurement sensors were configured to record long-term sound levels at two locations representing off-site noise-sensitive receptors around the development site (Bryn-y-Maes and Court Close), and local weather conditions (wind speed/direction, rainfall) at one location (Bryn-y-Maes). The long-term measurements were supplemented with short-term manual sampled measurements of sound and vibration within the development site and sound levels at the third receptor location (Maesderwen).

3.1.2. The locations used for the survey measurements and rationale are summarised in Table 6, and indicated in Figure 4.

Table 6: Summary of survey measurement locations

Reference	Approximate Coordinates (OS GB)		Objective	Positioning
1: Bryn-y-Maes	E: 315540	N: 294125	Background level for industrial noise impact and weather logging for filtering data	Garden adjacent to northeast façade
2: Maesderwen	E: 315933	N: 294387	Background level for industrial noise impact	Garden adjacent to southeast façade
3: Court Close	E: 316044	N: 294328	Background level for industrial noise impact	Field adjacent to southwest gardens
4: B4386 site perimeter	E: 315766	N: 294256	Incident road noise level for commercial buildings	Perimeter
5: Railway noise 1	E: 315828	N: 294241	Incident rail noise level for commercial buildings	20m from railway line
6: Railway noise 2	E: 315833	N: 294230	Close-range rail noise level	Perimeter, 10m from railway line
7: Railway vibration 1	E: 315819	N: 294237	Ground rail vibration at commercial buildings	20m from railway line
8: Railway vibration 2	E: 315827	N: 294227	Ground rail vibration at commercial buildings	Perimeter, 10m from railway line

Notes: the microphones used for sound level measurements were fixed at a height of approximately 1.5 m above ground in all cases; the vibration transducer used was coupled to a flattened area of firm, bare ground under its own weight

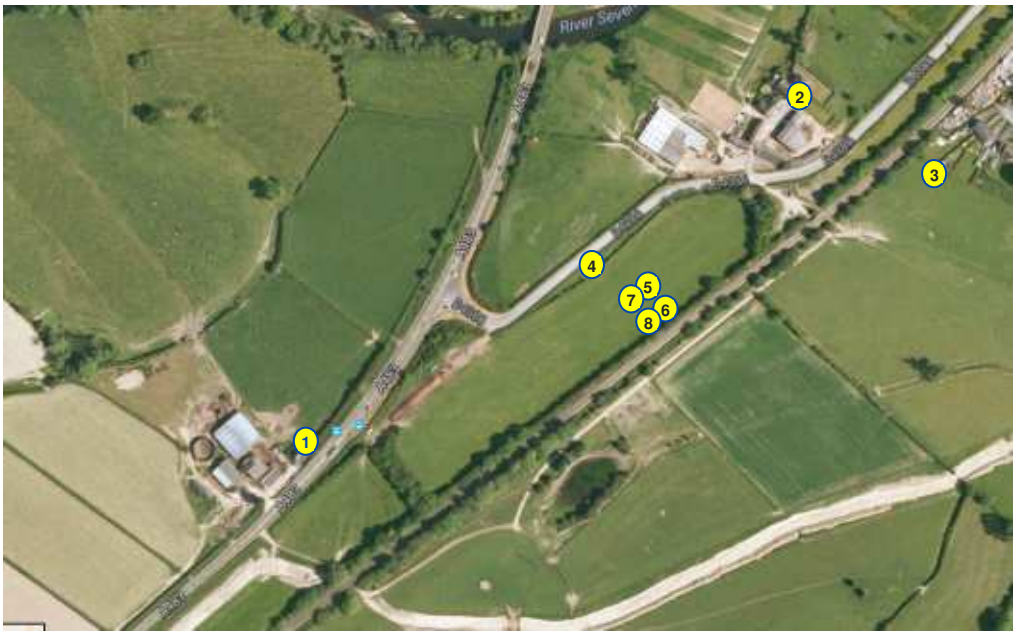


Figure 4: Satellite photo with survey measurement location annotation

BACKGROUND SOUND LEVELS

3.1.3. Representative background sound levels have been derived from analysis of the survey results for each of the nearest receptor locations. The values have been derived separately for the early morning period 0600-0700hrs and the daytime operating period 0700-1615hrs, as shown in Table 7.

Table 7: Summary of representative background sound levels

Receptor	Early morning 0600-0700hrs L_{A90}	Daytime 0700-1615hrs L_{A90}
Bryn-y-Maes	41 dB	44 dB
Maesderwen	32 dB	37 dB
Court Close	30 dB	35 dB

AMBIENT SOUND LEVELS

3.1.4. Ambient sound around the site has been characterised from observations during the day and from the survey results. A summary of the ambient sound levels at each measurement location and associated descriptions of sound sources is shown in Table 8.

Table 8: Summary of daytime ambient sound environment

Measurement location	Typical ambient sound levels	Ambient sound sources
1. Bryn-y-Maes	64-67 dB L_{Aeq} 67-70 dB L_{A10} ~60 dB L_{Aeq} (early morning 0600-0700hrs)	Dominant: A483 traffic Other: B4386 traffic; farm activity
2. Maesderwen	47-53 dB L_{Aeq}	Dominant: Nearby farm activity and domestic animals Other: Distant A438 traffic; B4386 traffic; wildlife and vegetation
3. Court Close	45-60 dB L_{Aeq} ~44 dB L_{Aeq} (early morning 0600-0700hrs)	Dominant: None Other: Distant A438 traffic; B4386 traffic; occasional trains on Cambrian Line; farm activity; wildlife and vegetation
4. B4386 site perimeter	57-60 dB L_{Aeq} 59-62 dB L_{A10}	Dominant: A483 and B4386 traffic Other: Occasional trains on Cambrian Line; farm activity
5. Railway line site perimeter (20m from track)	~59 dB L_{Aeq} 87-90 dB L_{AFmax} (train pass)	Dominant: A483 and B4386 traffic, occasional trains on Cambrian Line Other: farm activity, wildlife
6. Railway line site perimeter (10m from track)	~62 dB L_{Aeq} ~92 dB L_{AFmax} (train pass)	Dominant: A483 and B4386 traffic, occasional trains on Cambrian Line Other: farm activity, wildlife

AMBIENT VIBRATION

3.1.5. Vibration at the development site perimeter nearest to the railway has been measured during train pass events. A qualitative assessment also indicated that train pass events were not subjectively perceptible at the measurement locations, and no other areas of the site raised concerns about the potential for significant levels of ambient vibration. The results of the vibration measurements have been used alongside train timetables to derive conservative overall estimations of the expected VDVs over the daytime period, as summarised in Table 9.

Table 9: Summary of daytime ambient vibration environment

Measurement location	Overall estimated vibration dose value 0700-2300hrs	Ambient vibration sources
7. Railway line site perimeter (20m from track)	0.02 $ms^{-1.75}$	Occasional trains on Cambrian Line (total 23/day)
8. Railway line site perimeter (10m from track)	0.04 $ms^{-1.75}$	

3.2 RECYCLING BULKING FACILITY ACTIVITY NOISE

3.2.1. Full details of weather conditions, equipment, results and analysis of the survey data can be found in Appendix D. Automated measurements were made at locations along the site perimeter of Brecon Waste Transfer Station during normal daytime operations. These measurements were supplemented with close range sampled measurements of specific activities and plant to characterise the sources of noise deemed similar to those proposed for the Abermule Facility.

3.2.2. The noise source data acquired has been used alongside satellite and site photography to generate a computer model of the Brecon site employing the same methods as outlined in section 2.2. This model has been validated against the site survey results, and the noise source input data is therefore deemed suitable for use in the Abermule development site model. Further details of the Brecon noise source survey results is included in Appendix D, and the input data derived for use in the Abermule model are detailed in Appendix B.

4 ASSESSMENT

4.1 RECYCLING BULKING FACILITY NOISE IMPACT ASSESSMENT

INITIAL ASSESSMENT

Noise level predictions

4.1.1. The Recycling Bulking facility noise levels predicted at receptors in the absence of mitigation are summarised in Table 10 and corresponding noise maps are shown in Figure 5 and Figure 6.

Table 10: Summary of predicted recycling facility noise levels at off-site receptors without mitigation

Receptor	Early morning 0600-0700hrs $L_{Aeq,15min}$	Daytime 0700-1615hrs peak $L_{Aeq,1h}$
Bryn-y-Maes	42 dB	59 dB
Maesderwen	28 dB	29 dB
Court Close	30 dB	31 dB

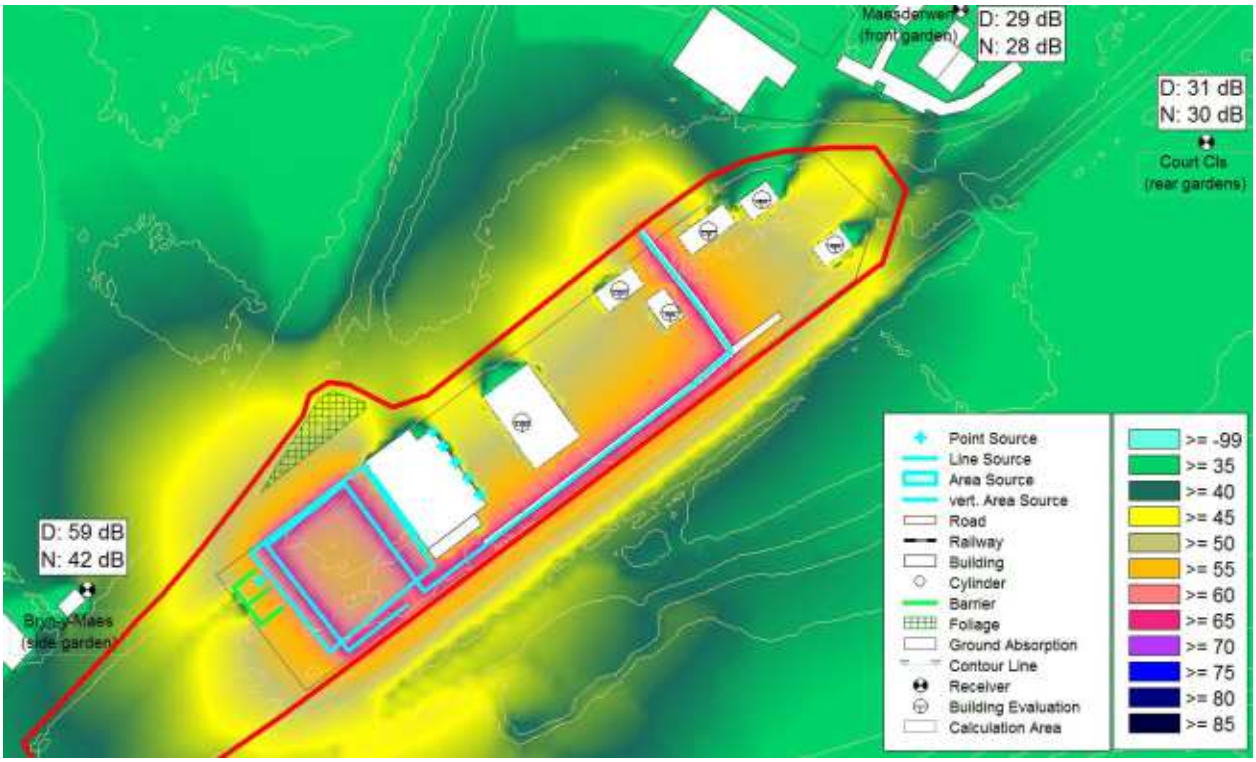


Figure 5: Calculated noise map of predicted early morning recycling facility noise levels ($L_{Aeq,15min}$ dB) without mitigation

4.1.2. The mapped levels in Figure 5 indicate that the noise emissions during the early morning operating period are expected to be generated by the arrivals of staff vehicles and departure of the recycling collection vehicle fleet; the processing plant will not be operational until 0700hrs or later.

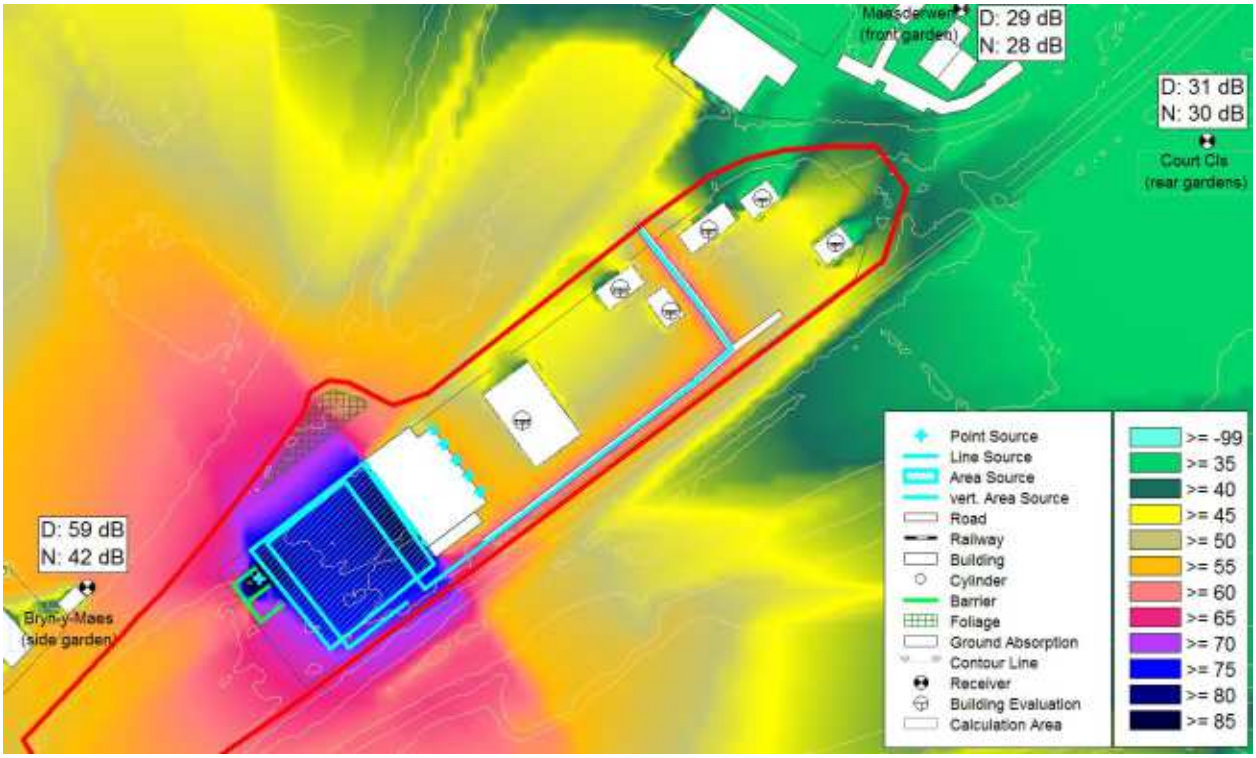


Figure 6: Calculated noise map of predicted daytime peak recycling facility noise levels ($L_{Aeq,1h}$ dB) without mitigation

4.1.3. The mapped levels in Figure 6 show the added noise contributions of the processing plant inside the facility, loading activity in the yard, and glass deposit into the glass materials hopper. The inclusion of the heavy vehicle activity on the site access represents the afternoon peak period around 1500-1600hrs, when most of the collection fleet will be returning to deposit materials and processing plant will still be running.

Unmitigated impact

4.1.4. The predicted early morning period noise emissions and the corresponding ambient sound levels at receptors are summarised below.

Table 11: Summary of unmitigated early morning recycling facility noise and typical ambient sound levels at off-site receptors

Receptor	Early morning 0600-0700hrs specific recycling facility noise $L_{Aeq,15min}$	Early morning 0600-0700hrs ambient sound $L_{Aeq,15min}$
Bryn-y-Maes	42 dB	60 dB
Maesderwen	28 dB	44 dB*
Court Close	30 dB	44 dB

*estimated using the transportation noise model, calibrated to survey measurement data

4.1.5. Based on the nature of the noise sources expected to be active during the early morning period, together with the difference between the predicted noise levels and the estimated typical ambient sound levels occurring at the same time, it is not expected that the noise from the Recycling Bulking Facility would be distinctive against the ambient sound environment. On this basis a 0 dB penalty for sound characteristics is considered appropriate.

4.1.6. The predicted daytime peak period noise emissions and the corresponding ambient sound levels at receptors are summarised below.

Table 12: Summary of unmitigated daytime peak recycling facility noise and typical ambient sound levels at off-site receptors

Receptor	Daytime 0700-1615hrs peak specific recycling facility noise $L_{Aeq,1h}$	Daytime 0700-1615hrs typical ambient sound $L_{Aeq,1h}$
Bryn-y-Maes	59 dB	64-67 dB
Maesderwen	29 dB	47-53 dB
Court Close	31 dB	45-60 dB

4.1.7. Based on the difference between predicted daytime specific noise levels at Maesderwen and Court Close, it is not expected that the Recycling Facility noise emissions will be distinctive compared with existing ambient sound. On this basis a 0 dB penalty rating is considered appropriate.

4.1.8. At Bryn-y-Maes, the noise may be audibly distinctive due to a smaller difference between the existing ambient sound and the specific noise, and the nature of the noise sources active during this period. The contributions from most significant noise sources active during the daytime peak period, and the characteristics of the noise in comparison with the ambient sound are summarised below alongside noise character penalties assigned according to the guidance in BS 4142:2014.

Table 13: Predicted noise contributions from specific recycling facility noise sources at Bryn-y-Maes and audibility of characteristics

Noise source	Daytime 0700-1615hrs peak specific source noise contribution $L_{Aeq,1h}$	Difference between typical ambient sound and specific source noise	Noise character	Estimated audibility	Noise penalty
Bay doors	56 dB	-8 to -11 dB	Broadband, steady	Barely audible during traffic passes; slightly audible during lulls in traffic	0 dB
Mobile loader white noise alarm	53 dB	-11 to -14 dB	Impulsive, repetitive	Barely audible during traffic passes; slightly audible during lulls in traffic	4 dB
Glass deposit	49 dB	-15 to -18 dB	Tonal, impulsive	Distinguishable for short period during activity	4 dB
Mobile loader manoeuvring	40 dB	-24 to -27 dB	Intermittent	Likely to be inaudible over ambient sound and other noise sources	0 dB

4.1.9. The rated noise levels are shown alongside the representative background sound levels in Table 14.

Table 14: Summary of unmitigated recycling facility noise ratings and representative background sound levels at off-site receptors

Receptor	Early morning 0600-0700hrs recycling facility noise rating $L_{Ar,15min}$	Early morning 0600-0700hrs background sound L_{A90}	Daytime 0700-1615hrs peak recycling facility noise rating $L_{Ar,1h}$	Daytime 0700-1615hrs background sound L_{A90}
Bryn-y-Maes	42 dB	41 dB	67 dB	44 dB
Maesderwen	28 dB	32 dB	29 dB	37 dB
Court Close	30 dB	30 dB	31 dB	35 dB

4.1.10. The initial impact assessment of the noise ratings is summarised in Table 15 below.

Table 15: Initial assessment of unmitigated recycling facility noise impact

Receptor	Early morning 0600-0700hrs recycling facility noise rating relative to background sound	Early morning 0600-0700hrs recycling facility noise impact	Daytime 0700-1615hrs peak recycling facility noise rating relative to background sound	Daytime 0700-1615hrs recycling facility noise impact
Bryn-y-Maes	+1 dB	Low/marginal adverse, unlikely to be significant	+23 dB	Adverse, likely to be significant
Maesderwen	-4 dB	Low	-8 dB	Low
Court Close	0 dB	Low	-4 dB	Low

4.1.11. The results of the initial assessment indicate a low noise impact for all receptors and periods with the exception of Bryn-y-Maes. Noise levels at Bryn-y-Maes during the daytime are predicted to exceed background sound levels by a relatively large margin, and the character of the noise is likely to increase the perceived impact further.

Assessment context

4.1.12. The ambient sound levels are relatively high at Bryn-y-Maes during the daytime, due to the proximity to the A483. The predicted recycling activity noise levels are similar in magnitude to the noise from road traffic. On the one hand, this may indicate that noise emissions from the Recycling Facility will only be readily distinctive during lulls in the traffic, which is relatively constant during the day. On the other hand, the existing road traffic noise levels are relatively high and adding further environmental noise of an industrial nature to the ambient sound may be considered unacceptable as it could exacerbate an already undesirable situation.

4.1.13. It should also be considered that, while road traffic affects the front and side of the property, at the rear a modicum of shielding from noise is afforded as vehicles pass immediately in front of the building. The addition of another environmental noise source at an angle that may partially degrade any zones where road traffic noise is slightly lower, could potentially interfere further with the value of these areas for amenity.

4.1.14. On the basis of the above considerations, the assessment indicates that a significant adverse impact is likely to occur at Bryn-y-Maes due to daytime noise from the proposed Recycling Facility, and mitigation for the daytime activity is therefore recommended to reduce the impact to an acceptable degree.

FINAL ASSESSMENT

Impact mitigation design

4.1.15. A scheme of noise mitigation for the Recycling Facility has been devised in consultation with the Powys Council design team. Available options are limited due to operational necessities, but the following measures have been considered, and either adopted or precluded for the reasons detailed below.

Table 16: Summary of considered noise mitigation options

Measure	Adopted	Details
Alteration of the processing shed layout to face southeast instead of southwest	Precluded	Insufficient land available to operate the yard facility effectively in front of a reorientated building. Would lead to increased noise impacts at Court Close caused by increased line of sight to main noise sources.
Restriction on bay door opening	Adopted	Two of the five doors will be kept shut during operation
Sound absorptive materials to be added to processing shed interior	Adopted	1092m^2 Class A sound absorptive panels to be installed – will also provide benefits to workers by reducing occupational noise exposure
Relocation of glass deposit	Adopted	Moved approx. 25 m southeast further away from Bryn-y-Maes
Installation of perimeter noise barrier	Precluded	A perimeter noise barrier would need to be relatively high to achieve a large beneficial effect so cost-effectiveness would be poor (a 3 m barrier could only reduce noise emissions at Bryn-y-Maes by up to around 5 dB due to restrictions on positioning)
Installation of local noise barrier at Bryn-y-Maes	Adopted	Powys Council ownership of the Bryn-y-Maes property enables this measure to be included in the mitigation scheme. A local barrier would be highly cost-effective (a 2.8 m barrier could reduce noise emissions at Bryn-y-Maes by up to around 12 dB).

4.1.16. The minimum performance specification for the absorptive panels to be installed inside the processing shed is shown below. The coverage of the panels must be distributed as evenly as possible over the soffit and walls to maximise the potential in-situ performance.

Table 17: Processing shed sound absorptive panels acoustic performance specification

Details	Octave band data								Overall	Notes
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz		
Minimum absorption coefficient performance, α	0.10	0.20	0.70	1.00	1.00	0.95	0.85	0.80	Class A	Perforated metal panel with mineral wool fill, 50mm thick, 1092m^2 coverage, evenly distributed over soffit and walls

4.1.17. As shown in Figure 7 below, the proposed noise barrier to be installed at Bryn-y-Maes would skirt the eastern perimeter of the property, would be approximately 2.8 m high and 22 m total length. To be effective the barrier must be specified and constructed with a minimum surface mass of 10 kgm^{-2}.

Figure 7: Annotated satellite photo indicating extent of proposed noise barrier at Bryn-y-Maes

Mitigated daytime impact

4.1.18. The predicted daytime peak period noise emissions with the above mitigation scheme in place are summarised in Table 18 alongside the existing ambient sound levels at receptors; the corresponding daytime noise map is shown in Figure 8 below (NB. the early morning mitigated noise map is not shown as it is almost identical to Figure 5, since the only change affecting the early morning operation is the addition of local screening of the Recycling Facility vehicles afforded to Bryn-y-Maes by the noise barrier).

Table 18: Summary of mitigated recycling facility noise and typical ambient sound levels at off-site receptors

Receptor	Early morning 0600-0700hrs specific recycling facility noise $L_{Aeq,15min}$	Early morning 0600-0700hrs ambient sound $L_{Aeq,15min}$	Daytime 0700-1615hrs peak specific recycling facility noise $L_{Aeq,1h}$	Daytime 0700-1615hrs typical ambient sound $L_{Aeq,1h}$
Bryn-y-Maes	33 dB	60 dB	44 dB	64-67 dB
Maesderwen	28 dB	44 dB*	28 dB	47-53 dB
Court Close	30 dB	44 dB	36 dB	45-60 dB

*estimated using the transportation noise model, calibrated to survey measurement data

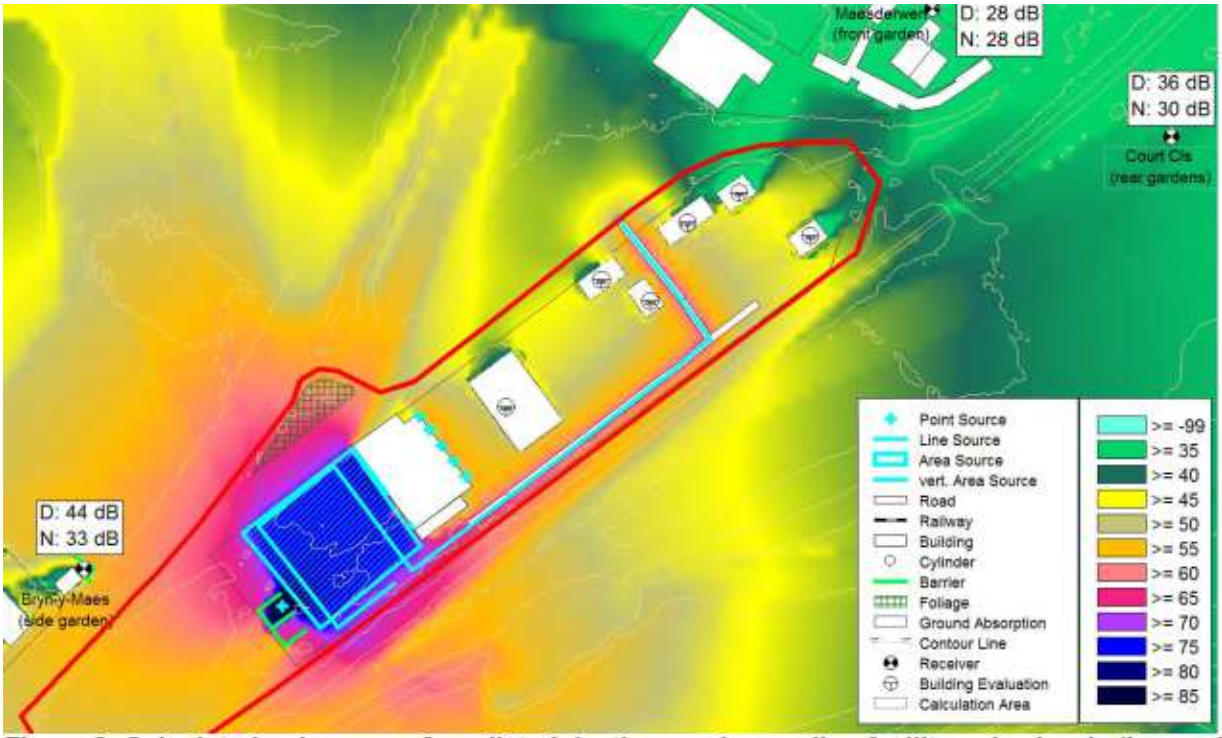


Figure 8: Calculated noise map of predicted daytime peak recycling facility noise levels ($L_{Aeq,1h}$ dB) with proposed mitigation scheme

4.1.19. The effect of the proposed mitigation scheme on the predicted Recycling Facility noise emissions is shown in Figure 9 below. This map shows the calculated sound level difference between the unmitigated and mitigated scenarios for the daytime peak period.

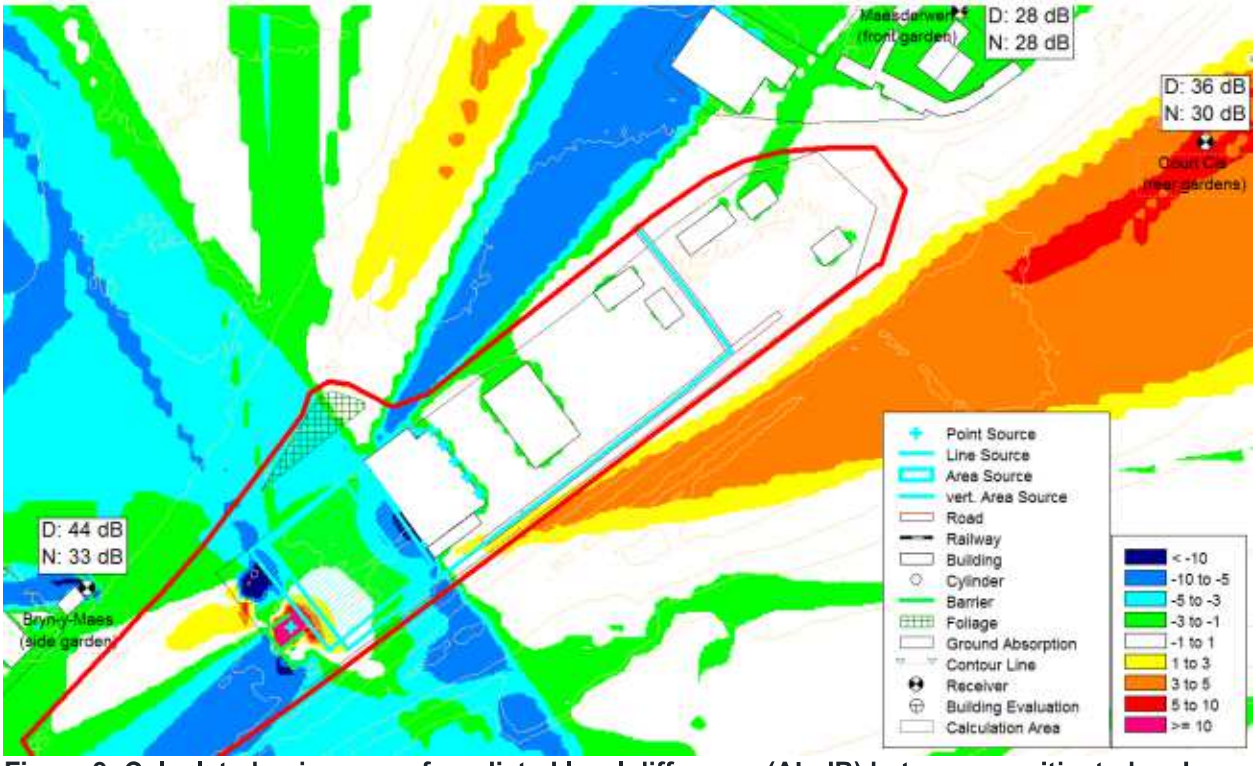


Figure 9: Calculated noise map of predicted level difference (ΔL dB) between unmitigated and mitigated Recycling Facility daytime peak noise emissions

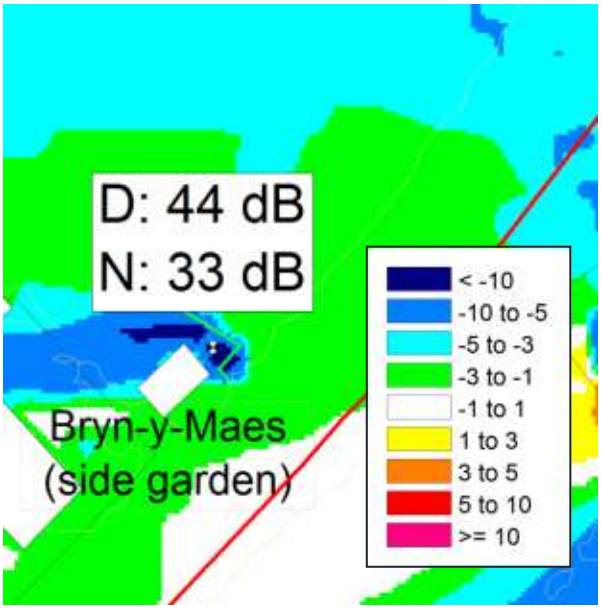


Figure 10: Zoomed calculated noise map (focussed on Bryn-y-Maes) showing predicted level difference (ΔL dB) between unmitigated and mitigated Recycling Facility daytime peak noise emissions

4.1.20. The results in Figure 9 and Figure 10 illustrate that the mitigation scheme provides significant benefits in reducing noise emissions at Bryn-y-Maes. It can also be seen in Figure 9 that the mitigation, which includes relocating the glass deposit, leads to higher predicted noise impact at Court Close, compared with the unmitigated scheme. This is due to increased line of sight to the relocated glass materials hopper. However, the overall noise levels predicted at Court Close with the mitigation scheme (shown in Figure 8) remain relatively low.

4.1.21. The most significant daytime peak noise sources at Bryn-y-Maes are summarised below alongside the individual effects of the mitigation, the levels relative to the ambient sound and the corresponding noise character penalties.

Table 19: Predicted noise contributions from specific recycling facility noise sources at Bryn-y-Maes and audibility of characteristics with mitigation

Noise source	Daytime 0700-1615rs peak specific source noise contribution $L_{Aeq,1h}$	Effect of mitigation on source contribution	Difference between typical ambient sound and mitigated source noise	Noise character	Estimated audibility	Noise penalty
Bay doors	35 dB	-21 dB	-29 to -32 dB	Broadband, steady	Inaudible during traffic passes; barely audible during lulls in traffic	0 dB
Mobile loader white noise alarm	41 dB	-12 dB	-23 to -26 dB	Impulsive, repetitive	Inaudible during traffic passes; just audible during lulls in traffic	0 dB
Glass deposit	36 dB	-13 dB	-28 to -31 dB	Tonal, impulsive	Barely audible for short period during activity	3 dB
Mobile loader manoeuvring	31 dB	-9 dB	-24 to -27 dB	Intermittent	Inaudible over ambient sound and other noise sources	0 dB

4.1.22. In view of the predicted increase in noise at Court Close, the most significant daytime peak noise sources at the receptor are also summarised below alongside the individual effects of the mitigation, the levels relative to the ambient sound and the corresponding noise character penalties.

Table 20: Predicted noise contributions from specific recycling facility noise sources at Court Close and audibility of characteristics with mitigation

Noise source	Daytime 0700-1615hrs peak specific source noise contribution $L_{Aeq,1h}$	Effect of mitigation on source contribution	Difference between typical ambient sound and mitigated source noise	Noise character	Estimated audibility	Noise penalty
Recycling Facility vehicles on site access	26 dB	0 dB	-19 to -34 dB	Vehicles	Likely to be inaudible and indistinguishable from other road noise sources	0 dB
Mobile loader white noise alarm	27 dB	0 dB	-18 to -33 dB	Impulsive, repetitive	Likely to be inaudible or barely noticeable	0 dB
Glass deposit	35 dB	+12 dB	-10 to -25 dB	Tonal, impulsive	Distinguishable for short period during activity	4 dB
Mobile loader manoeuvring	16 dB	0 dB	-29 to -44 dB	Intermittent	Inaudible over ambient sound and other noise sources	0 dB

4.1.23. The rated (mitigated) noise levels are shown alongside the representative background sound levels in Table 21.

Table 21: Summary of mitigated recycling facility noise ratings and representative background sound levels at off-site receptors

Receptor	Daytime 0700-1615hrs peak recycling facility noise rating $L_{Ar,1h}$	Daytime 0700-1615hrs background sound L_{A90}
Bryn-y-Maes	47 dB	44 dB
Maesderwen	28 dB	37 dB
Court Close	40 dB	35 dB

4.1.24. The final impact assessment of the noise ratings is summarised in Table 22 below.

Table 22: Final assessment of mitigated recycling facility noise impact

Receptor	Early morning 0600-0700hrs recycling facility noise rating relative to background sound	Early morning 0600-0700hrs recycling facility noise impact	Daytime 0700-1615hrs peak recycling facility noise rating relative to background sound	Daytime 0700-1615hrs recycling facility noise impact
Bryn-y-Maes	-8 dB*	Low	+3 dB	Potential adverse impact
Maesderwen	-4 dB	Low	-9 dB	Low
Court Close	0 dB	Low	+5 dB	Potential adverse impact

*incorporates the localised shielding benefit of the noise barrier at Bryn-y-Maes; corresponding impacts at Maesderwen and Court Close are unaffected in the early morning period

4.1.25. The results of the assessment indicate a low noise impact for all receptors during the early morning period. The assessment indicates a low impact during the daytime peak period at Maesderwen. The potential for

adverse impact at Bryn-y-Maes and Court Close during the daytime is indicated, despite the introduction of mitigation measures.

Assessment context

4.1.26. The main contextual factors that are considered to have importance in determining the final assessment outcome are:

1. The magnitude of the noise ratings relative to the background sound
2. The absolute rated levels of noise and the potential for audibility and distinctive sound characteristics
3. The existing sensitivity of the receptors potentially impacted, and the period of potential adverse impacts arising, ie during the daytime hours 0700-1615hrs
4. The adoption and feasibility of available mitigation measures to minimise potential impacts

4.1.27. The magnitudes of the noise ratings relative to background sound for receptors subject to potential adverse impacts are no more than +5 dB. This is within the target identified by the Environmental Health Dept as an upper limit of acceptability.

4.1.28. The peak daytime activity rated noise level at Court Close is 40 dB $L_{Ar,1h}$, while the corresponding rated noise level at Bryn-y-Maes is 47 dB $L_{Ar,1h}$. These rating levels are predicted for hours of peak activity within the working period. The most distinctive activity noise in terms of audibility is likely to be the glass deposit when a recycling collection vehicle returns to unload. These events would generally occur during the peak activity periods, but much more sporadically at other times of day, when steady noise emissions would be significantly lower, and less distinctive. For example, during operational times when no glass deposits are made, the predicted rated noise levels are expected to be around 30 dB $L_{Ar,T}$ at Court Close, and 43 $L_{Ar,1h}$ at Bryn-y-Maes. All these levels are well below the indicative WHO 1999 guideline thresholds for annoyance. Furthermore, according to more recent research evidence (described in section 2.2), no more than around 3% of people would be expected to be highly annoyed due to exposure to industrial noise at levels of 43 dB $L_{Aeq,16h}$, increasing to around 4% at levels of 47 dB $L_{Aeq,16h}$; this suggests there would be a very small (and probably negligible) risk of significant adverse impact.

4.1.29. As shown in Figure 11, the area around Court Close contains a mixture of existing industrial/commercial areas and dwellings. The land around Maesderwen is also used as an active farm, including use of agricultural machinery and equipment. It may be expected that the sensitivity of the occupants of these residential areas to industrial type noise sources and associated vehicles is likely to be influenced by familiarity and (presumably) acceptance of the existing use of the land for these purposes, ie the sensitivity is expected to be lower than might occur with equivalent dwellings exposed to a completely new type of noise source in a solely residential area.

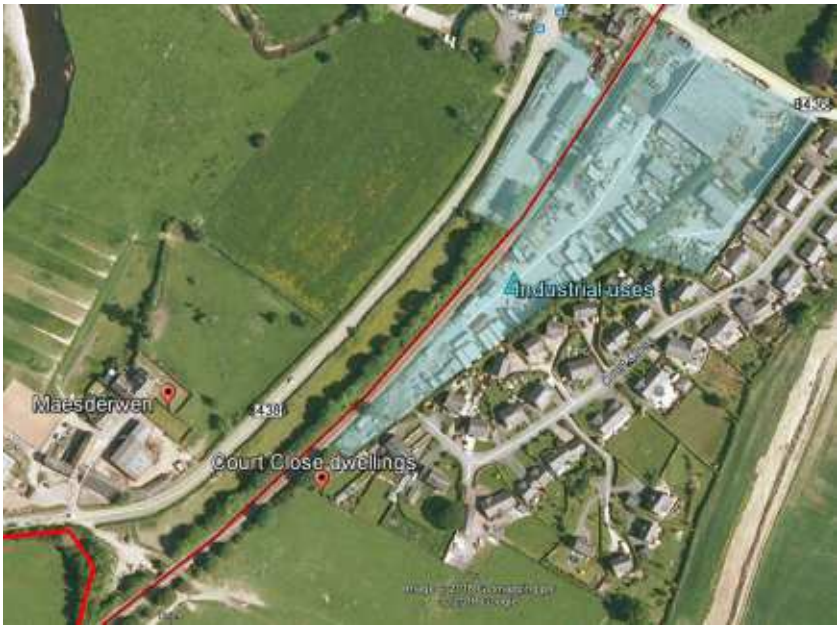


Figure 11: Existing industrial use of land near Court Close dwellings

4.1.30. It should also be noted that in order to reflect the worst case, levels at Court Close have been estimated at the nearest point at the end of the residential gardens; noise levels propagating into and around the areas of gardens nearer to the actual dwellings would be correspondingly lower than predicted above. Furthermore, only the nearest and most exposed properties on Court Close are likely to be subject to the predicted levels of noise from the development; other nearby properties would have lower incident levels due to increased distance from, and reduced line of sight to the noise sources.

4.1.31. The potential for adverse impacts arising is limited to daytime activity hours in the period 0700-1615hrs, which for many people is a less noise-sensitive period of the day, compared with evening or night-time periods often used for rest and relaxation.

4.1.32. A range of possible mitigation measures (listed in Table 16) has been considered in designing the proposed scheme. The majority of these measures have been adopted, and the preclusion of any potential measures considered infeasible has been justified – this is considered as a best practicable means approach to minimising the potential for noise impacts.

IMPACT ASSESSMENT OUTCOME

4.1.33. In view of the final assessment results alongside the contextual factors considered above (and the uncertainty minimisation approach described below), noise emissions from the Recycling Bulking Facility are considered unlikely to cause adverse impacts on residential amenity or human health. On this basis, the proposed scheme is considered to be in accordance with the relevant parts of local and national planning policies.

IMPACT ASSESSMENT UNCERTAINTY

4.1.34. Uncertainty is an unavoidable feature of environmental assessments involving varying physical phenomena, measurements and predictions. Sound measurements in the field can be subject to many factors, weather conditions typically being the most significant of which, but local activities in general can also be variable. The prediction of sound levels necessarily rely on assumptions, and the accuracy and applicability of the algorithms and parameters employed. Subjective responses to noise vary considerably, and are not simply dependant on the magnitude or character of the sound in question, but also on a wide array of non-acoustic factors.

4.1.35. In keeping with the scale of each project, WSP aim to minimise uncertainty at each stage as far as reasonably practicable. With this is mind, the control measures listed in Appendix E have been adopted, which have been developed from the recommendations made within relevant guidance documents, including BS 4142, and WSP's professional experience.

4.1.36. Specifically, measurements have been undertaken by suitably qualified staff referring to nationally-recognised guidance, using high-quality calibrated measurement equipment, at suitable locations and over extended periods, identifying and minimising the influence of adverse weather conditions on the results.

4.1.37. The predictions have also been undertaken by suitably qualified staff, using standard international engineering techniques. The method of determining background sound and noise source emission levels for the assessment has adopted a robust approach tending toward the 'reasonable worst case'; for most periods and the majority of the time, the impact of noise from the Recycling Bulking Facility would be expected to be lower than identified for these purposes.

4.1.38. It is our position that uncertainty has been kept to a realistic minimum and that the outcome of this assessment is sufficiently representative for its purpose.

4.2 BUSINESS UNITS NOISE AND VIBRATION ASSESSMENT

NOISE IMPACT ASSESSMENT

4.2.1. As stated in section 1.3, the application for the employment units on the Business Park site is for reserved matters consent; no specific noise-generating uses have been defined. Therefore, noise impact from the units can and should be controlled by imposing a planning condition requiring that when specific uses are proposed further assessment information must be submitted to demonstrate adherence to acceptable noise impact criteria. To assist future noise assessments for these units, the information in this assessment report should be reviewed and could be reused if deemed appropriate (eg the background sound levels derived herein for nearby receptors).

4.2.2. Typically for planning use class B1 units, externally-located ventilation and heating plant tends to be the primary source of steady noise emissions, which can be mitigated using appropriate design and noise

attenuation devices. Other potential noise impacts from specific activities could be mitigated via suitable building design and operational controls, designed and specified according to the submissions made under the reserved matters condition requirements.

4.2.3. In addition, to ensure that the combined noise impact of any business unit plant or activity with that of the Recycling Bulking Facility remains within acceptable limits, it may be considered appropriate to develop individual noise limits for each unit, such that the overall levels do not alter the outcomes of the impact assessment. One approach to dealing with this issue is to apportion remaining headroom to noise limits, an approach that has become standard practice when dealing with multiple sites in wind turbine noise planning assessments (Cand, Davis, Jordan, Hayes, & Perkins, 2013). In this case, it is not multiple sites, but multiple 'zones' of noise emission within a single site, emitting presumed noise from unknown sources to be defined (and controlled) for each individual business unit. The following represents recommendations that can be used as a reference for planning the distribution of noise impact from within the development site.

4.2.4. To ensure an acceptable overall level of combined noise impact is maintained, it is recommended that the total rated noise levels from the combined emissions from the business units do not exceed the levels shown in Table 23, while the Recycling Bulking Facility is in operation. As indicated, these values would ensure that either the representative background sound level at each receptor is not exceeded (corresponding to a low impact), or (if the Recycling Bulking Facility noise emissions are already predicted to exceed the background sound) do not increase any predicted margin of noise rating above background sound.

Table 23: Recommended business units noise emission limits (combined)

Receptor	Business units daytime 0700-1615hrs noise rating combined limit $L_{Ar,1h}$	Recycling Bulking Facility daytime 0700-1615hrs peak noise rating level $L_{Ar,1h}$	Combined Abermule Business Park daytime 0700-1615hrs peak noise rating level $L_{Ar,1h}$	Daytime 0700-1615hrs background sound L_{A90}	Daytime 0700-1615hrs peak combined noise rating relative to background sound
Bryn-y-Maes	37 dB	47 dB	47 dB	44 dB	+3 dB
Maesderwen	36 dB	28 dB	37 dB	37 dB	0 dB
Court Close	30 dB	40 dB	40 dB	35 dB	+5 dB

4.2.5. It is relatively straightforward to assign speculative limits to each individual unit such that the combined level from the business units could meet the values in Table 23, although different strategies could be employed; three are outlined below.

4.2.6. The first simplistic approach assumes that the noise limits are simply split equally between the units, which means that those closest to each receptor would have more onerous noise requirements than those further away. The main advantage to this strategy is that it implies a development design that encourages placing higher noise emitting uses further away from sensitive receptors, in order to minimise the expense of mitigation measures (and the risk of impacts arising). The individual unit noise limits are calculated by subtracting 10log10(*N*) from the combined limit, where *N* is the number of business units (ie subtracting 8 dB from the values in column 2 of Table 23). The resulting individual unit limits are shown in Table 24 (obviously these are identical for each unit).

Table 24: Recommended business units noise emission limits (individual, strategy 1: equal apportionment)

Receptor	Business Unit 1	Business Unit 2	Business Unit 3	Business Unit 4	Business Unit 5	Business Unit 6
Bryn-y-Maes	29 dB $L_{Ar,1h}$	29 dB $L_{Ar,1h}$	29 dB $L_{Ar,1h}$	29 dB $L_{Ar,1h}$	29 dB $L_{Ar,1h}$	29 dB $L_{Ar,1h}$
Maesderwen	28 dB $L_{Ar,1h}$	28 dB $L_{Ar,1h}$	28 dB $L_{Ar,1h}$	28 dB $L_{Ar,1h}$	28 dB $L_{Ar,1h}$	28 dB $L_{Ar,1h}$
Court Close	22 dB $L_{Ar,1h}$	22 dB $L_{Ar,1h}$	22 dB $L_{Ar,1h}$	22 dB $L_{Ar,1h}$	22 dB $L_{Ar,1h}$	22 dB $L_{Ar,1h}$

4.2.7. Conversely, the disadvantage to this approach is that units located closest to receptors are offered the least attenuation benefit from distance propagation and so would face greater restriction on noise emissions. Since other factors (such as building size and suitability) may dictate the type of use proposed for each unit, this

could result in overly-onerous limits where noisier uses in units located closer to receptors are unavoidable, and which would benefit from a greater share of the available noise headroom.

4.2.8. A different strategy that takes into account the different distances between units and receptors (and so allowing for a somewhat increased share of noise limits for units located nearer to receptors – ie the allowable individual limits are inversely related to the propagation distances) can be devised by initially assuming that noise levels will typically be reduced due to distance propagation by approximately $20\log_{10}(r)$, where r is the range from the unit to each receptor. Approximate shortest unobstructed straight line ranges for each receptor and business unit combination are given in Table 25 (business unit numbering refers to the units sequentially from west to east when viewed on the site plan – eg, see Figure 12 below). [NB. The values in Table 25 ignore screening and reflected paths for obstructed line of sight.]

Table 25: Approximate shortest unobstructed straight line distances, metres

Receptor	Business Unit 1	Business Unit 2	Business Unit 3	Business Unit 4	Business Unit 5	Business Unit 6
Bryn-y-Maes	215	265	285	310	345	375
Maesderwen	260	190	185	140	115	125
Court Close	310	265	250	215	195	165

4.2.9. The distance values in Table 25 can then be used to derive proportional noise limits as described above and shown in Table 26.

Table 26: Recommended business units noise emission limits (individual, strategy 2: distance-dependent apportionment)

Receptor	Business Unit 1	Business Unit 2	Business Unit 3	Business Unit 4	Business Unit 5	Business Unit 6
Bryn-y-Maes	31 dB $L_{Ar,1h}$	30 dB $L_{Ar,1h}$	29 dB $L_{Ar,1h}$	28 dB $L_{Ar,1h}$	27 dB $L_{Ar,1h}$	27 dB $L_{Ar,1h}$
Maesderwen	24 dB $L_{Ar,1h}$	26 dB $L_{Ar,1h}$	27 dB $L_{Ar,1h}$	29 dB $L_{Ar,1h}$	31 dB $L_{Ar,1h}$	30 dB $L_{Ar,1h}$
Court Close	17 dB $L_{Ar,1h}$	19 dB $L_{Ar,1h}$	19 dB $L_{Ar,1h}$	20 dB $L_{Ar,1h}$	23 dB $L_{Ar,1h}$	25 dB $L_{Ar,1h}$

4.2.10. Finally, a third strategy would be to simply adopt a 'first come first served' approach, in which the entire available noise headroom at each receptor is assigned to each business unit use proposed on a chronological basis. This would have the advantage of simplicity, but could emburden future proposals for occupancy of units for which uses are identified later, by those occupied sooner. The initial limits in this approach would be equal to the combined limits (shown in column 2 of Table 23), and subsequent limits for other units would then depend on the headroom occupied by each unit, which would need to be determined individually.

4.2.11. The above recommendations should be reviewed and could be used to inform further noise assessment work for specific uses of the individual business units. Since the development is addressed by a single (hybrid) application, it should be possible to secure achievement of combined noise impact criteria by imposition of a planning condition. A suggested form of condition is outlined as follows (NB. this suggestion would need to be subjected to appropriate scrutiny to ensure legal validity and compliance with relevant planning legislation):

> **Condition:** *Prior to occupation of the business/employments units on the development, an impact assessment will be submitted to and approved by the Council to demonstrate how the proposed use, design and any required mitigation measures will ensure that the amenity of nearby noise-sensitive properties shall not be unacceptably affected by levels of noise. The assessment will consider the potential combined impacts of noise from all permitted uses on the Abermule Business Park development site (ie including the Recycling Bulking Facility), and will be conducted in accordance with the method set out in BS 4142:2014, and must demonstrate that the combined noise impact from the development site will be no greater than indicated in the Abermule Business Park Noise Impact Assessment report ref 70032991-NV1-02-R1.*

Reason: *To comply with Powys Council Local Development Plan policy DM13, 'Design and Resources'.*

Information: *The assessment applies to the business units consented with matters reserved. The assessment should have regard to the existing noise impact assessment information and recommendations contained in the Abermule Business Park Noise Impact Assessment report ref 70032991-NV1-02-R1 dated June 2018.*

NOISE INGRESS ASSESSMENT

4.2.12. The combined transportation and recycling noise emissions incident at the Business Park employment units have been calculated as shown in Figure 12. The highest incident noise levels are listed in Table 27.

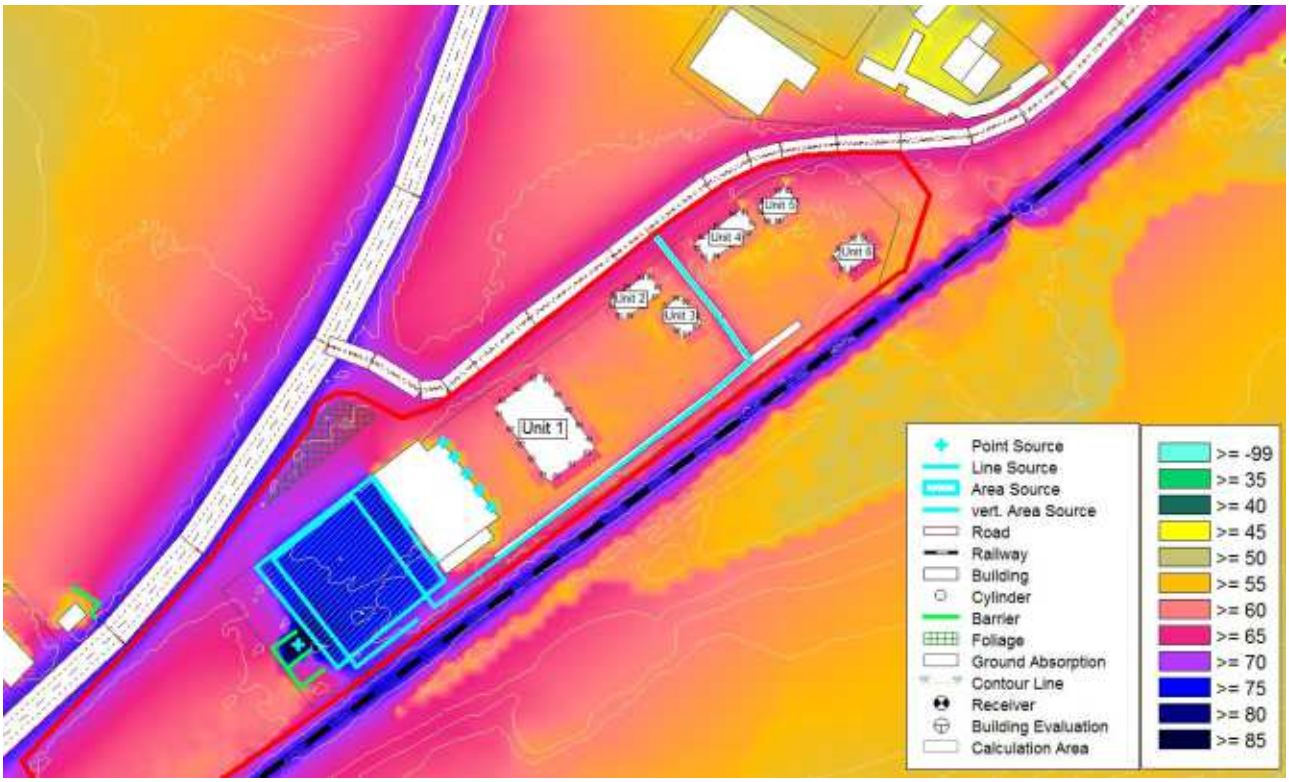


Figure 12: Calculated noise map of predicted combined transportation and Recycling Bulking Facility noise levels

Table 27: Highest incident combined transportation and Recycling Bulking Facility noise levels predicted at business unit façades (free-field)

Business Unit 1	Business Unit 2	Business Unit 3	Business Unit 4	Business Unit 5	Business Unit 6
63 dB $L_{Aeq,T}$	64 dB $L_{Aeq,T}$	61 dB $L_{Aeq,T}$	63 dB $L_{Aeq,T}$	63 dB $L_{Aeq,T}$	63 dB $L_{Aeq,T}$

4.2.13. Depending on the type of commercial space that is on the internal side of the façade, different recommended noise limits are applicable, as set out in section 2.1. The minimum sound insulation performance required across the façade subject to the highest incident noise can be estimated by comparing the values in Table 27 with the guideline values in Table 2 and Table 4, as summarised in Table 28.

Table 28: Recommended minimum sound insulation performance requirements for façade subject to highest incident noise levels

Internal space type	Business Unit 1	Business Unit 2	Business Unit 3	Business Unit 4	Business Unit 5	Business Unit 6
Open plan offices	21 $R_w + C_{tr}$	22 $R_w + C_{tr}$	19 $R_w + C_{tr}$	21 $R_w + C_{tr}$	21 $R_w + C_{tr}$	21 $R_w + C_{tr}$

Internal space type	Business Unit 1	Business Unit 2	Business Unit 3	Business Unit 4	Business Unit 5	Business Unit 6
Meeting rooms	24 $R_w + C_{tr}$	25 $R_w + C_{tr}$	22 $R_w + C_{tr}$	24 $R_w + C_{tr}$	24 $R_w + C_{tr}$	24 $R_w + C_{tr}$
Executive/cellular offices	29 $R_w + C_{tr}$	30 $R_w + C_{tr}$	27 $R_w + C_{tr}$	29 $R_w + C_{tr}$	29 $R_w + C_{tr}$	29 $R_w + C_{tr}$

4.2.14. The values in Table 28 apply to sound insulation across the entire building envelope, including the combination of the façade, glazing, ventilation and (where relevant) roof/ceiling elements. Typically the glazing and any ventilation penetrations are the weakest elements in the envelope. The values in Table 28 are slightly higher than might be achieved across some open window configurations, if these were intended to be used to provide whole building ventilation. This indicates that either attenuated passive ventilation systems, or alternatively mechanical ventilation systems would be more appropriate for rooms situated on the most exposed façades. In the latter case it is advised that the indoor noise from mechanical systems should generally be limited to NR38 ($L_{eq,T}$).

4.2.15. The recommendations provided in Table 28 address only office-type spaces; with planning use B1 units, light industrial workshops may form part of the specified uses, in which case, internally-generated noise is likely to dominate levels in workshop-type spaces (and potentially intrude into adjacent office areas). Noise exposure affecting health and safety in the workplace is regulated under the Control of Noise at Work Regulations 2005, and guidance on suitable steady noise limits to secure reliable speech communication in noisy work areas can be found in BS 8233:2014.

4.2.16. Appropriate design of the building envelope and ventilation systems is primarily a commercial concern to ensure suitable conditions for the occupants of the business units, and therefore does not need to be secured via planning condition (apart from noise breakout from any mechanical systems to off-site receptors, which has been addressed in the previous section). The recommendations provided in this report may be used to inform the further design of the units.

VIBRATION ASSESSMENT

4.2.17. As detailed in Appendix D, the vibration magnitudes measured during train passes on the Cambrian railway line have been used to derive estimated worst case vibration dose values over the course of a working day, at a distance of approximately 20 m from the line, as shown in Table 29.

Table 29: Summary of assessment of tactile vibration impact affecting business units

Distance from railway line	Business Unit 1	Difference relative to BS 6472-1:2008 criteria for 'low probability of adverse comment' in offices
20 m	0.02 $ms^{-1.75}$	-0.38 to -0.78 $ms^{-1.75}$

4.2.18. Since the margin beneath the criteria is relatively large, and in view of the fact that the majority of the business units are situated considerably further from the railway line than 20 m, the risk of tactile vibration impact adversely affecting use of the business units is considered to be negligible and no specific mitigation measures are recommended.

5 CONCLUSIONS

5.1 RECYCLING BULKING FACILITY NOISE IMPACT ASSESSMENT

5.1.1. The initial assessment of potential noise impact from the Recycling Bulking Facility indicated that in the absence of mitigation, significant adverse impacts would be likely to arise at Bryn-y-Maes due to daytime activities, while low impacts would be expected at Maesderwen and the Court Close dwellings.

5.1.2. A recommended mitigation scheme has been devised to reduce daytime noise levels incident at Bryn-y-Maes. The effect of the mitigation scheme is expected to significantly reduce rated noise levels at Bryn-y-Maes by up to around 20 dB. A side-effect caused by relocating some sources of noise is to result in an increase in the predicted noise rating at the Court Close dwellings. However, the noise ratings at both locations would be expected to be no more than 5 dB above typical background sound levels, which meets the target limit indicated by Powys Council Environmental Health Dept.

5.1.3. Furthermore, consideration of a range of relevant contextual factors (including the absolute levels of noise, relevant threshold values for the typical onset of potential adverse effects, the likely sensitivity of receptors and the existing ambient sound environment) indicates that the risk of potential adverse impact is very low. The mitigation scheme developed is considered to represent a best practicable means approach to minimising this risk of impacts, and noise emissions from the Recycling Bulking Facility are considered unlikely to cause adverse impacts on residential amenity or human health. On this basis, the proposed scheme is considered to be in accordance with the relevant parts of local and national planning policies.

5.2 BUSINESS UNITS NOISE AND VIBRATION ASSESSMENT

5.2.1. The potential for noise emissions from the business units affecting off-site noise-sensitive receptors has been considered. Since no specific uses for the units are applied for in the application, it is recommended that Powys Council secure achievement of acceptable noise impact via imposition of a suitable planning condition – a possible form of condition has been proposed, which would need to be scrutinised by a qualified expert to ensure compliance with planning legislation. The noise impact of the business units should be controlled to ensure that the combined impact of noise from the Abermule Business Park development (ie including the Recycling Bulking Facility noise) remains at acceptable levels. Recommendations have been provided for a range of strategies that could be employed by the designer and assessor to fulfil this requirement.

5.2.2. The combination of noise from the Recycling Bulking Facility and from existing transportation sources in the vicinity intruding to the business units has been assessed. Recommended minimum sound insulation performance values for the building envelopes of each unit have been provided. Achievement of a suitable indoor noise environment within the business units is primarily a commercial concern, and it is not considered necessary to control this via planning condition.

5.2.3. The potential for tactile vibration impacting on the use of the business units has also been assessed, and the risk is considered to be negligible; accordingly, no mitigation measures have been recommended.

5.3 SUMMARY

5.3.1. The noise impact and acoustic design of the development has been assessed and recommendations made to ensure suitability. Subject to the recommendations in this report, the proposed development is considered acceptable with regards to acoustics, noise and vibration.

6 REFERENCES

Abbott, P., Edwards, J., Hemsworth, B., Leventhall, G., Nelson, P., Parry, G., & Sargent, J. (1995). *Calculation of Railway Noise.* London: Department of Transport (Crown copyright).

Applied Acoustic Design. (2017). *Southall Lane Waste Depot: waste handling noise assessment.* London: Hounslow Borough Council.

BCO. (2014). *Guide to specification.* London: British Council for Offices.

BSI. (1991). *BS 7445-2:1991 Description and measurement of environmental noise - Part 2: Guide to the acquisition of data pertinent to land use.* London: British Standards Institution.

BSI. (2003). *BS 7445-1:2003 Description and measurement of environmental noise - Part 1: Guide to quantities & procedures.* London: British Standards Institution.

BSI. (2008). *BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings. Part 1. Vibration sources other than blasting.* London: British Standards Institution.

BSI. (2013). *BS EN 61672-1:2013 Electroacoustics — Sound level meters. Part 1: Specifications.* London: British Standards Institution.

BSI. (2014a). *BS 4142:2014 Methods for rating and assessing industrial and commercial sound.* London: British Standards Institution.

BSI. (2014b). *BS 8233:2014 Guidance on sound insulation and noise reduction for buildings.* London: British Standards Institution.

CAA. (2017). *CAP 1506: Survey of noise attitudes 2014: Aircraft.* Civil Aviation Authority.

Cand, M., Davis, R., Jordan, C., Hayes, M., & Perkins, R. (2013). *A good practice guide to the application of ETSU-R-97 for the assessment and rating of wind turbine noise.* St Albans: Institute of Acoustics.

Department of Transport, Welsh Office. (1988). *Calculation of Road Traffic Noise.* Crown copyright.

ISO. (1996). *ISO 9613-2:1996 Acoustics - Attenuation of sound during propagation outdoors.* Geneva: International Standards Organization.

Miedema, H. M., & Vos, H. (2004). Noise annoyance from stationary sources: relationships with exposure metric day–evening–night level (DENL) and their confidence intervals. *Journal of the Acoustical Society of America, 116*(1), 334-343.

Powys County Council. (2018). *Powys Local Development Plan 2011-2026: Written Statement (Adopted April 2018).*

Welsh Government. (1997). *Technical Advice Note 11: Noise.*

Welsh Government. (2014). *Technical Advice Note 21: Waste.* Crown copyright.

Welsh Government. (2016). *Planning Policy Wales.* Crown copyright. Retrieved from http://gov.wales/topics/planning/policy/ppw/?lang=en

WHO. (1999). *Guidelines for community noise.* Geneva: World Health Organisation.

WHO. (2009). *Night noise guidelines for Europe.* Geneva: World Health Organisation.

Appendix A

GLOSSARY

GLOSSARY OF ACOUSTICS TERMINOLOGY

Ambient Sound	The totally encompassing sound in a given situation, at a given time, including sound from any source in any direction.
Area source	A real or theoretical source that radiates as a planar surface. Sound from an area source at close range is radiated as plane waves rather than spherical waves, close range being considered as where the source is large relative to the wavelength of the sound produced. In the far field, the sound waves from an area source become spherical.
A-Weighting	The human ear can detect a wide range of frequencies, from 20Hz to 20kHz, but it is more sensitive to some frequencies than others. Generally, the ear is most sensitive to frequencies in the range 1 to 4 kHz. The A-weighting is a filter that can be applied to measured results at varying frequencies, to mimic the frequency response of the human ear, and therefore better represent the likely perceived loudness of the sound. SPL readings with the A-weighting applied are represented in dB(A).
Background sound	A component of the ambient and residual sound, comprising the steady sounds underlying sources that fluctuate in level within a period of consideration. This can be evaluated using the L_{A90} metric.
Band-Pass Filter	A band-pass filter allows defined sound frequencies with a certain range (or band) to pass with little or no impediment, while removing or impeding any other frequencies in the signal.
Decibel (dB)	The decibel scale is used in relation to sound because it is a logarithmic rather than a linear scale. The decibel scale compares the level of a sound relative to another. The human ear can detect a wide range of sound pressures, typically between $2x10^{-5}$ and 200 Pa, so the logarithmic scale is used to quantify these levels using a more manageable range of values.
Equivalent Continuous Level ($L_{eq,T}$)	The Equivalent Continuous Level represents a theoretical continuous sound, over a stated time period, T, which contains the same amount of energy as a number of sound events occurring within that time, or a source that fluctuates in level. For example, a noise source with an SPL of 80 dB(A) operating for two hours during an eight-hour working day, has an equivalent A-weighted continuous level over eight hours of 74 dB, or $L_{Aeq,8hrs}$ = 74 dB. The time period over which the L_{eq} is calculated should always be stated.
Level Envelope	The envelope of a signal describes its variation in amplitude over time, and 'encloses' the short-term variation in instantaneous signal levels.
Line Source	A theoretical source of sound, with length only, often used to model long, thin sound sources, such as roads.
Loudness	The loudness of a sound is subjective, and differs from person to person. The human ear perceives loudness in a logarithmic fashion, hence the suitability of the decibel scale. Generally, a perceived doubling or halving of loudness will correspond to an increase or decrease in SPL of 10dB. Note that a doubling of sound energy corresponds to an increase in SPL of only 3dB.

L_{10}, L_{90} and other L_n percentile-based measures	Percentile measures express statistical measures of noise: L_{10} represents the SPL exceeded for 10% of the time period considered; L10 is often used to describe typical noise levels of road traffic. L_{90} represents the SPL which is exceeded for 90% of the time, expressed in dB or dB(A); L_{A90} is used to quantify underlying 'background sound' levels. Other percentile-based measures are sometimes used for various types of noise assessment. These include L_{01}, L_{50}, L_{99}.
Masking Noise	The human perception of a sound is affected by the presence of other audible sounds. Noise can provide masking for sounds that would otherwise be more clearly perceived. A masked sound may appear less distinct or may even not be detectable at all by a listener when a masking noise is present. In some situations, such as wind farms with residential neighbours, some masking noise (such as wind blowing through local vegetation) may be desirable.
Maximum Sound Level (L_{max})	The maximum sound level, L_{max} (or L_{Amax} if A-weighted) is the highest SPL that occurs during a given event or time period.
Minimum Sound Level (L_{min})	Similarly, the minimum sound level, L_{min} (or L_{Amin} if A-weighted) is the lowest SPL that occurs during a given event or time period.
Noise	A noise can be described as an unwanted sound. Noise can cause nuisance.
Noise Sensitive Receptors (NSRs)	Any identified receptor likely to be affected by noise. These are generally human receptors, and may include residential dwellings, work places, schools, hospitals, community facilities, places of worship and recreational spaces.
Octave	In reference to the frequency of a sound, an octave describes the difference between a given frequency and that which is double that frequency, e.g. 125Hz to 500Hz, or 4kHz to 8kHz.
Octave Band / Third Octave Bands	A sound made up of more than one frequency can be described using a frequency spectrum, which shows the relative magnitude of the different frequencies within it. The possible range of frequencies is continuous, but can be split up into discrete bands, often an octave or third-octave in width. Each octave band is referred to by its centre frequency, generally 63Hz, 125Hz, 250Hz, 500Hz, 1kHz etc.
Point Source	A theoretical source of sound, with zero size and mass, often used as an approximation to model small sources. Sound from a point source radiates spherically in all directions.
Residual Sound	Another component of the ambient sound, associated with any sources other than the specific source(s) under consideration.
RMS	Root-mean-square. Instantaneous sound pressure can take positive or negative values around the mean (atmospheric pressure). To describe the energy in pressure waves the instantaneous pressure is squared, and averaged over a finite time interval. The square root reduces the mean-square value to linear, rather than squared, units.
Sound Power Level (SWL)	The Sound Power Level defines the rate at which sound energy is emitted by a source, and is also expressed in dB. It is defined as follows: $SWL\ (dB) = 10\ Log_{10}(W/W_{ref})$ where W = Sound Power (in Watts) W_{ref} = Reference Power 1 picoWatt

Sound Pressure Level (SPL)	The Sound Pressure Level has units of decibels, and compares the level of a sound to the smallest sound pressure generally perceptible by the human ear, or the reference pressure. It is defined as follows: $SPL\ (dB) = 10\ Log_{10}(P/P_{ref})^2$ where P = RMS Sound Pressure (in Pa) P_{ref} = Reference Pressure $2x10^{-5}$ Pa An SPL of 0dB suggests the Sound Pressure is equal to the reference pressure. This is known as the *threshold of hearing*. An SPL of 140dB represents the *threshold of pain*.
Specific Sound	A component of the ambient sound, associated with a specific source/s under consideration.
Spectral content	Sounds are typically made up of acoustic energy present in many frequencies of the audible spectrum. The frequency spectrum describes this signal 'content'.
Time Weighting	The sound pressure level is calculated from the root-mean-square (RMS) value of the instantaneous acoustic pressure. Calculation of the RMS value requires a finite time interval over which to calculate the mean. Sound level meters use a time-weighted average, which multiplies the squared pressure sample by an exponential function of the constant time interval over which the average is calculated. Standard time constants in current use include 'Fast', 'Slow', and 'Impulse' which have values of 0.125s, 1s, and 0.035s respectively. The weighting used is designated by subscripts attached to a level descriptor, e.g. $L_{p,F}$; L_{Smax} etc. The L_{eq} is not a time-weighted level descriptor.

Appendix B

NOISE MODEL PARAMETERS

Noise model parameters

Parameter	Setting / value
Air temperature	10°C
Relative humidity	70%
Order of reflection	1st
Building surface reflectivity	1 dB reflection loss (smooth façade / reflective barrier)
Ground absorption factor	Grassland areas: 1 (acoustically soft) Site paved areas and roads: 0 (acoustically hard)

Recycling Bulking Facility activity noise source sound level data

Source	Octave band sound power levels, dB								L_w, dB(A)	Notes
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz		
Recycling processing shed bay door	91	93	92	92	92	89	85	77	96	3 open, 2 shut; continuous, daytime only; vertical plane area source
Recycling processing shed wall louvre	72	78	77	78	70	70	78	71	81	2 at low level on front façade; vertical plane area source
Recycling processing shed extraction fan	72	72	71	70	69.	67	64	64	74	5 at high level on rear façade; 500 mm diameter axial fan, each ~2 m^3s^{-1} at 50 Pa; daytime only; broadband; point source; height 6.5 m
Waste distribution loader/handler (moving, engine)	96	95	91	90	90	89	82	75	95	1 active; intermittent (approx. 50% on-time), daytime only Ref: BS 5228-1+A1:2014 C.4.14; horizontal plane area source; effective height 1 m
Waste distribution loader/handler (reversing alarm, white noise)	103	96	95	94	108	111	101	86	114	1 active; intermittent, modulated 50/50 sound on/off (approx. 20% total on-time, ie active sound level present for 10%), daytime only; impulsive; horizontal plane area source; effective height 0.7 m

Source	Octave band sound power levels, dB								L_w, dB(A)	Notes
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz		
Glass deposit	101	105	108	113	115	126	126	119	131	Intermittent (up to 1 event per hour, duration approx. 15s each), daytime only; tonal; point source; effective height 1 m
Heavy vehicles (Romaquips, delivery lorries)	75	79	82	86	89	87	82	77	93	Intermittent events, but assumed continuous time-averaged source during ref periods (based on vehicle data: levels -0.7 dB for daytime, +2.8 for night); line source; effective height 0.7 m Adapted from AAD report
Light vehicles (staff cars, vans, cage truck)	70	74	77	81	84	82	77	72	88	Intermittent events, but assumed continuous time-averaged source during ref periods (based on vehicle data: levels -4.6 dB for daytime, -1.5 for night); line source; effective height 0.5 m Adapted from AAD report; assumed -5 dB from heavy vehicle spectrum

Recycling Bulking Facility mitigation acoustic data

Details	Octave band data								Overall	Notes
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz		
Processing shed absorptive panel absorption coefficient performance, α	0.10	0.20	0.70	1.00	1.00	0.95	0.85	0.80	Class A	Perforated metal panel with mineral wool fill, 50mm thick
Expected reverberant sound pressure level reduction with absorptive panels	0	0	-2	-5	-4	-4	-3	-2	-3 dBA	1092m^2 coverage assumed, distributed evenly over soffit and walls

Appendix C

VEHICLE DATA

Recycling Bulking Facility vehicle count data

Vehicle Type	**Estimated No. of Vehicles**	**Estimated No. of Trips per Day**	**Cumulative No of Trips per day**	**Estimated No. of Junction Manoeuvres per day** (on and off the Trunk Rd)	**Estimated No. of Junction Manoeuvres per week** (on and off the Trunk Rd)
Large Romaquip	8	2	16	32	128
Small Romaquip	3	2	6	12	48
FEL 32T 8 Wheeler	1	3	3	6	24
26t 70/30 (Trade)	1	1	1	2	8
26t (Glass Lorry)	2	1	2	4	24
26t Open Back (Residual)	2	2	4	8	48
15t (Residual)	2	2	4	8	48
Cage Vehicle	3	3+	9	18+	72
Small Van	3	3+	9	18+	72
Estimated Total	25	19+	54	**108**	**472**

Staff Car	32	1	32	**64**	**256**

Estimated Total	58	23+	89	**178**	**712**

Appendix D

SOUND AND VIBRATION SURVEYS

TECHNICAL NOTE

AUTHOR	Michael Lotinga	**CHECKED**	Pete Bushell
DATE	**15 June 2018**	**CONFIDENTIALITY**	**Public**
SUBJECT	**70032991 - Abermule Business Park – Sound and vibration surveys**		

1. INTRODUCTION

1.1. Document scope

This note documents the details of the sound and vibration surveys carried out in relation to the above project on behalf of Powys Council.

Two site surveys have been conducted:

1. Ambient and background sound and vibration survey in the vicinity of the proposed development site at Abermule
2. Noise source characterisation survey at the Brecon Waste Transfer Station (WTS)

1.2. Survey objectives

The surveys aimed to acquire the following information:

- Representative background sound levels at noise-sensitive receptors potentially affected by the development
- Information on the characteristics of the ambient sound environment at the same locations
- Ambient sound levels incident on the parts of the site proposed for class B1 employment units
- Railway vibration magnitudes incident on the parts of the site proposed for class B1 employment units
- Representative activity and plant noise levels and duration data during operations at Brecon WTS of similar or identical nature to those proposed for the Abermule Business Park Bulk Recycling Facility.

2. ABERMULE AMBIENT SOUND AND VIBRATION SURVEY

2.1. Measurement locations

The measurement locations employed are listed below and indicated in Figure D1.

Table D1: Abermule survey measurement location details

REFERENCE	PERIOD	APPROXIMATE COORDINATES (OS GB)		OBJECTIVE	POSITIONING
1: Bryn-y-Maes	11/05/17 – 18/05/17	E: 315540	N: 294125	Background level for industrial noise impact and weather logging for filtering data	Garden adjacent to northeast façade
2: Maesderwen	11/05/17	E: 315933	N: 294387	Background level for industrial noise impact	Garden adjacent to southeast façade
3: Court Close	11/05/17 – 12/05/17	E: 316044	N: 294328	Background level for industrial noise impact	Field adjacent to southwest gardens
4: B4386 site perimeter	11/05/17 and 18/05/17	E: 315766	N: 294256	Incident road noise level for commercial buildings	Perimeter
5: Railway noise 1	18/05/17	E: 315828	N: 294241	Incident rail noise level for commercial buildings	20m from railway line

REFERENCE	PERIOD	APPROXIMATE COORDINATES (OS GB)		OBJECTIVE	POSITIONING
6: Railway noise 2	18/05/17	E: 315833	N: 294230	Close-range rail noise level	Perimeter, 10m from railway line
7: Railway vibration 1	18/05/17	E: 315819	N: 294237	Ground rail vibration at commercial buildings	20m from railway line
8: Railway vibration 2	18/05/17	E: 315827	N: 294227	Ground rail vibration at commercial buildings	Perimeter, 10m from railway line
Notes: the microphones used for sound level measurements were fixed at a height of approximately 1.5 m above ground in all cases; the vibration transducer used was coupled to a flattened area of firm, bare ground under its own weight					

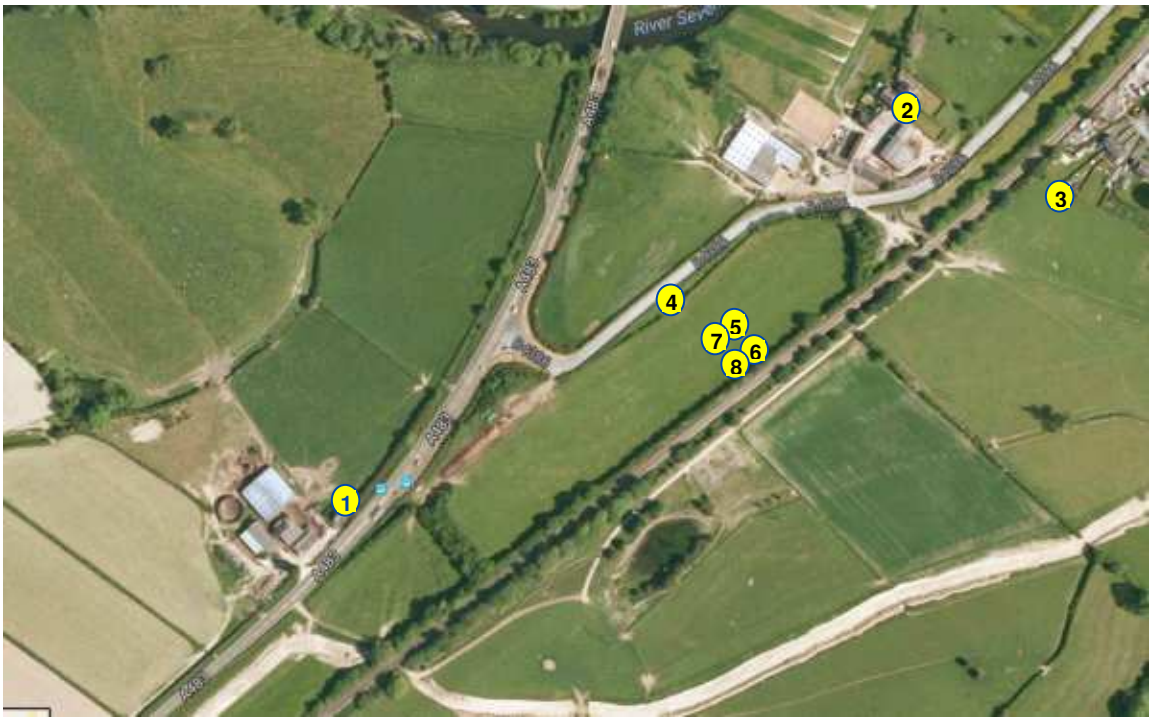


Figure D1: Development site survey measurement locations satellite photo

The local equipment siting and positioning of sensors are shown in the survey photographs appended to the end of this note, together with observational notes made during the measurements.

2.2. Survey period

The survey measurements were carried out within the period Thursday 11 May 2017 to Thursday 18 May 2017.

A week-long continuously-logged measurement was taken at location 1, supplemented with a 24-hr continuously-logged measurement at location 3, and daytime sampled measurements taken at locations 2 and 4 to 8.

2.3. Equipment

The equipment used in the survey is listed below:

Table D2: Abermule survey equipment details

SYSTEM	DETAILS	SERIAL
Sound level meter, mic and preamp	01dB Cube	10629
Sound calibrator	01dB Cal21	34344462
Sound level meter, mic and preamp	01dB Duo	10594
Sound calibrator	01dB Cal21	34924020
Sound level meter, mic and preamp	01dB Fusion	10796
Sound calibrator	01dB Cal21	34254632
Sound level meter, mic and preamp	01dB Solo Blue	60531
Sound calibrator	Brüel & Kjær Type 4230	1558662
Vibration meter	Instantel Blastmate III	BA8004
Vibration sensor	Instantel X10 714A8302 triaxial geophone	714A0301
Weather measurement station	Davis Vantage Vue 6250UK weather station	MK141008083

All sound level measurement equipment used in the survey conforms to the class 1 specifications of BS EN 61672-1:2013. Field calibration of sound level meters was checked before and after measurement periods with no significant drift apparent. Laboratory (UKAS accredited) calibration certificates for all sound level meters and field calibrators valid at the time of measurements are appended to the end of this note. Laboratory (traceable) calibration certificates for vibration meters and sensors are similarly appended.

Statistical sound levels have been evaluated using 'Fast' (125 ms) exponential time-weighting.

2.4. Weather

Meteorological conditions of importance were monitored continuously throughout the survey period using a weather station at location 1, logging wind speed, wind direction, temperature, humidity and rainfall in 10-minute intervals.

Wind direction during the survey was predominantly southerly; 96% of the survey period had winds from the SSW, S and SSE sectors. Average wind speeds were relatively low, with an overall average of 0.5 ms^{-1}, and a standard deviation of 0.6 ms^{-1}. On this basis it is concluded the influence of wind on the measured sound data is negligible.

The weather dataset collected was analysed for periods of either rainfall or strong winds (>5 ms^{-1}) and measured sound level data were filtered to exclude these periods from further analysis, including the hour following the cessation of any periods of rainfall (to account for the possible contribution of rain runoff sounds and elevated tyre-road interaction noise).

The wind and rain data recorded are shown on the chart below:

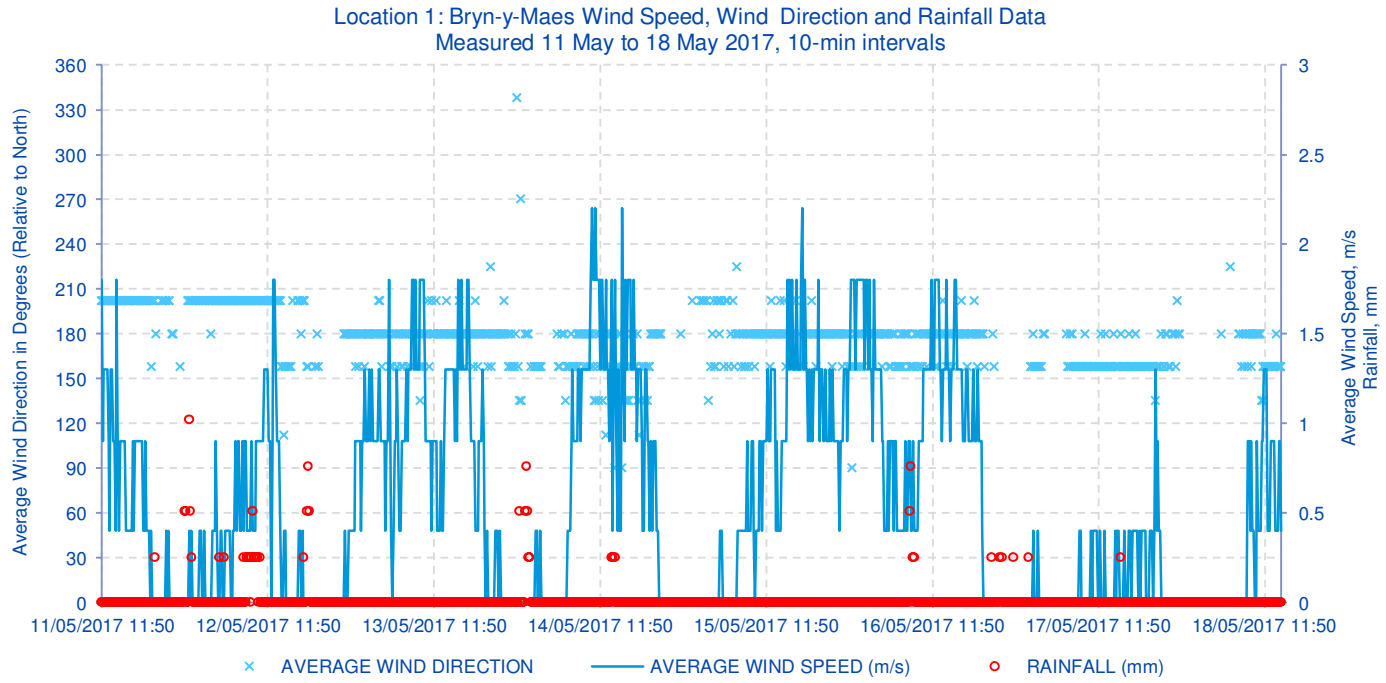


Figure D2: Meteorological survey data recorded at location 1 (10-minute intervals)

2.5. Sound level data analysis

LOCATION 1: BRYN-Y-MAES

The week-long continuously-logged sound level data calculated over hourly intervals at location 1 is shown in Figure D3 below (NB. Figure D3 presents all measured data, including data filtered due to inclement weather):

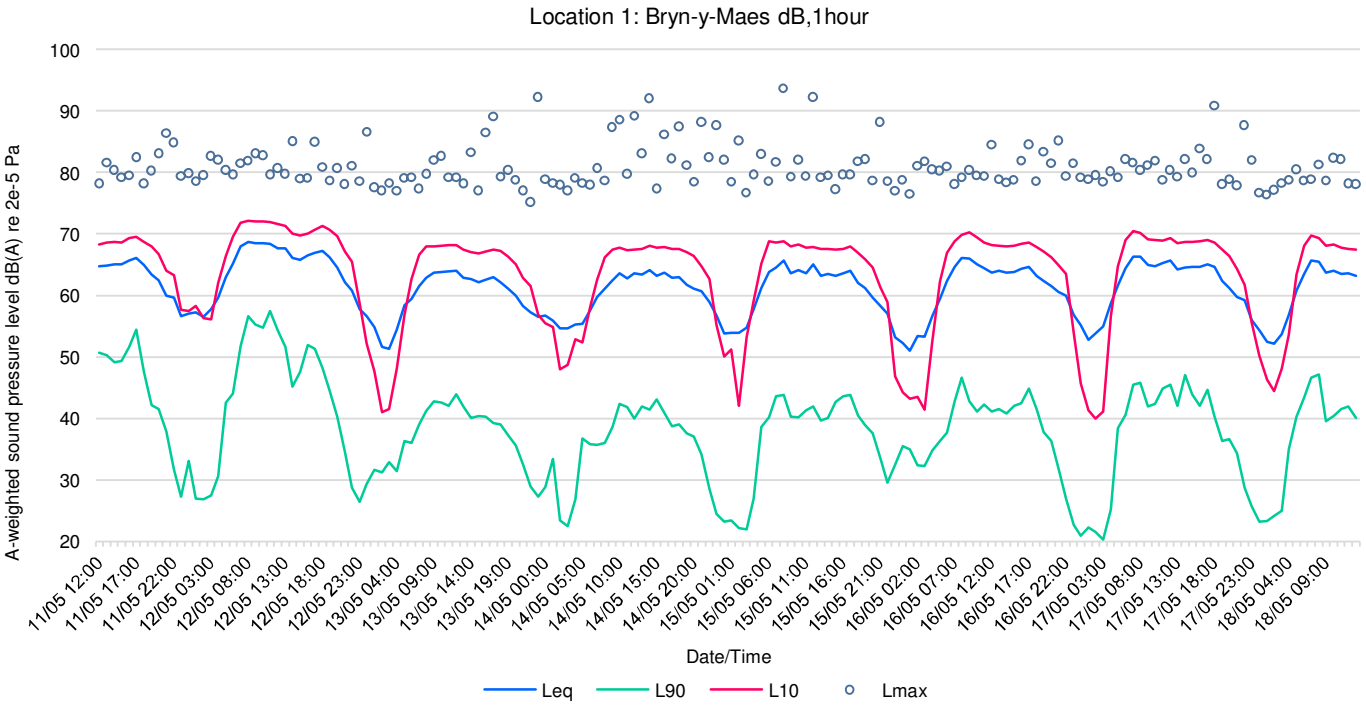


Figure D3: Sound level survey data recorded at location 1 (hourly intervals)

Observations during the day at location 1 indicate that the ambient sound is dominated by road traffic on the A483. The survey measurements shown in Figure D3 show that typical road traffic noise levels during the day

are around 67-70 dB $L_{A10,1h}$; the corresponding average ambient sound levels during these times are around 64-67 dB $L_{Aeq,1h}$. Typical weekday early morning average levels (0600-0700hrs) are around 60 dB $L_{Aeq,1h}$.

The data in Figure D3 suggest that background sound levels during the day are typically between 40 and 45 dB $L_{A90,1h}$, though higher levels of around 50 to 55 dB $L_{A90,1h}$ were measured during the first two days of the survey (Thursday and Friday).

Figure D4 below shows an hour period of 1-second interval averaged levels. This shows typical fluctuations in the short-term levels of between 50 and 70 dB $L_{Aeq,1s}$, which generally correspond to traffic passing the location; dips to levels of 40 to 45 dB $L_{Aeq,1s}$ occur sporadically during brief gaps between successive vehicles.

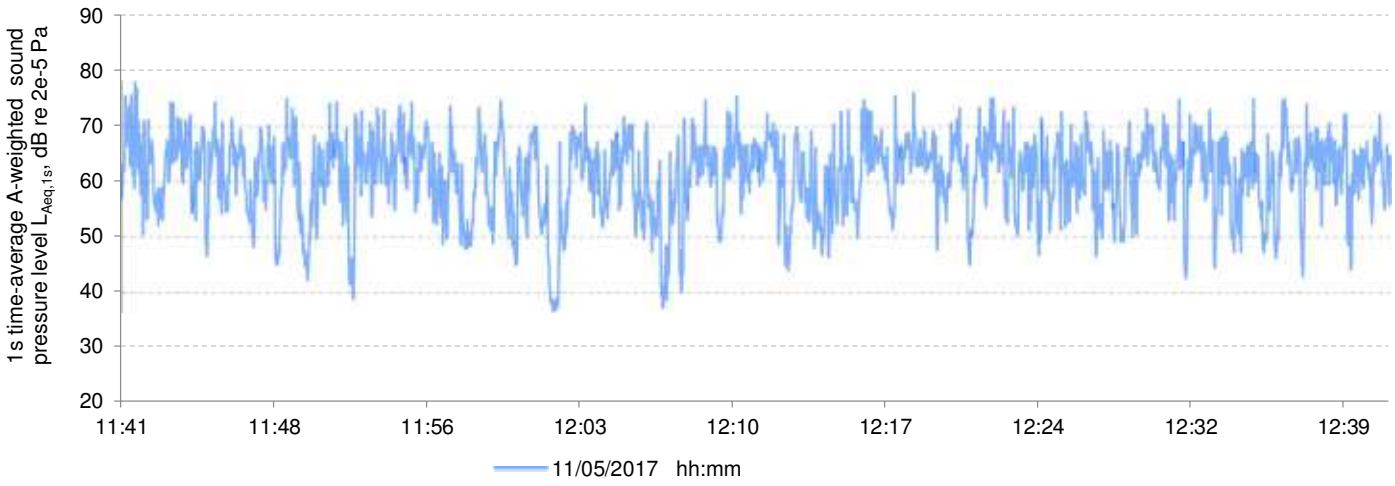


Figure D4: Sound level survey data recorded at location 1 at midday on 11/05/2017 (1-second intervals)

The hourly background sound levels measured during the operating hours of the proposed Recycling Bulking Facility at the development site have been averaged to derive a representative level for each period. The daytime period is derived from the valid recorded data during the weekday working period of 0700-1600hrs, and the 'night-time' period (more accurately: the early morning period) is derived from the weekday data during 0600-0700hrs. The results of this analysis are shown in Figure D5 below.

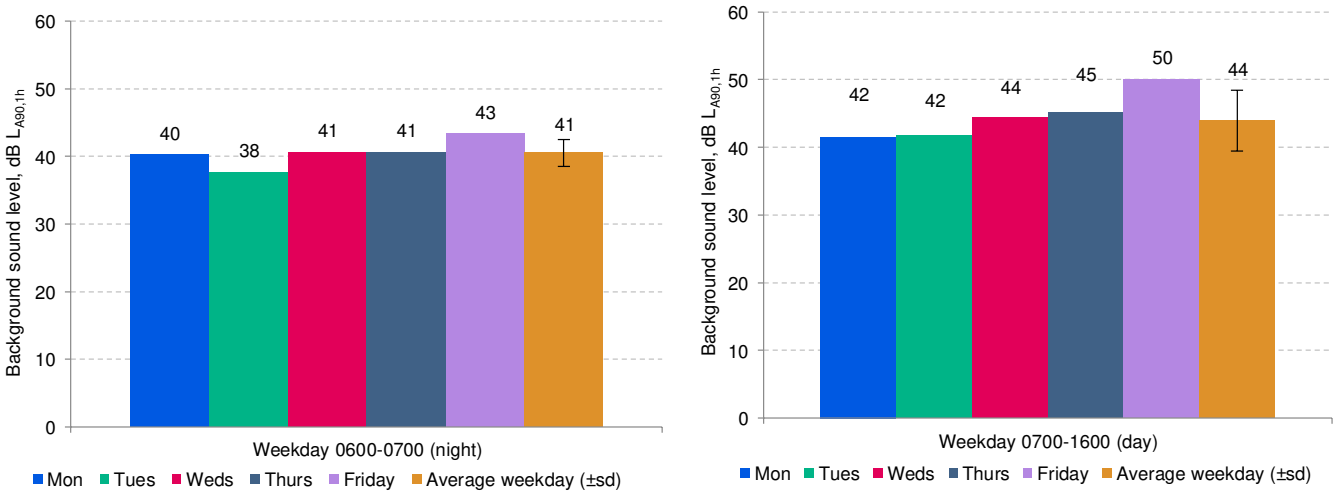


Figure D5: Background sound level analysis for location 1; (left) early morning period; (right) daytime period

The analysis in Figure D5 indicates representative background sound levels at location 1 of 44 dB L_{A90} during the daytime operating hours, and 41 dB L_{A90} during the early morning operating hours.

LOCATION 3: COURT CLOSE

The 24hr continuously-logged sound level data at location 3 is shown calculated over hourly intervals in Figure D6 below, and calculated over 15-minute intervals in Figure D7 below.

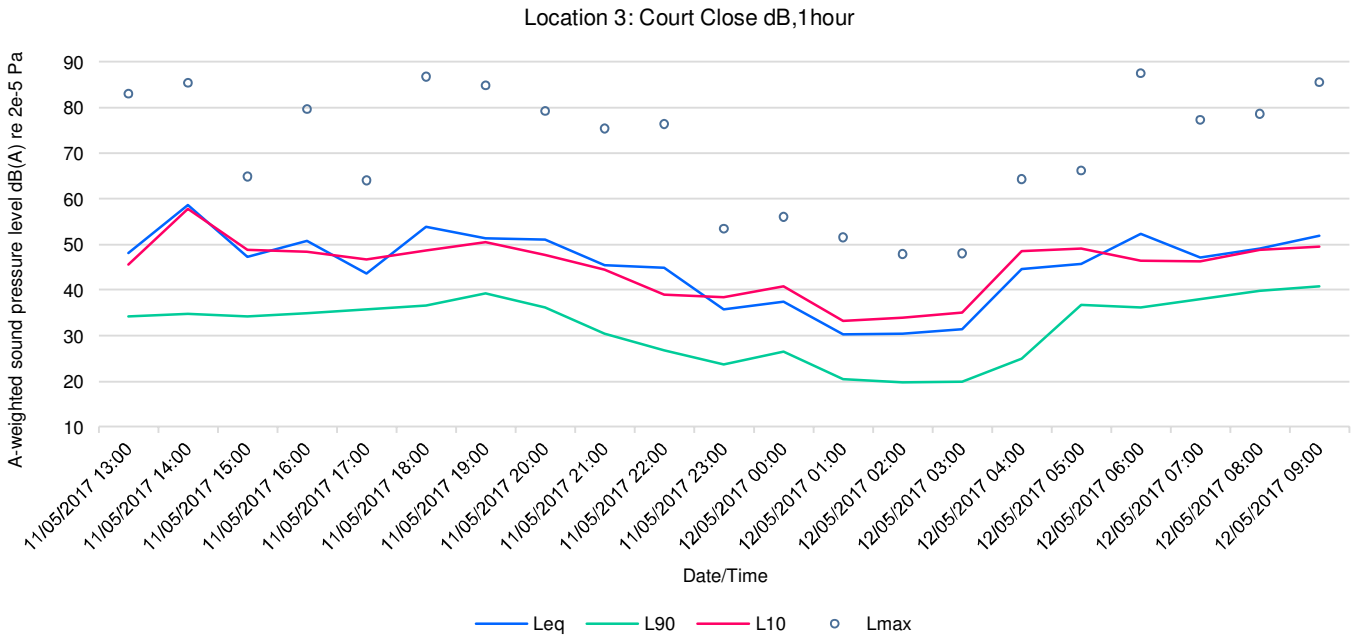


Figure D6: Sound level survey data recorded at location 3 (hourly intervals)

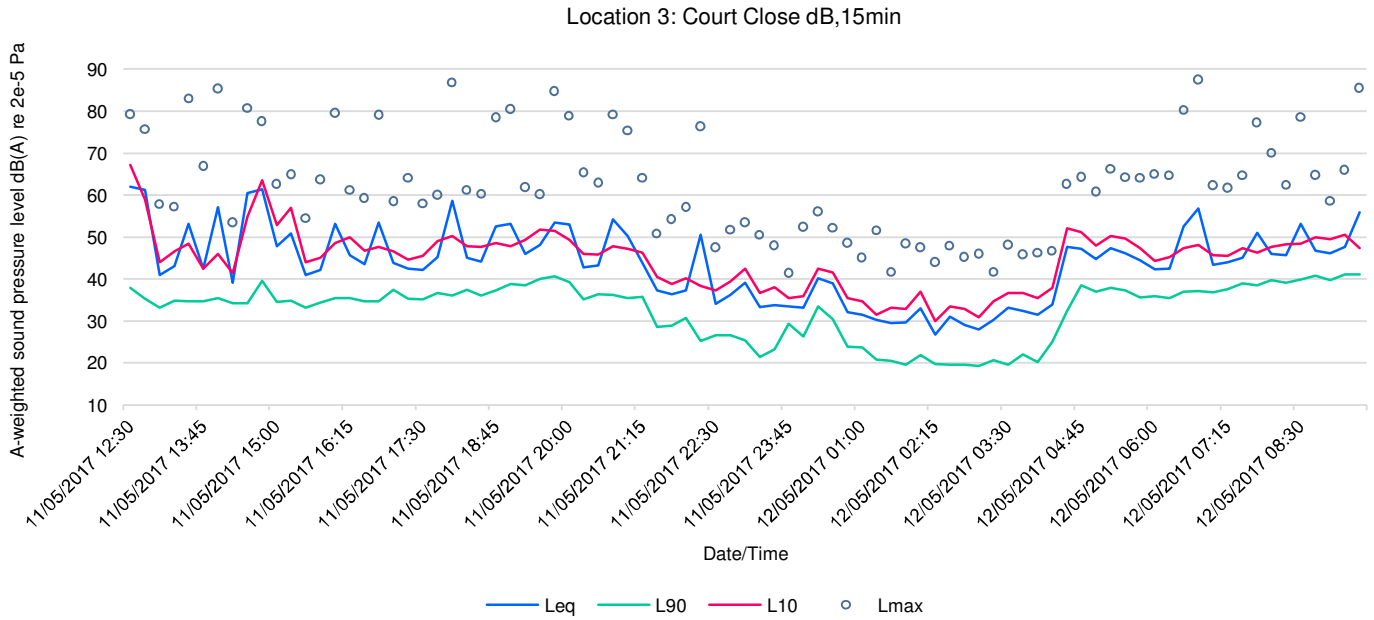


Figure D7: Sound level survey data recorded at location 3 (15-minute intervals)

Observations during the day at location 3 indicate that the ambient sound environment is characterised by distant (faint) traffic on the A483, less frequent traffic on the B4386, occasional trains, and by local community activity and natural sounds, including sheep grazing, farm activity and birdsong. Average sound levels during the daytime varied between around 45 to 60 dB L_{Aeq}. Background sound levels during the daytime operating hours were typically around 35 dB L_{A90}. Measurements during the early morning period of 12 May were affected by rainfall, so the data has been excluded. Based on the data in the night-time period preceding the rainfall, a conservative estimate of the weekday early morning average levels (0600-0700hrs) is around 44 dB $L_{Aeq,15min}$. Similarly, a conservative estimate of the early morning period representative background sound

levels at location 3 based on the distance from the A483 and the pattern of levels measured during the week at location 1 in the same period, is estimated as ~30 dB L_{A90}.

LOCATION 2: MAESDERWEN

Sampled measurements were taken during the day at location 2, the ambient sound environment of which was observed to be broadly similar to that at Court Close, but with additional and more intense farm activity and domestic animal sounds (due to the nature of the use of the property as a working farm). The results of the measurements are summarised below.

Table D3: Sound level survey data recorded at location 2 (sampled)

DATE/TIME/DURATION	L_{Aeq}	L_{A90}	L_{AFmax}
11/05/2017 1240-1255hrs	53 dB	40 dB	75 dB
11/05/2017 1421-1437hrs	47 dB	37 dB	72 dB

On the basis of the measured levels, and comparison with the measurements made at locations 1 and 3, the representative background sound levels at location 2 are estimated as ~37 dB L_{A90} during the daytime operating hours, and ~32 dB L_{A90} during the early morning operating hours.

LOCATION 4: B4386 SITE PERIMETER

Short-term continuously-logged measurements were taken at location 4 during the daytime on Thursday 11 May and Thursday 18 May 2017. Observations indicate that the ambient sound is dominated by the A483 traffic, punctuated by less frequent but closer range vehicles on the B4386. Other sources of note include occasional trains on the Cambrian Line to the south, and farm activity sounds from the vicinity of Maesderwen. The results of the measurements are shown in Table D4 (11/05/2017 data) and Figure D8 (18/05/2017 data) below.

Table D4: Sound level survey data recorded at location 4 (logged, 15-min intervals)

DATE/TIME/DURATION	L_{Aeq}	L_{A90}	L_{A10}	L_{AFmax}
11/05/2017 1348-1403hrs	60 dB	41 dB	59 dB	82 dB
11/05/2017 1403-1418hrs	57 dB	41 dB	59 dB	79 dB

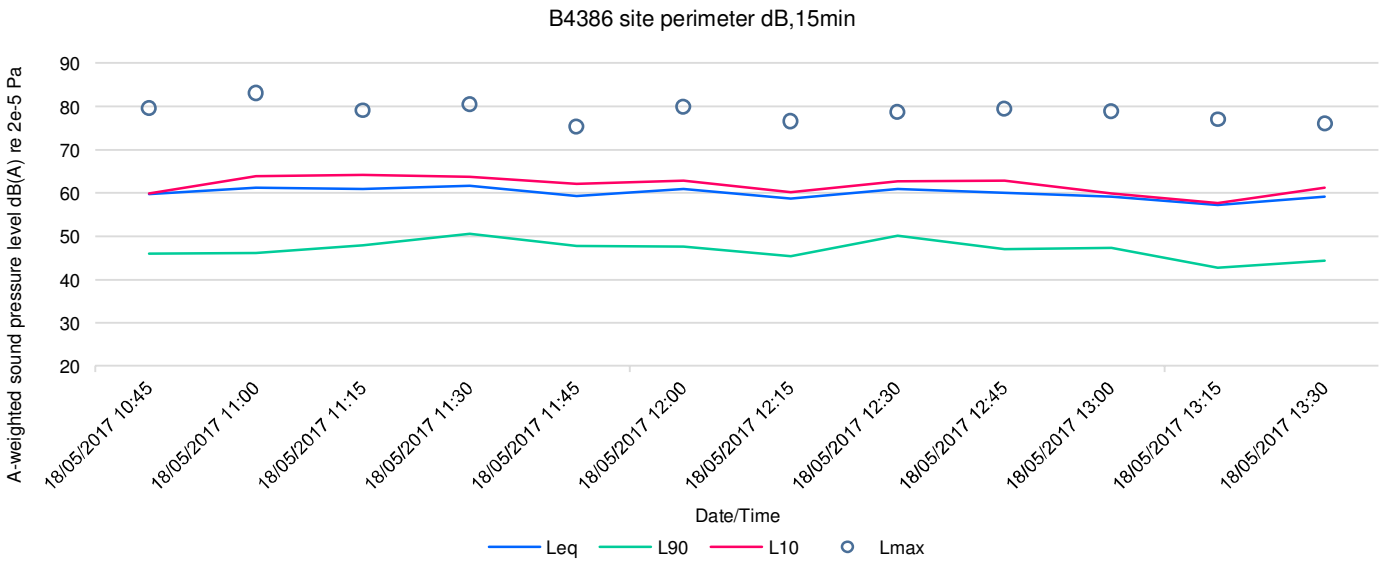


Figure D8: Sound level survey data recorded at location 4 (15-minute intervals)

The measured data at location 4 indicates that typical average levels are around 57 to 60 dB $L_{Aeq,15min}$ during the day with road traffic noise levels around 59 to 62 dB $L_{A10,15min}$.

LOCATIONS 5 & 6: CAMBRIAN RAILWAY LINE SITE PERIMETER

Short-term continuously-logged sound level measurements were taken at locations 5 and 6 during the day on 18 May 2017, at respective distances of approximately 20m and 10m away from the railway track. Observations indicate that the ambient sound at these locations contains a significant component of road traffic noise from the A483 and B4386, punctuated by occasional, louder, short-term noise events as trains pass on the railway line. Around six train passes occurred during the measurements; these included movements in both directions, and a mix of 4-car and 2-car trains. The results of the measurements are shown in Table D5 (10m distance) and Figure D9 (20m distance) below.

Table D5: Sound level survey data recorded at location 6 (logged, 15-min intervals)

DATE/TIME/DURATION	L_{Aeq}	L_{A90}	L_{AFmax}
18/05/2017 1347-1402hrs	50 dB	46 dB	63 dB
18/05/2017 1402-1417hrs	49 dB	44 dB	57 dB
18/05/2017 1417-1432hrs	70 dB	45 dB	92 dB

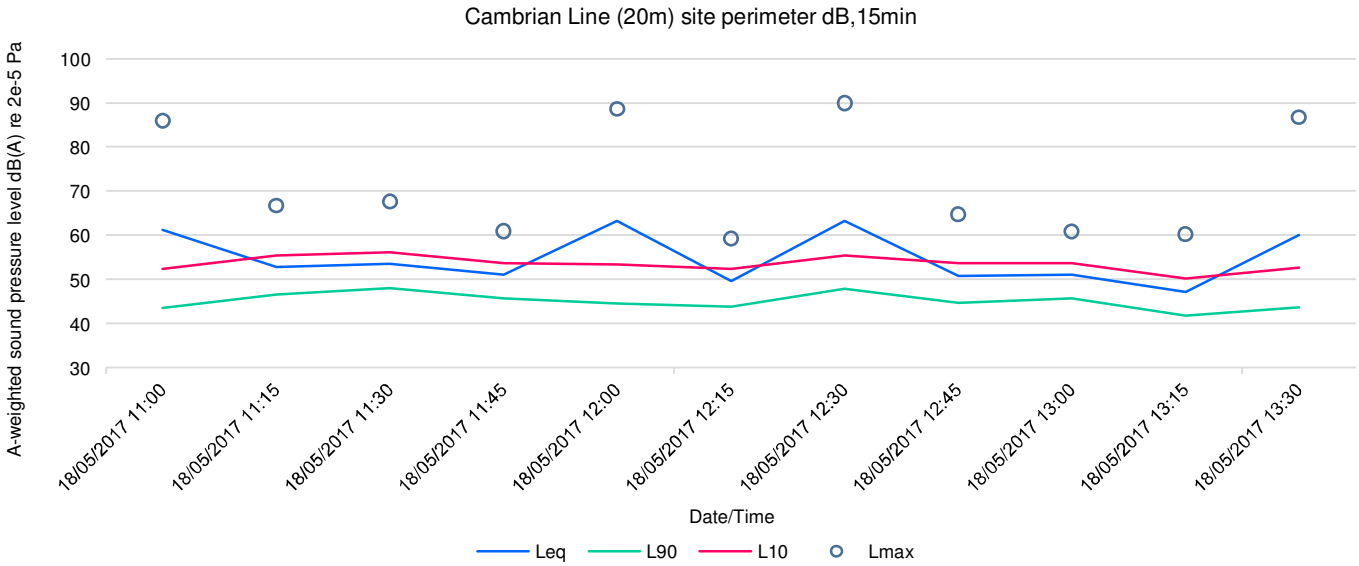


Figure D9: Sound level survey data recorded at location 5 (15-minute intervals)

The measured noise data at locations 5 and 6 indicate that typical ambient levels during the day average to around 62 dB $L_{Aeq,45min}$ at the site perimeter, falling to an average of around 59 dB $L_{Aeq,165min}$ at around 20 m from the track. Maximum sound levels during a train pass were recorded as 92 dB L_{AFmax} at the site perimeter, falling to around 87 to 90 dB L_{AFmax} at approx. 20m from the track.

2.6. Vibration data analysis

LOCATIONS 7 & 8: CAMBRIAN RAILWAY LINE SITE PERIMETER

Vibration measurements were taken at the same distances from the railway track as described above (~10 m and ~20 m), simultaneously with the corresponding sound level measurements. These measurements were triggered manually to include the vibration from individual train pass events. During the survey, five passenger train passes were measured in a period of five hours; no freight trains passed while the daytime surveys took place, and this is not expected to be a line used for frequent freight movements. A triaxial sensor was used to measure the vibration during events in all translational axes. The data showed that at least 97% of the measured root-mean-square vibration acceleration was concentrated in the vertical axis, which is typical for surface measurements of railway vibration. The analysis of vibration dose values (VDV) according to BS 6472-1:2008 has therefore been taken from the vertical axis data. The results of the measurements are summarised below.

Table D6: Vibration survey data recorded at locations 7 (20 m from track) & 8 (10 m from track)

DATE/TIME	DURATION (S)	DISTANCE FROM TRACK	DIRECTION OF TRAVEL	NUMBER OF CARRIAGES	VERTICAL VDV (W_b weighted)
09:40	6.9	20 m	Newtown-Welshpool	2	0.008 $ms^{-1.75}$
12:01	6.4	20 m	Welshpool-Newtown	4	0.007 $ms^{-1.75}$
12:43	7.0	20 m	Newtown-Welshpool	4	0.007 $ms^{-1.75}$
13:43	5.8	20 m	Newtown-Welshpool	2	0.006 $ms^{-1.75}$
14:22	4.9	10 m	Welshpool-Newtown	4	0.017 $ms^{-1.75}$

Consultation of the railway timetables for the line indicates that a total of 23 passenger trains pass the site during the daytime period 0700-2300hrs. Taking the highest VDV values from Table D6 as representative of every train movement during this period results in estimated daytime VDVs of 0.04 $ms^{-1.75}$ at approx. 10 m from the track, and 0.02 $ms^{-1.75}$ at approx. 20 m from the track.

3. BRECON WASTE TRANSFER STATION SOURCE NOISE SURVEY

3.1. Measurement locations

Three short-term continuous logging locations were employed as detailed in Table D8 and indicated in Figure D10 below:

Table D7: Brecon survey measurement location details

REFERENCE	APPROXIMATE COORDINATES (OS GB)		OBJECTIVE	POSITIONING
Log 1	E: 309032	N: 231580	General activity monitor at close range	Approx. 16 m from processing shed; full view of all loading bay doors and outside manoeuvring area
Log 2	E: 309062	N: 231561	General activity monitor at medium range	Approx. 50 m from processing shed; full view of 5/6 loading bay doors and partial view of outside manoeuvring area
Log 3	E: 309087	N: 231543	General activity monitor at long range	Approx. 80 m from processing shed; full view of 3/6 loading bay doors and obscured view of outside manoeuvring area
Note: the microphones were fixed at a height of approximately 1.5 m above ground in all cases				

In addition, concurrent measurements were taken at close range to the most significant activity noises occurring on site: waste/recycling bulking processing (measured in the bay door openings to the processing shed, mobile loader manoeuvring in the yard (including the white noise reversing alarm), and unloading of glass into the storage hopper. Other activities were observed during the survey (eg unloading of food waste and plastic for recycling), but these generated much lower noise levels compared with the main sources noted.

Survey photos showing measurement positioning relative to the site layout and noise sources are appended to this note.

Figure D10: Brecon site survey logging measurement locations satellite photo

3.2. Survey period

The survey was conducted during normal daytime operation of the Waste Transfer Station on 12 February 2018.

3.3. Equipment

The equipment used in the survey is listed below:

Table D8: Abermule survey equipment details

SYSTEM	DETAILS	SERIAL
Sound level meter, mic and preamp	Rion NL-52	01021291
Sound calibrator	Rion NC-74	35125825
Sound level meter, mic and preamp	Rion NL-52	01021290
Sound calibrator	Rion NC-74	01020510
Anemometer	Lutron LM-81 AM	70368

3.4. Weather

Meteorological conditions during the survey comprised cold temperatures (~5-6°C), with a very light coating of recent snow on the ground (see photos), dry and bright with little cloud cover and low winds (around 0 to 1.5 ms^{-1} at microphone height). No precipitation fell during the measurements and the lying snow is not considered thick enough to have significantly affected the sound propagation during the survey.

3.5. Noise data analysis

LOGGED DATA

The average levels logged at position Log 1 are shown below, evaluated over 100 ms, 1-minute and 5-minute intervals:

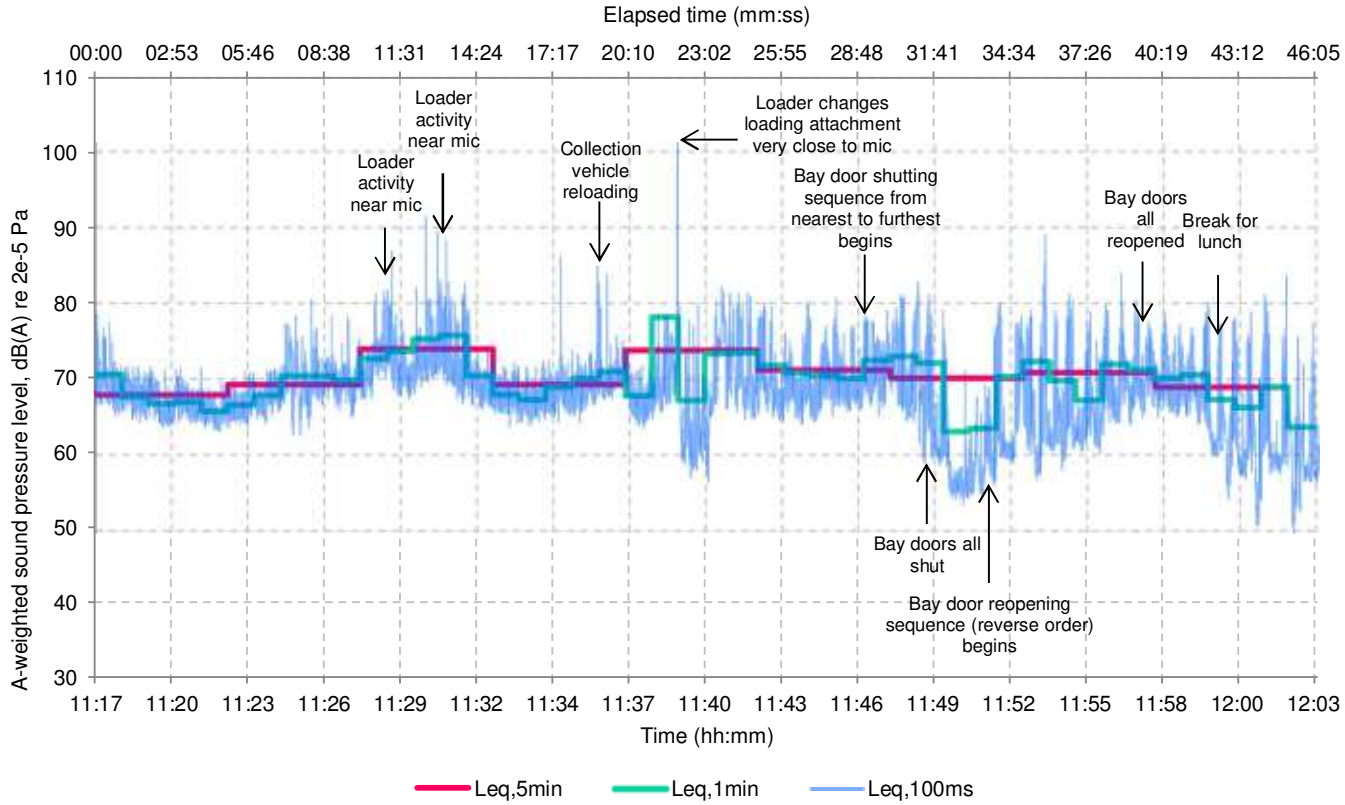


Figure D11: Activity noise survey data recorded at location Log 1

The results in Figure D11 show that 5-minute average levels at Log 1 were relatively steady throughout normal operations, ranging between 68 to 74 dB $L_{Aeq,5min}$. Short term average levels fluctuate more widely according to the activities taking place (and proximity to the measurement position). It can also be seen that there is roughly a 10 dB drop in bulking activity noise levels when all the bay doors are shut, compared with having them all open.

The average levels logged at position Log 2 are shown below, evaluated over 100 ms, 1-minute and 5-minute intervals:

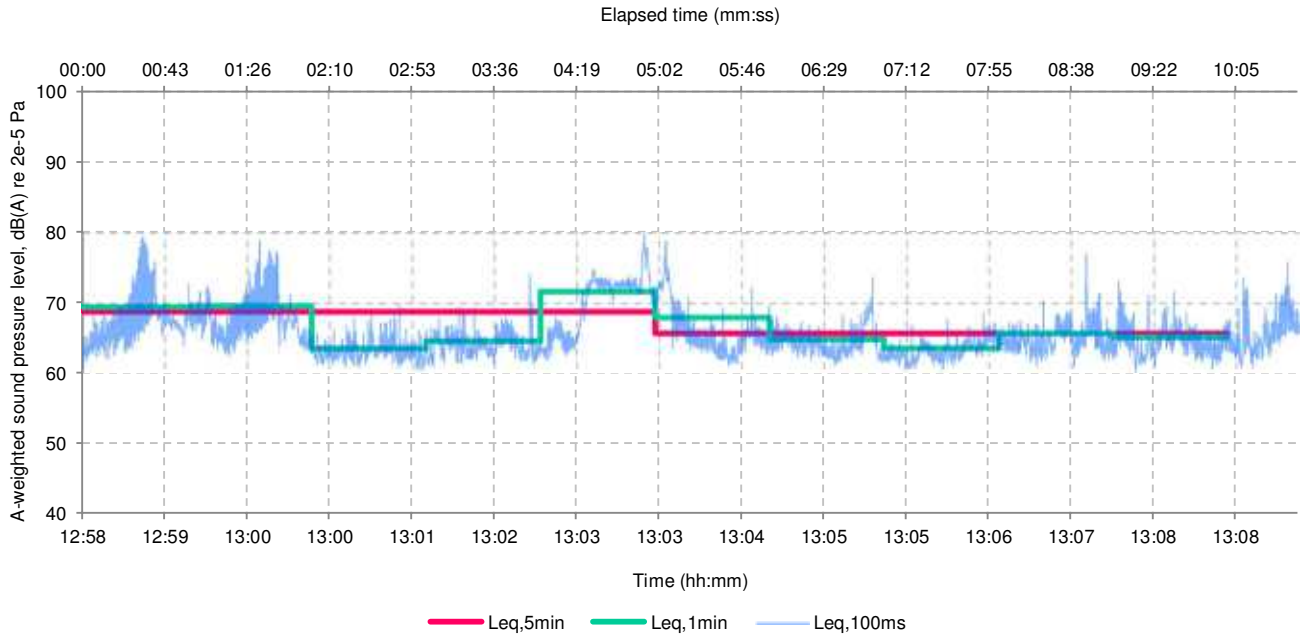


Figure D12: Activity noise survey data recorded at location Log 2

The results in Figure D12 show that 5-minute average levels were around 66 to 69 dB $L_{Aeq,5min}$ at Log 2, indicating a drop in overall average levels of around 2 to 5 dB compared with Log 1.

The average levels logged at position Log 3 are shown below, evaluated over 100 ms, 1-minute and 5-minute intervals:

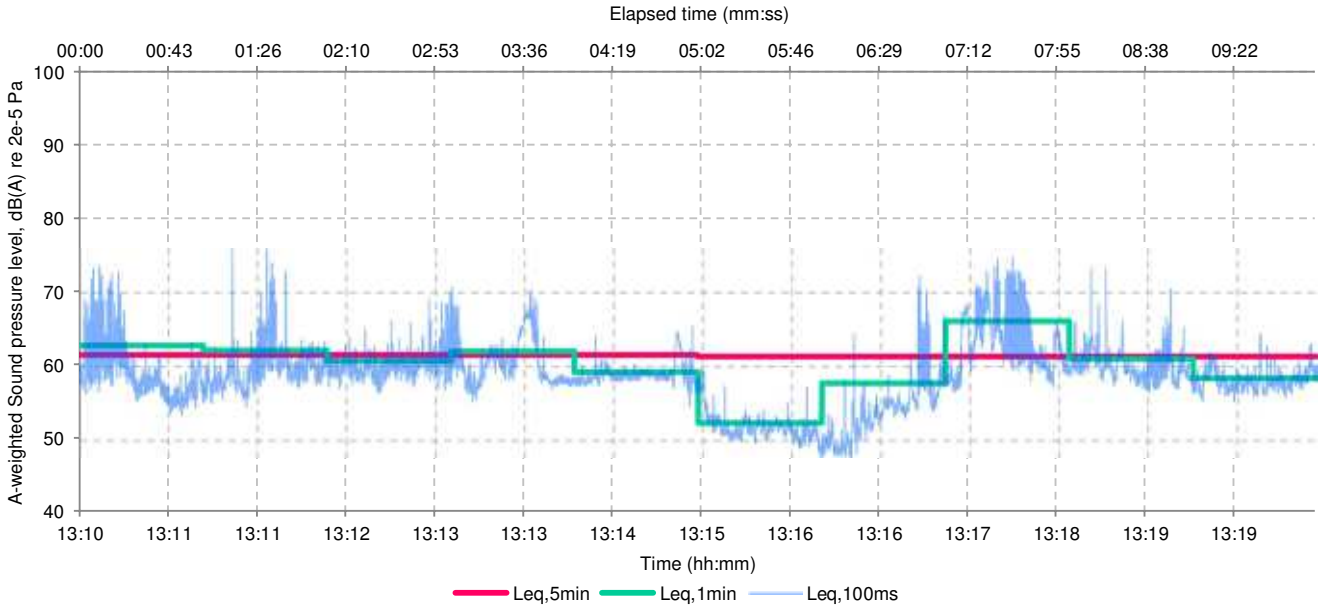


Figure D13: Activity noise survey data recorded at location Log 3

The results in Figure D13 show that 5-minute average levels were steady at 61-62 dB $L_{Aeq,5min}$ at Log 3, indicating a drop in overall average levels of around 10 dB compared with Log 1.

SAMPLED DATA

The third-octave band average sound level spectra measured inside the bay doors during bulking activities are shown in Figure D14. The variation in levels reflects the layout of the processing shed, with the main bulking plant located at the southernmost end, nearest to bay door 1, and furthest from bay door 6.

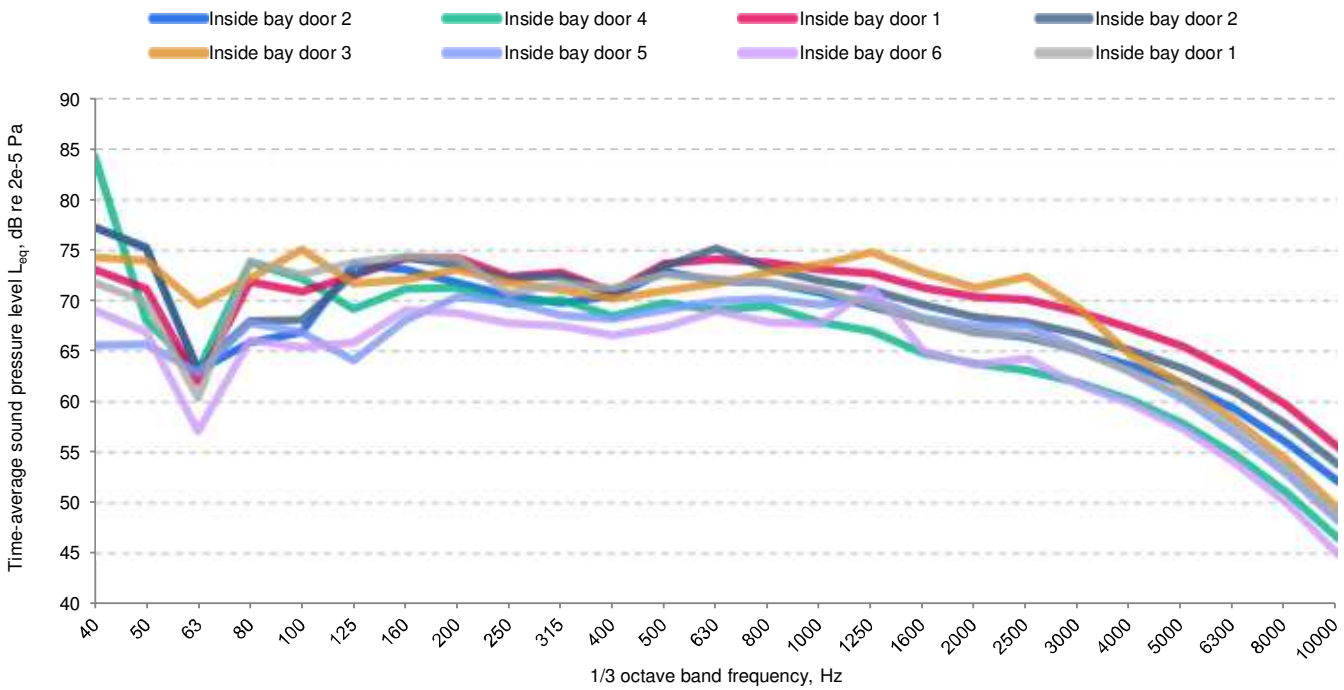


Figure D14: Bulking processing activity noise level spectra measured inside bay doors

The data in Figure D14 in have been analysed using the open area of the bay doors to estimate the octave band sound power levels of the opening. The spectra measured in bay doors 1 to 3 have been averaged to provide a conservative estimate, as shown in Figure D15 below (error bars indicate standard deviation).

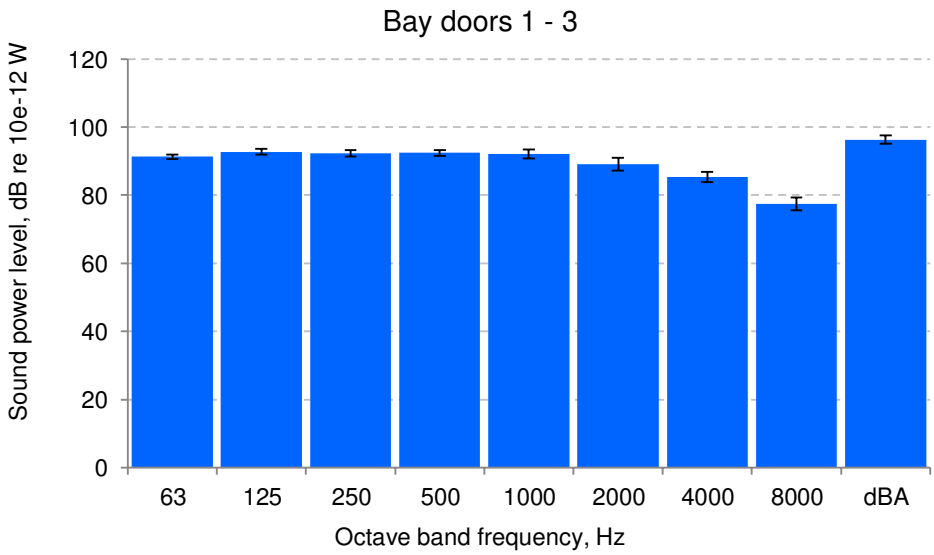


Figure D15: Estimated bulking processing activity sound power level spectrum at bay door

The maximum sound level spectrum measured during reversing of a mobile loader in the manoeuvring yard at a range of approx. 5 m is shown in Figure D16. The maximum level spectrum corresponds to the sound of the white noise reversing alarm in use during the measurement.

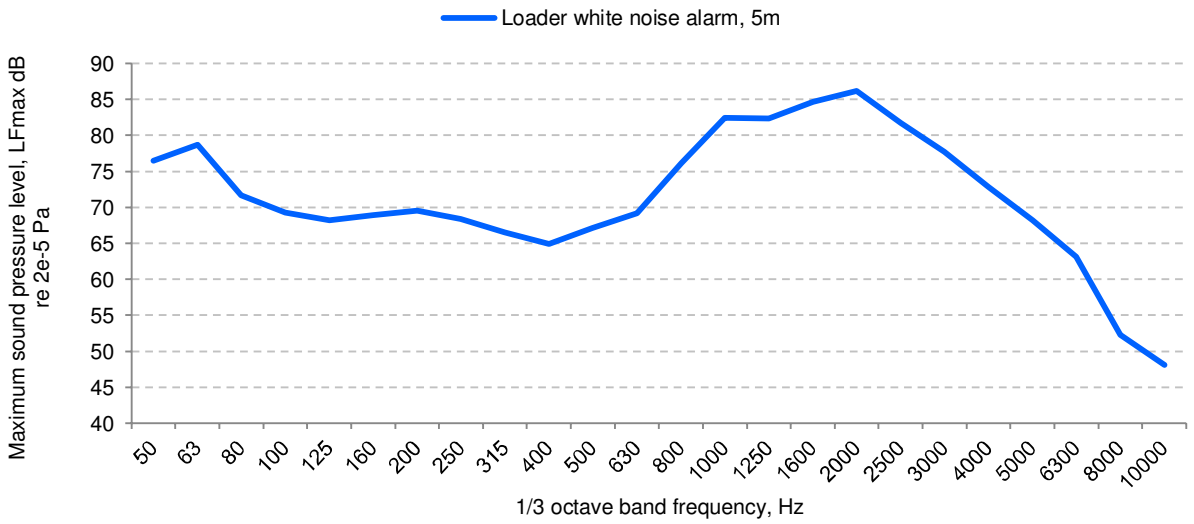


Figure D16: Measured maximum sound level spectrum at close range to mobile loader during white noise reversing alarm use

The maximum sound level spectra measured during the unloading of a glass recycling vehicle and the subsequent compressing of the materials into the glass hopper by a mobile loader at a range of approx. 5 m is shown in Figure D17 below.

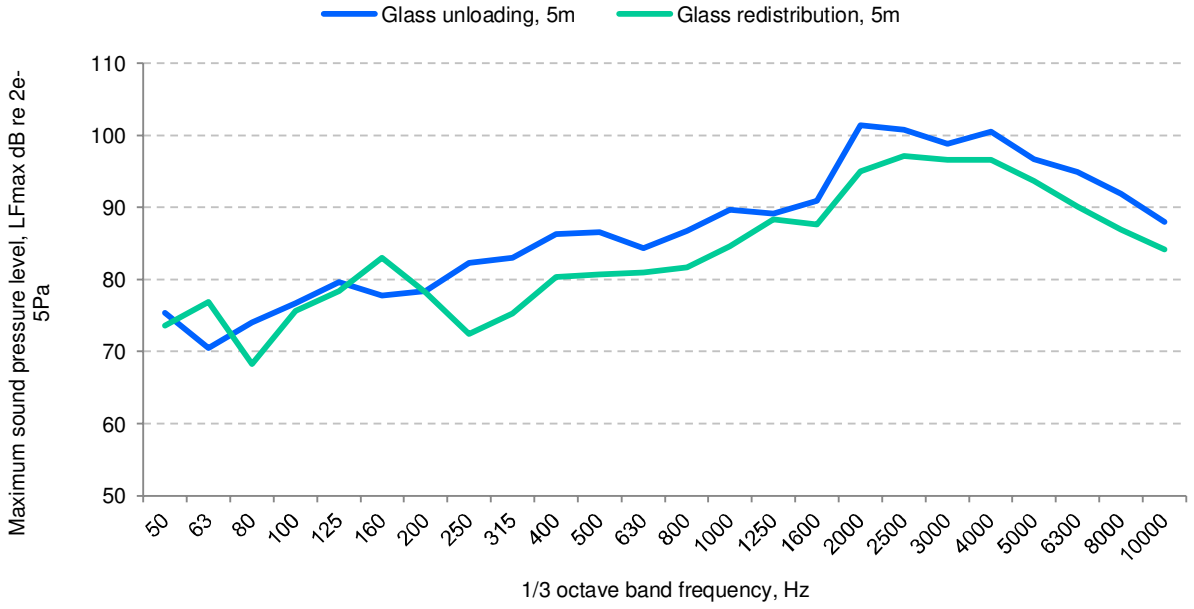


Figure D17: Measured maximum sound level spectra at close range to glass deposit and redistribution activity

DATA APPLICATION

The data analysed from the Brecon survey have been entered into a calibration computer simulation model generated in CadnaA (2018). The model implements the calculation method of ISO 9613-2:1996, and utilises the satellite and site survey photography together with the measurement coordinates to calculate levels using the source noise input data detailed above. The calculated levels at the logging measurement positions indicate that the source input data are valid for transfer into the Abermule development site model.

Table D9: Noise source input data validation calculation results

MODELLED VALIDATION LOCATION	CALCULATED STEADY AVERAGE ACTIVITY NOISE LEVEL $L_{Aeq,t}$	MEASURED STEADY AVERAGE ACTIVITY NOISE LEVELS $L_{Aeq,t}$
Log 1	75 dB	68-74 dB
Log 2	67 dB	66-69 dB
Log 3	61 dB	61-62 dB

Abermule survey: measurement location positioning and notes

1. Bryn Y Maes

Notes:

Road traffic noise on A483 is dominant and continuous

Other farm noise will feature, including machinery and livestock, although the main farming activity is on the opposite side of the property

Weather station located with this logger. All periods of rain (including an hour after rainfall) and high wind removed.

2. Maesderwen

Notes:

Infrequent traffic on B4386 (dominant), distant traffic to north just distinguishable but well screened

Farm machinery and animals (kennelled dogs) feature heavily

Further measurments on 18/05/17 were impeded by incessant dog barking nearby

3. Court Close

Notes:

Lawn mower in nearby garden to start
Distant road traffic just audible (A483), infrequenct local traffic on B4386
Bird song, animals and general farm activities feature
Power failure with Solo10 meant only a single day of data has been captured.
All periods of rain (including an hour after rainfall) and high wind removed using weather station located at Bryn y Maes

4. B4386 Site Boundary

Notes:

Road traffic noise from A483 continuous and dominant
Infrequent local traffic on B4386
Some occasional tractor noise from farm opposite
Bird song/ sheep feature
Cccasional train on Cambrian line south

5 & 7. Railway Site Boundary - 20m from railway

Notes:
Road traffic noise from A483 continuous
Infrequent local traffic on B4386
Some occasional tractor noise from farm opposite
Bird song/ sheep feature


6 & 8. Railway Site Boundary - 10m from railway

Notes:
Road traffic noise from A483 continuous
Infrequent local traffic on B4386
Bird song/ sheep feature


Abermule survey: measurement equipment calibration certificates

Campbell Associates
SOUND & VIBRATION SOLUTIONS
www.campbell-associates.co.uk

UKAS CALIBRATION 0789

Sonitus House, 5b Chelmsford Road Industrial Estate
Great Dunmow, Essex, CM6 1HD

Sales Tel: 01371 871033 Hire Tel: 01371 871037
Admin Tel: 01371 871030 Fax Tel: 01371 879106
E-Mail: info@campbell-associates.co.uk
Website: www.campbell-associates.co.uk

CUBE 2.

Technical Report

Customer: WSP Parsons Brinckerhoff Ltd

Contact: Tom Farmer

Order No: 20031331

Technical log No: 10108

Report Date: 16 September 2016

Internal ref: 19525/WSP200H

Service Req'd: Calibration

Comments: Please UKAS Calibrate SLM and Calibrator

Equipment ID:- 01dB-CUBE.10629

Service Request:- Please UKAS Calibrate 01dB-CUBE.10629

Report: UKAS calibration of 01dB-Cube.10629 complete with 01dB-PRE22.10563 and Gras-40CD.161937 using 01dB-CAL21.34344462 as the associated calibrator. Cert issued.
Certificate number: U22670

Equipment ID:- 01DB-PRE22.10563

Service Request:-

Report: Used during the UKAS calibration of 01dB-Cube.10629.
Certificate number: U22670

Equipment ID:- GRAS-40CD.161937

Service Request:- Diaphragm - okay

Report: Traceable calibration complete and cert issued.
Certificate number: 22669

Equipment ID:- 01db-cal21.34344462

Service Request:- Please UKAS Calibrate 01db-cal21.34344462
c/w - leather case and adapter

Report: UKAS calibration complete and cert issued.
Certificate number: U22668

Accessories supplied: c/w - cable

Technician: M. Hassell

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, Essex, GB-CM6 1HD
www.campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CUBE 2

CALIBRATION 0789

Certificate of Calibration and Conformance

Certificate Number:- U22670

Test object:	**Sound Level Meter, BS EN IEC 61672-1:2003 Class 1 (Precision)**
Manufacturer:	**01dB**
Type:	**CUBE**
Serial no:	**10629**
Customer:	**WSP Parsons Brinckerhoff**
Address:	**6 Devonshire Square, London. EC2M 4YE.**
Contact Person:	**Tom Farmer**
Order No:	**20031331**

Method :
Calibration has been performed as set out in CA Technical Procedures TP01 & 02 as appropriate. These are based on the procedures for periodic verification set out in BS EN IEC 61672-3:2006. Results and conformance statement are overleaf and detailed results are in the attached Test Report.

	Producer:	Type:	Serial No:	Certificate number
Microphone	GRAS	40CD_90	161937	22669
Calibrator*	01dB	Cal21	34344462	U22668
Preamplifier	01dB	PRE22	10563	Included

Additional items that also have been submitted for verification

Wind shield	01dB	01dB
Attenuator	None	
Extension cable	01dB	RAL135-10M

These items have been taken into account wherever appropriate.

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	100.39 ± 0.01kPa	22.8 ± 0.2°C	51.2 ± 2%RH

Date received : 12/09/2016
Date of calibration: 16/09/2016
Date of issue: 16/09/2016

Engineer

Palanivel Marappan B.Eng (Hons), M.Sc

Supervisor

Darren Batten Tech IOA

Certificate of Calibration and Conformance

UKAS Laboratory Number 0789

Certificate Number:- U22670

Conformance

From markings on the sound level meter or by reference to the manufacturer's published literature it has been determined that the instrument submitted for verification was originally manufactured to BS EN IEC 61672-1:2002 and similarly that the associated sound calibrator conforms to BS EN IEC 60942.

Statement of conformance

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of BS EN IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available[1], from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with BS EN IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in BS EN IEC 61672-1:2002, and that the sound level meter submitted for testing conforms to the class 1 requirements of BS EN IEC 61672-1:2003.

[1] This evidence is held on file at the calibration laboratory

Measurement Results:

Indication at the calibration check frequency - IEC61672-3 Ed.1 #9	Passed
Self-generated noise - IEC 61672-3 Ed.1 #10	Passed
Acoustical test of a frequency weighting - IEC 61672-3 Ed.1 #11	Passed
Frequency weightings: A Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: C Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency weightings: Z Network - IEC 61672-3 Ed.1 #12.3	Passed
Frequency and time weightings at 1 kHz IEC 61672-3 Ed.1 #13	Passed
Level linearity on the reference level range - IEC 61672-3 Ed.1 #14	Passed
Toneburst response - IEC 61672-3 Ed.1 #16	Passed
Peak C sound level - IEC 61672-3 Ed.1 #17	Passed
Overload indication - IEC 61672-3 Ed.1 #18	Passed
Combined electrical and acoustical test - IEC 61672-3 Ed.1 #12	Passed

Comment

Correct level with associated calibrator is 93.8dB(A).

The 01dB CUBE meter was calibrated in the following set up:
GRAS-40CD microphone, Outdoor DMK01 unit - Reference direction set to 90 Degree, Small windscreen with Nose cone RA0208 and RAL135/10M microphone extension cable via External microphone input.

Observations

The details of the uncertainty for each measurement is available from the Calibration Laboratory on request and is based on the standard uncertainty multiplied by a coverage factor K=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements. Details on the sources of corrections and their associated uncertainties that relate to this verification are contained the detailed test report accompanying this certificate.

CUBE2

Calibration Report

Certificate Number:-22669

Manufacturer:	**GRAS**
Type:	**40CD_90**
Serial no:	**161937**

Customer:	**WSP Parsons Brinckerhoff**
Address:	**6 Devonshire Square, London. EC2M 4YE.**
Order No:	**20031331**
Contact Person:	**Tom Farmer**

Measurement Results:

	Sensitivity: (dB re 1V/Pa)	Capacitance: (pF)
1:	-25.45	12.8
2:	-25.45	12.8
3:	-25.45	12.8
Result (Average):	**-25.45**	**12.8**
Expanded Uncertainty:	0.10	2.00
Degree of Freedom:	>100	>100
Coverage Factor:	2.00	2.00

The following correction factors have been applied during the measurement:
Pressure:-0.007 dB/kPa Temperature:-0.010 dB/°C Relative humidity:0.000 dB/%RH

Reference Calibrator: WSC1 - Nor1253-24269 Volume correction: 0.000 dB
Records:K:\C A\Calibration\Nor-1504\Nor-1017 MicCal\2016\GRAS40CD_90_161937_M1.nmf
Measurement procedure: TP05
All results quoted are directly traceable to National Physical Laboratory, London

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA publication EA-4/02.

Comment:

Environmental conditions:

Pressure:	Temperature:	Relative humidity:
100.169 ± 0.041 kPa	22.4 ± 0.3 °C	54.9 ± 2.7 %RH

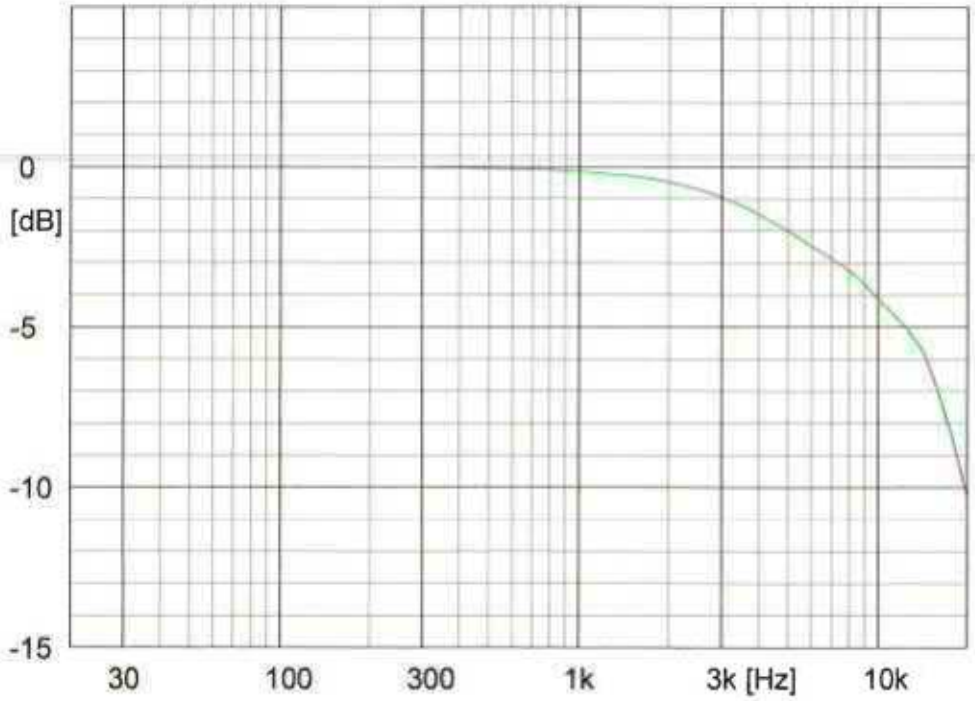
Date of calibration: 15/09/2016
Date of issue: 15/09/2016

Supervisor : Darren Batten TechIOA
Engineer :

Campbell Associates
www.campbell-associates.co.uk

Palanivel Marappan B.Eng(Hons), M.Sc
Software version: 6.0h

Microphone Calibration Certificate



GRAS
Type: 40CD_90

Serial no: 161937

Sensitivity: 53.39 mV/Pa
-25.45 ±0.10 dB re. 1 V/Pa
Capacitance: 12.8 ±2.0 pF
Date: 15/09/2016

Signature: M. Hanivel

Measurement conditions:

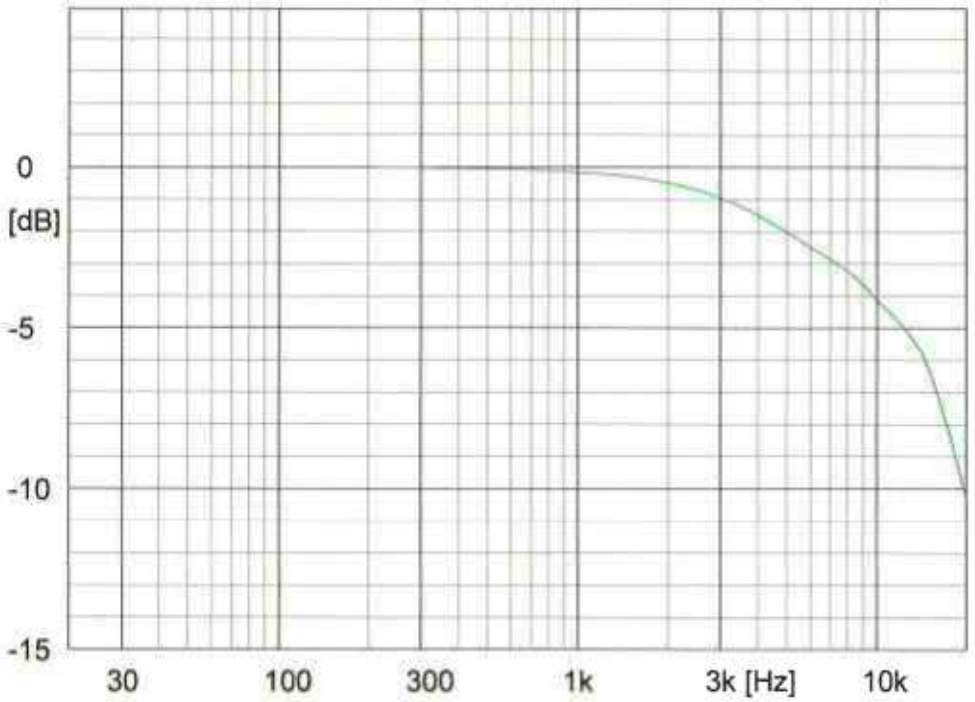
Polarisation voltage:	0.0 V
Pressure:	100.17 ±0.04 kPa
Temperature:	22.4 ±0.3 °C
Relative humidity:	54.9 ±2.7 %RH

Results are normalised to the reference conditions.

Pressure (Actuator) response

Campbell Associates
www.campbell-associates.co.uk

Microphone Calibration Certificate



GRAS
Type: 40CD_90

Serial no: 161937

Sensitivity: 53.39 mV/Pa
-25.45 ±0.10 dB re. 1 V/Pa
Capacitance: 12.8 ±2.0 pF
Date: 15/09/2016

Signature: M. Hanivel

Measurement conditions:

Polarisation voltage:	0.0 V
Pressure:	100.17 ±0.04 kPa
Temperature:	22.4 ±0.3 °C
Relative humidity:	54.9 ±2.7 %RH

Results are normalised to the reference conditions.

Pressure (Actuator) response

Campbell Associates
www.campbell-associates.co.uk

Comment:

CUBE2

Test Report

Manufacturer:	01dB
Instrument type:	CUBE
Serial no:	10629
Customer:	WSP Parsons Brinckerhoff
Department:	
Order No:	20031331
Contact Person:	Tom Farmer
Address:	6 Devonshire Square, London. EC2M 4YE.

Environmental conditions:

Pressure:	100.39 kPa
Temperature:	22.8 °C
Relative humidity:	51.2 %RH

Supervisor	Darren Batten Tech IOA
Engineer	Palanivel Marappan B.Eng (Hons), M.Sc
Date:	16/09/2016

Measurement Results:

Indication at the calibration check frequency - IEC61672-3 Ed.1 Clause 9

```
Reference Calibrator: WSC6 - B&K-4231-1882939
Reference calibrator level: 93.99
Before calibration:
  Environmental corrections: 0.00
  Other corrections: -0.2
  Notional level: 93.79
Reference calibrator level before calibration: 93.8
After calibration:
  Environmental corrections: 0.00
  Other corrections: -0.2
  Notional level: 93.79
Reference calibrator level after calibration: 93.8
Associated Calibrator: 01dB - Cal21 - 34344462
Associated calibrator level: 94.04
Initial level check:
  Environmental corrections before calibration: 0.00
  Other corrections: -0.2
  Notional level: 93.84
Indicated level before calibration: 93.8
Final level statement:
  Environmental corrections after calibration: 0.00
  Other corrections: -0.2
  Notional level: 93.84
Indicated level after calibration: 93.8
Calibrated in manufacturers recommended configuration, calibrate to this value.
Test Passed
```

Self-generated noise - IEC 61672-3 Ed.1 Clause 10

Network	Level (dB)	Comment			
A	17.1	20.0	0.49	P	Microphone installed
A	13.2	16.0	0.49	P	Equivalent capacity
C	14.4	17.0	0.49	P	Equivalent capacity
Z	19.4	21.0	0.49	P	Equivalent capacity

Test Passed

Acoustical test of a frequency weighting - IEC 61672-3 Ed.1 Clause 11

C-Weighted results

Frequency	SLM Meas (dB)	SLM U (dB)	Microphone Corr (dB)	Microphone U (dB)	Case Refl. Corr (dB)	Case Refl. U (dB)	Wind Screen Corr (dB)	Wind Screen U (dB)	Uncert (dB)	Lim (dB)	Result (dB)	
125 Hz	91.5	0.2	0.0	0.3			0.0	0.2	0.4	± 1.5	0.0	P
1 kHz	91.4	0.2	0.0	0.3			0.0	0.2	0.4	± 1.1	0.0	P
8 kHz	91.4	0.1	1.7	0.4			1.6	0.3	0.52.1	/-3.1	-1.3	P

CUBE2.

Acoustical test of a frequency weighting - IEC 61672-3 Ed.1 Clause 11

The overall frequency response of the sound level meter, typical wind screen response and microphone response has shown to conform with the requirements in IEC 61672-3 for a class 1 sound level meter.
Frequency response test using electrostatic actuator.
Sources for correction data:
  Microphone field corrections and uncertainty: 01dB DOC 1144 June 2016
  Case reflections and uncertainty:
  Wind screen corrections and uncertainty: DOC1112 June 2016 I - FWa 2.37
Test Passed
Tabular information

Calibrator =	
txtMFCL125 =	
txtMFCLU125 =	
txtSU125 =	0.20
txtM125_1 =	91.2
txtM125_2 =	91.3
txtM125_3 =	91.3
txtMFCL1k =	
txtMFCLU1k =	
txtSU1k =	0.22
txtM1k_1 =	91.3
txtM1k_2 =	91.4
txtM1k_3 =	91.4
txtMFCL8k =	
txtMFCLU8k =	
txtSU8k =	0.22
txtM8k_1 =	83.8
txtM8k_2 =	83.8
txtM8k_3 =	83.8
txtSLM125 =	91.27
txtNC125 =	0.2
txtSLMU125 =	0.2
txtMic125 =	-0.03
txtMicU125 =	0.25
txtCR125 =	
txtCRU125 =	
txtWS125 =	0.0
txtWSU125 =	0.2
txtSLM1k =	91.37
txtNC1k =	0
txtSLMU1k =	0.2
txtMFCL1k =	
txtMFCLU1k =	
txtMic1k =	0
txtMicU1k =	0.25
txtCR1k =	
txtCRU1k =	
txtWS1k =	0.02
txtWSU1k =	0.2
txtSLM8k =	83.8
txtNC8k =	3.0
txtSLMU8k =	0.1
txtMFCL8k =	
txtMFCLU8k =	
txtMic8k =	1.71
txtMicU8k =	0.35
txtCR8k =	
txtCRU8k =	
txtWS8k =	1.62

Acoustical test of a frequency weighting - IEC 61672-3 Ed.1 Clause 11

txtWSU8k = 0.3

Frequency weightings: A Network - IEC 61672-3 Ed.1 Clause 12.3

Freq (Hz)	Ref. (dB)	Meas. (dB)	Tol. (dB)	Tol. (dB)	Uncert. (dB)	Dev. (dB)	Result
63.1	92.0	91.6	1.5	-1.5	0.12	-0.4	P
125.9	92.0	91.8	1.5	-1.5	0.12	-0.2	P
251.2	92.0	91.9	1.4	-1.4	0.12	-0.1	P
501.2	92.0	91.9	1.4	-1.4	0.12	-0.1	P
1000.0	92.0	92.0	1.1	-1.1	0.12	0.0	P
1995.3	92.0	92.1	1.6	-1.6	0.12	0.1	P
3981.1	92.0	92.5	1.6	-1.6	0.12	0.5	P
7943.3	92.0	90.5	2.1	-3.1	0.12	-1.5	P
15848.9	92.0	89.9	3.5	-17.0	0.12	-2.1	P

Test Passed

Frequency weightings: C Network - IEC 61672-3 Ed.1 Clause 12.3

Freq (Hz)	Ref. Level (dB)	Meas. Value (dB)	Tol. (dB)	Tol. (dB)	Uncert. (dB)	Dev. (dB)	Result
63.1	92.0	91.8	1.5	-1.5	0.12	-0.2	P
125.9	92.0	91.9	1.5	-1.5	0.12	-0.1	P
251.2	92.0	91.9	1.4	-1.4	0.12	-0.1	P
501.2	92.0	92.0	1.4	-1.4	0.12	0.0	P
1000.0	92.0	92.0	1.1	-1.1	0.12	0.0	P
1995.3	92.0	92.2	1.6	-1.6	0.12	0.2	P
3981.1	92.0	92.5	1.6	-1.6	0.12	0.5	P
7943.3	92.0	90.5	2.1	-3.1	0.12	-1.5	P
15848.9	92.0	89.8	3.5	-17.0	0.12	-2.2	P

Test Passed

Frequency weightings: Z Network - IEC 61672-3 Ed.1 Clause 12.3

Freq (Hz)	Ref. Level (dB)	Meas. Value (dB)	Tol. (dB)	Tol. (dB)	Uncert. (dB)	Dev. (dB)	Result
63.1	92.0	91.8	1.5	-1.5	0.12	-0.2	P
125.9	92.0	91.9	1.5	-1.5	0.12	-0.1	P
251.2	92.0	91.9	1.4	-1.4	0.12	-0.1	P
501.2	92.0	92.0	1.4	-1.4	0.12	0.0	P
1000.0	92.0	92.0	1.1	-1.1	0.12	0.0	P
1995.3	92.0	92.2	1.6	-1.6	0.12	0.2	P
3981.1	92.0	92.6	1.6	-1.6	0.12	0.6	P
7943.3	92.0	90.9	2.1	-3.1	0.12	-1.1	P
15848.9	92.0	94.9	3.5	-17.0	0.12	2.9	P

Test Passed

Frequency and time weightings at 1 kHz IEC 61672-3 Ed.1 Clause 13

Weightings		Ref.	Measured	Lim.		Uncert.	Dev.	Result
Time	Netw	(dB)	(dB)	(dB)	(dB)	(dB)	(dB)	
Fast	A	94.0	94.0	0.4	-0.4	0.12	0.0	P
Fast	C	94.0	94.0	0.4	-0.4	0.12	0.0	P
Fast	Z	94.0	94.0	0.4	-0.4	0.12	0.0	P
Slow	A	94.0	94.0	0.3	-0.3	0.12	0.0	P
Leq	A	94.0	94.0	0.3	-0.3	0.12	0.0	P
SEL	A	114.0	114.1	0.3	-0.3	0.12	0.1	P

Test Passed

Level linearity on the reference level range - IEC 61672-3 Ed.1 Clause 14

Ref. (dB)	Measured (dB)	Lim. (dB)	(dB)	Uncert. (dB)	Dev. (dB)	Result
Full scale setting: 130dB						
The following measurements are SPL measurements						
Measured at 8 kHz						
94.0	94.0	1.1	-1.1	0.12	0.0	P
99.0	99.0	1.1	-1.1	0.12	0.0	P
104.0	103.9	1.1	-1.1	0.12	-0.1	P
109.0	108.9	1.1	-1.1	0.12	-0.1	P
114.0	113.9	1.1	-1.1	0.12	-0.1	P
119.0	118.8	1.1	-1.1	0.12	-0.2	P
124.0	123.9	1.1	-1.1	0.12	-0.1	P
126.9	126.8	1.1	-1.1	0.12	-0.1	P
127.9	127.7	1.1	-1.1	0.12	-0.2	P
128.9	128.7	1.1	-1.1	0.12	-0.2	P
129.9	129.8	1.1	-1.1	0.12	-0.1	P
130.9	130.7	1.1	-1.1	0.12	-0.2	P
131.9	131.7	1.1	-1.1	0.12	-0.2	P
94.0	94.0	1.1	-1.1	0.12	0.0	P
89.0	89.0	1.1	-1.1	0.12	0.0	P
84.0	84.0	1.1	-1.1	0.12	0.0	P
79.0	79.0	1.1	-1.1	0.12	0.0	P
74.0	74.0	1.1	-1.1	0.12	0.0	P
69.0	68.9	1.1	-1.1	0.12	-0.1	P
64.0	64.0	1.1	-1.1	0.12	0.0	P
59.0	58.9	1.1	-1.1	0.12	-0.1	P
54.0	53.9	1.1	-1.1	0.12	-0.1	P
49.0	49.0	1.1	-1.1	0.12	0.0	P
44.0	44.0	1.1	-1.1	0.12	0.0	P
39.0	39.0	1.1	-1.1	0.12	0.0	P
34.0	34.0	1.1	-1.1	0.12	0.0	P
29.0	29.1	1.1	-1.1	0.12	0.1	P
27.0	27.1	1.1	-1.1	0.12	0.1	P
26.0	26.2	1.1	-1.1	0.12	0.2	P
25.0	25.3	1.1	-1.1	0.12	0.3	P
24.0	24.4	1.1	-1.1	0.12	0.4	P
23.0	23.4	1.1	-1.1	0.12	0.4	P
22.0	22.5	1.1	-1.1	0.12	0.5	P

Test Passed

Toneburst response - IEC 61672-3 Ed.1 Clause 16

Burst type	Ref. (dB)	Measured (dB)	Tol. (dB)	Tol. (dB)	Uncert. (dB)	Dev. (dB)	Result
Fast 200 mSec	134.0	134.0	0.8	-0.8	0.16	0.0	P
Fast 2.0 mSec	117.0	116.8	1.3	-1.8	0.16	-0.2	P
Fast 0.25 mSec	108.0	107.7	1.3	-3.3	0.16	-0.3	P
Slow 200 mSec	127.6	127.6	0.8	-0.8	0.16	0.0	P
Slow 2.0 mSec	108.0	108.0	1.3	-3.3	0.16	0.0	P
SEL 200 mSec	128.0	128.1	0.8	-0.8	0.16	0.1	P
SEL 2.0 mSec	108.0	108.0	1.3	-1.8	0.16	0.0	P
SEL 0.25 mSec	99.0	98.7	1.3	-3.3	0.16	-0.3	P

Test Passed

Peak C sound level - IEC 61672-3 Ed.1 Clause 17

Pulse Type	Pulse Freq. (Hz)	Ref. RMS (dB)	Ref. Peak (dB)	Measured Value (dB)	Lim. (+/-dB)	Uncert. (dB)	Dev. (dB)	Result
1 cycle	8k	126.0	129.4	129.1	2.4	0.2	-0.3	P
Pos 1/2 cycle	500	129.0	131.4	131.7	1.4	0.2	0.3	P
Neg 1/2 cycle	500	129.0	131.4	131.8	1.4	0.2	0.4	P

Test Passed

Overload indication - IEC 61672-3 Ed.1 Clause 18

	Measured (dB)	Lim. (+/-dB)	Uncert. (dB)	Result
Level difference of positive and negative pulses:	0.4	1.8	0.16	P
Positive 1/2 cycle 4 kHz. Overload occurred at:	140.3			
Negative 1/2 cycle 4 kHz. Overload occurred at:	140.7			

Test Passed
01dBCUBE.ini

Combined electrical and acoustical test - IEC 61672-3 Ed.1 Clause 12

A-Weighted results

Frequency	SLM Val (dB)	SLM U (dB)	Microphone Val (dB)	Microphone U (dB)	Case Refl. Val (dB)	Case Refl. U (dB)	Wind Screen Val (dB)	Wind Screen U (dB)	Uncert (dB)	Tol (dB)	Result (dB)	
63 Hz	-0.4	0.1	-0.3	0.3	0.2	0.3	0.0	0.2	0.5	+-1.0	-0.5	P
125 Hz	-0.2	0.1	-0.3	0.3	0.2	0.3	0.0	0.2	0.5	+-1.0	-0.3	P
250 Hz	-0.1	0.1	-0.3	0.3	0.1	0.3	0.0	0.2	0.5	+-1.0	-0.3	P
500 Hz	-0.1	0.1	-0.3	0.3	0.1	0.3	0.0	0.2	0.5	+-1.0	-0.3	P
1 kHz	0.0	0.1	-0.3	0.3	0.1	0.3	0.0	0.2	0.5	+-0.7	-0.2	P
2 kHz	0.1	0.1	-0.2	0.3	-0.3	0.3	0.1	0.2	0.5	+-1.0	-0.3	P
4 kHz	0.5	0.1	0.3	0.3	-0.9	0.3	0.6	0.2	0.5	+-1.0	0.4	P
8 kHz	-1.5	0.1	1.3	0.4	-2.6	0.4	1.6	0.3	0.6	+1.5/-2.5	-1.2	P
16 kHz	-2.1	0.1	-3.9	0.5	-0.6	0.4	-5.2	0.3	0.7	+2.5/-16.0	-11.8	P

C-Weighted results

CUBE2.

Combined electrical and acoustical test - IEC 61672-3 Ed.1 Clause 12

Frequency	SLM Val (dB)	SLM U (dB)	Microphone Val (dB)	Microphone U (dB)	Case Refl. Val (dB)	Case Refl. U (dB)	Wind Screen Val (dB)	Wind Screen U (dB)	Uncert (dB)	Tol (dB)	Result (dB)	
63 Hz	-0.2	0.1	-0.3	0.3	0.2	0.3	0.0	0.2	0.5	+-1.0	-0.3	P
125 Hz	-0.1	0.1	-0.3	0.3	0.2	0.3	0.0	0.2	0.5	+-1.0	-0.2	P
250 Hz	-0.1	0.1	-0.3	0.3	0.1	0.3	0.0	0.2	0.5	+-1.0	-0.3	P
500 Hz	0.0	0.1	-0.3	0.3	0.1	0.3	0.0	0.2	0.5	+-1.0	-0.2	P
1 kHz	0.0	0.1	-0.3	0.3	0.1	0.3	0.0	0.2	0.5	+-0.7	-0.2	P
2 kHz	0.2	0.1	-0.2	0.3	-0.3	0.3	0.1	0.2	0.5	+-1.0	-0.2	P
4 kHz	0.5	0.1	0.3	0.3	-0.9	0.3	0.6	0.2	0.5	+-1.0	0.4	P
8 kHz	-1.5	0.1	1.3	0.4	-2.6	0.4	1.6	0.3	0.6	+1.5/-2.5	-1.2	P
16 kHz	-2.2	0.1	-3.9	0.5	-0.6	0.4	-5.2	0.3	0.7	+2.5/-16.0	-11.9	P

Z-Weighted results

Frequency	SLM Val (dB)	SLM U (dB)	Microphone Val (dB)	Microphone U (dB)	Case Refl. Val (dB)	Case Refl. U (dB)	Wind Screen Val (dB)	Wind Screen U (dB)	Uncert (dB)	Tol (dB)	Result (dB)	
63 Hz	-0.2	0.1	-0.3	0.3	0.2	0.3	0.0	0.2	0.5	+-1.0	-0.3	P
125 Hz	-0.1	0.1	-0.3	0.3	0.2	0.3	0.0	0.2	0.5	+-1.0	-0.2	P
250 Hz	-0.1	0.1	-0.3	0.3	0.1	0.3	0.0	0.2	0.5	+-1.0	-0.3	P
500 Hz	0.0	0.1	-0.3	0.3	0.1	0.3	0.0	0.2	0.5	+-1.0	-0.2	P
1 kHz	0.0	0.1	-0.3	0.3	0.1	0.3	0.0	0.2	0.5	+-0.7	-0.2	P
2 kHz	0.2	0.1	-0.2	0.3	-0.3	0.3	0.1	0.2	0.5	+-1.0	-0.2	P
4 kHz	0.6	0.1	0.3	0.3	-0.9	0.3	0.6	0.2	0.5	+-1.0	0.5	P
8 kHz	-1.1	0.1	1.3	0.4	-2.6	0.4	1.6	0.3	0.6	+1.5/-2.5	-0.8	P
16 kHz	2.9	0.1	-3.9	0.5	-0.6	0.4	-5.2	0.3	0.7	+2.5/-16.0	-6.8	P

Actual frequency response of GRAS / 40CD_90 161937 has been used in this test.

Test Passed

The overall frequency response of the sound level meter, nominal case reflections, typical wind screen response and microphone response has shown to conform with the requirements in IEC 61672-3 for a class 1 sound level meter.

01dBCUBE.ini

CUBE 2 CAL

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, CM6 1HD, England
www.campbell-associates.co.uk
info@campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION

0789

Certificate number: U22668

Certificate of Calibration and Conformance

Test object:	**Sound Calibrator**
Manufacturer:	**01dB**
Type:	**Cal21**
Serial no:	**34344462**
Customer:	WSP Parsons Brinckerhoff
Address:	6 Devonshire Square, London. EC2M 4YE.
Contact Person:	Tom Farmer
Order No:	20031331

Measurement Results:	Level	Level Stability	Frequency	Frequency Stability	Distortion
1:	94.04 dB	0.01 dB	1003.15 Hz	0.00 %	1.34 %
2:	94.04 dB	0.01 dB	1003.14 Hz	0.00 %	1.34 %
3:	94.04 dB	0.01 dB	1003.12 Hz	0.00 %	1.39 %
Result (Average):	**94.04 dB**	**0.01 dB**	**1003.14 Hz**	**0.00 %**	**1.36 %**
Expanded Uncertainty:	0.10 dB	0.02 dB	1.00 Hz	0.01 %	0.11 %
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20µPa. The level is traceable to National Standards.
The stated level is valid at reference conditions. The following correction factors have been applied during the measurement: Pressure: 0.000 dB/kPa Temperature: 0.000 dB/°C Relative humidity: 0.000 dB/%RH Load volume : 0.00072 dB/mm3
The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.
Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2016\01dBCAL21_34344462_M1.nmf

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	100.170 ± 0.040 kPa	22.2 ± 0.4 °C	55.1 ± 2.5 %RH

Date received for calibration:	12/09/2016
Date of calibration:	15/09/2016
Date of issue:	15/09/2016
Engineer	

M. Palanivel

Palanivel Marappan BEng(Hons), MSc

Supervisor

Darren Batten TechIOA

Certificate number: U22668

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Measurements
The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Instruments and program
A complete list of equipment, hardware and software that has been used in this calibration is available from the calibration laboratory on request.

Traceability
The measured values are traceable to the following laboratories:
Sound Pressure Level: National Physical Laboratory, United Kingdom
Voltage: National Physical Laboratory, United Kingdom
Frequency: National Physical Laboratory, United Kingdom
Ambient Pressure: National Physical Laboratory, United Kingdom
Temperature & Relative Humidity: National Physical Laboratory, United Kingdom

Comment
Calibrated as received, no adjustments made.

Statement of conformance
As public evidence was available[1], from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in annex A of BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

[1] This evidence is held on file at the calibration laboratory.

Notes:
The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in **BOLD** are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Sonitus House, 5b Chelmsford Road Industrial Estate, Great Dunmow, GB-CM6 1HD
Tel (+44) 01371 871030 Fax (+44) 01371 879106
email calibration@campbell-associates.co.uk

Certificate of Calibration

Issued by University of Salford (Acoustics Calibration Laboratory)
UKAS ACCREDITED CALIBRATION LABORATORY NO. 0801

APPROVED SIGNATORIES
Claire Lomax [x] Andy Moorhouse [ ]
Gary Phillips [ ] Danny McCaul [ ]

acoustic calibration laboratory
The University of Salford, Salford, Greater Manchester, M5 4WT, UK
http://www.acoustics.salford.ac.uk
t 0161 295 3030/0161 295 3319 f 0161 295 4456 e c.lomax1@salford.ac.uk

UKAS CALIBRATION 0801

University of Salford MANCHESTER

Certificate Number: 03108/1 Date of Issue: 2 March 2017

PERIODIC TEST OF A SOUND LEVEL METER to IEC 61672-3:2006

FOR:	WSP | Parsons Brinckerhoff 6 Devonshire Square London EC2M 4YE
FOR THE ATTENTION OF:	Tom Farmer
PERIODIC TEST DATE:	1st and 2nd March 2017
TEST PROCEDURE:	CTP12 (Laboratory Manual)

Sound Level Meter Details

Manufacturer	01dB	
Model	DUO	
Serial number	10594	
Class	1	
Hardware version	LIS1005G	Application FW: 2.38. Metrology FW: 2.12

Associated Items	**Microphone**	**Preamplifier**
Manu	GRAS	01dB
Model	40CD	PRE22
Serial Number	224313	1507076

Test Engineer (initial): GP Name: Gary Phillips

Certificate Number: 03108/1 Date of Issue: 2 March 2017

Procedures from IEC 61672-3: 2006 and TPS 49 Edition 2 June 2009 were used to perform the periodic tests. The manufacturer's instruction manual was marked as follows: DOC1112 June 2014 G - DUO User Manual GB.

Adjustment data used to adjust the sound levels indicated in response to the application of a multi-frequency sound calibrator to sound levels equivalent to those that would be indicated in response to plane, progressive sound waves were obtained from the manufacturer.

The sound level meter calibration check frequency is 1000 Hz; the reference sound pressure level is 94 dB. As this instrument only has a single range, this range is the reference level range.

The environmental conditions in the laboratory at the start of the test were:
Static pressure 99.001 kPa ± 0.017 kPa, air temperature 23.8 °C ± 0.3 °C, relative humidity 36.7 % ± 1.9%.

The initial response of the instrument to application of the suitable laboratory sound calibrator was 93.4 dB (C). The instrument was then adjusted to indicate 93.7 dB (C). This indication was obtained from the calibration certificate of the calibrator and information in the manufacturer's instruction manual specified in this certificate, when the instrument is configured for use with the RAL135-10m microphone extension cable, DMK01 unit and the following instrument settings; Microphone input: External, Microphone type: 40CD, Reference direction: 90°, High-pass filter: 10 Hz, Nose cone: Yes.

With the microphone installed, the level of self-generated noise was:

A: 17.3 dB*

With the microphone replaced by an electrical input device with a similar capacitance to that of the electrical input device specified by the manufacturer, the levels of self-generated noise were:

A: 10.7 dB*
B: 10.2 dB*
C: 11.5 dB*
Z: 21.6 dB†

* Under-range indicated on instrument display.
†Indicates that the measured level exceeds the highest anticipated level of self-generated noise stated in the manufacturer's instruction manual.

The environmental conditions in the laboratory at the end of the test were:
Static pressure 100.233 kPa ± 0.017 kPa, air temperature 23.1 °C ± 0.3 °C, relative humidity 38.3 % ± 1.9%.

Certificate Number: 03108/1 Date of Issue: 2 March 2017

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

The instrument failed to meet the requirements for the test of electrical signal tests of frequency weightings at 250 Hz, 500 Hz and 1 kHz for the A, B, C and Z-weightings, as the uncertainty of measurement exceeded the maximum permitted value due to a significant contribution from data supplied by the manufacturer. If the manufacturer's uncertainty data were not included, the meter would meet the requirements of the Standard.

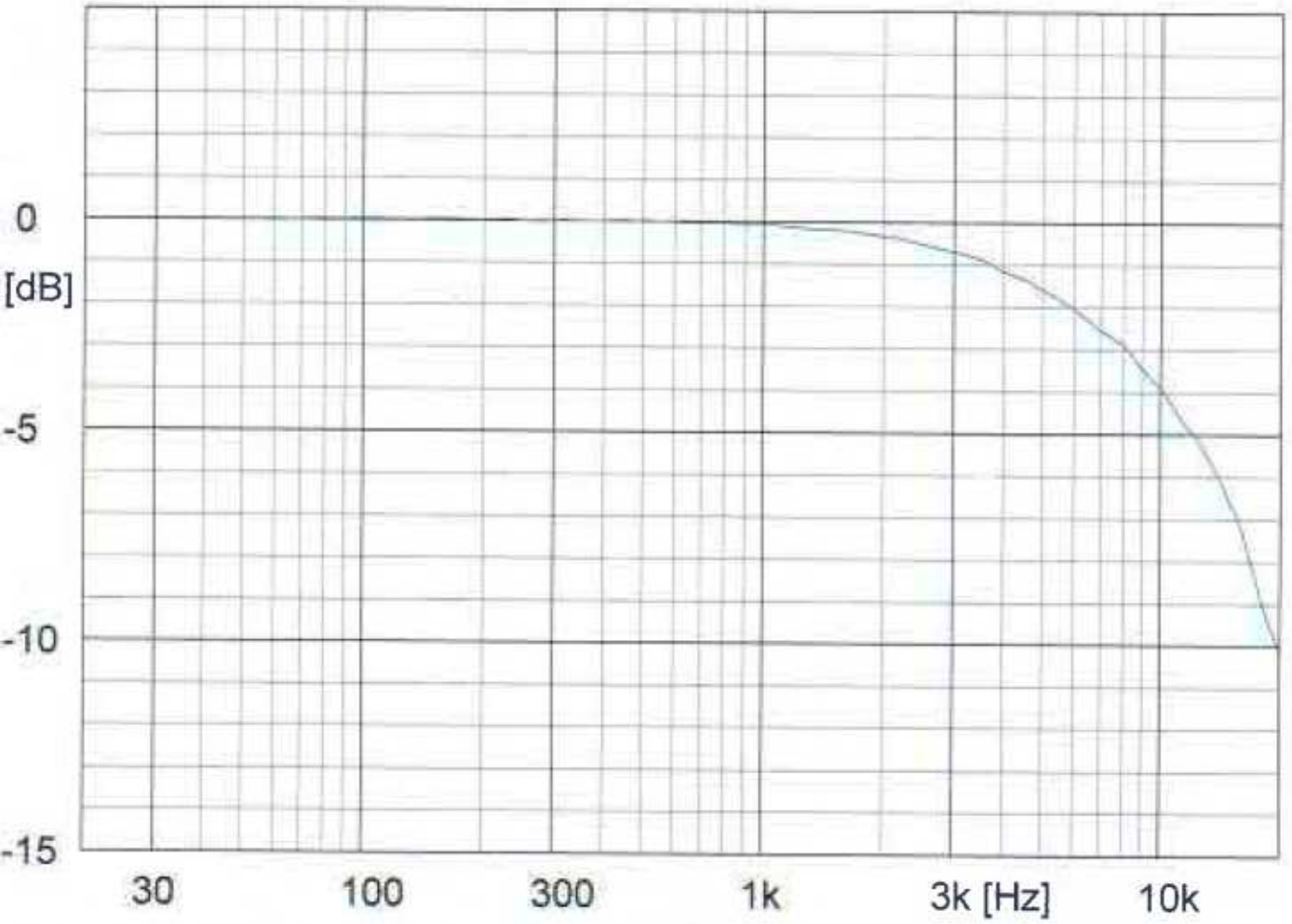
As the actual frequency response of the microphone was unavailable, the typical frequency response for the model of microphone has been used to correct the level differences determined in the electrical signal test of frequency weighting.

Instruments used in the verification procedure were traceable to *National Standards*. The multi-frequency calibrator method was employed in the acoustical tests of a frequency weighting.

The uncertainty evaluation has been carried out in accordance with UKAS requirements. All measurement results are retained at the acoustic calibration laboratory for at least four years.

Microphone Calibration Certificate

Duo 5



GRAS
Type : GRAS40CD

Serial no : 224313

Sensitivity :
0.00 ±0.00 dB re. 1 V/Pa
Capacitance : 14.6 ±2.0 pF
Date : 20/02/2017

Signature :

Measurement conditions :

Polarisation voltage :	0.0 V
Pressure :	00.00 ±0.00 kPa
Temperature :	00.0 ±0.0 °C
Relative humidity :	0.0 ±0.0 %RH

Results are normalised to the reference conditions.

Free field response
Diffuse field response
Pressure (Actuator) response

Salford University
www.aee.salford.ac.uk

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, CM6 1HD, England
www.campbell-associates.co.uk
info@campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

DUOS CAL

CALIBRATION

0789

Certificate number: U22621

Certificate of Calibration and Conformance

Test object:	**Sound Calibrator**
Manufacturer:	**01dB**
Type:	**Cal21**
Serial no:	**34924020**
Customer:	WSP Parsons Brinckerhoff
Address:	2nd Floor, The Victoria, 150 - 182 The Quays, Salford, Greater Manchester. M50 3SP.
Contact Person:	Benjamin Reed - Assistant Engineer

Measurement Results:	Level	Level Stability	Frequency	Frequency Stability	Distortion
1:	94.11 dB	0.01 dB	1002.29 Hz	0.00 %	1.38 %
2:	94.11 dB	0.01 dB	1002.29 Hz	0.00 %	1.40 %
3:	94.12 dB	0.01 dB	1002.28 Hz	0.00 %	1.39 %
Result (Average):	**94.11 dB**	**0.01 dB**	**1002.28 Hz**	**0.00 %**	**1.39 %**
Expanded Uncertainty:	0.10 dB	0.02 dB	1.00 Hz	0.01 %	0.10 %
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20µPa. The level is traceable to National Standards.
The stated level is valid at reference conditions. The following correction factors have been applied during the measurement: Pressure: 0.000 dB/kPa Temperature: 0.000 dB/°C Relative humidity: 0.000 dB/%RH Load volume : 0.00072 dB/mm3
The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.
Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2016\01dBCAL21_34924020_M1.nmf

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	100.846 ± 0.041 kPa	21.2 ± 0.3 °C	52.3 ± 2.2 %RH

Date received for calibration:	05/09/2016
Date of calibration:	09/09/2016
Date of issue:	09/09/2016
Engineer	

M. Panivel

Palanivel Marappan BEng(Hons), MSc

Supervisor

Darren Batten TechIOA

Certificate number: U22621

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Measurements
The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Instruments and program
A complete list of equipment, hardware and software that has been used in this calibration is available from the calibration laboratory on request.

Traceability
The measured values are traceable to the following laboratories:
Sound Pressure Level: National Physical Laboratory, United Kingdom
Voltage: National Physical Laboratory, United Kingdom
Frequency: National Physical Laboratory, United Kingdom
Ambient Pressure: National Physical Laboratory, United Kingdom
Temperature & Relative Humidity: National Physical Laboratory, United Kingdom

Comment
Calibrated as received, no adjustments made.

Statement of conformance
As public evidence was available[1], from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in annex A of BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

[1] This evidence is held on file at the calibration laboratory.

Notes:
The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in **BOLD** are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Sonitus House, 5b Chelmsford Road Industrial Estate, Great Dunmow, GB-CM6 1HD
Tel (+44) 01371 871030 Fax (+44) 01371 879106
email calibration@campbell-associates.co.uk

Certificate of Calibration

Issued by University of Salford (Acoustics Calibration Laboratory)
UKAS ACCREDITED CALIBRATION LABORATORY NO. 0801

APPROVED SIGNATORIES
Claire Lomax [x] Andy Moorhouse [ ]
Gary Phillips [ ] Danny McCaul [ ]

UKAS CALIBRATION
0801

acoustic calibration laboratory
The University of Salford, Salford, Greater Manchester, M5 4WT, UK
http://www.acoustics.salford.ac.uk
t 0161 295 3030/0161 295 3319 f 0161 295 4456 e c.lomax1@salford.ac.uk

University of Salford MANCHESTER

Certificate Number: 02359/4 Date of Issue: 6 August 2015

PERIODIC TEST OF A SOUND LEVEL METER to IEC 61672-3:2006

FOR:	WSP Acoustics The Victoria 150-182 The Quays Salford M50 3SP
FOR THE ATTENTION OF:	Benjamin Reed
PERIODIC TEST DATE:	5th and 6th August 2015
TEST PROCEDURE:	CTP12 (Laboratory Manual)

Sound Level Meter Details

Manufacturer	01dB	
Model	FUSION	
Serial number	10796	
Class	1	
Hardware version	LIS006E	Application FW: 2.34

Associated Items	**Microphone**	**Preamplifier**	**Calibrator**
Manu	GRAS	01dB	01dB
Model	40CE	PRE22	CAL21
Serial Number	207588	10882	34254632 (2015)
Calibrator Adaptor	-	-	UC0210

Test Engineer (initial): GP Name: Gary Phillips

Certificate Number: 02359/4 Date of Issue: 6 August 2015

Procedures from IEC 61672-3: 2006 and TPS 49 Edition 2 June 2009 were used to perform the periodic tests.

Manufacturer's instruction manual was marked as follows: DOC1131 June 2014 G - FUSION User Manual GB. Adjustment data used to adjust the sound levels indicated in response to the application of an electrostatic actuator to sound levels equivalent to those that would be indicated in response to plane, progressive sound waves were obtained from the manufacturer.

The sound level meter calibration check frequency is 1000 Hz, the reference sound pressure level is 94 dB. As this instrument only has a single range, this range is the reference level range.

The environmental conditions in the laboratory at the start of the test were:
Static pressure 100.458 kPa, air temperature 23.8 °C, relative humidity 48.7 %.

The following instrument settings were used; Microphone Input: External, Microphone type: 40CE, Reference direction 90˚, Nose cone: Yes, High-pass Filter: 10Hz. The initial response of the instrument to application of the associated sound calibrator was 93.3 dB (C). The instrument was then adjusted to indicate 93.7 dB (C). This indication was obtained from the calibration certificate of the calibrator, and information in the manufacturer's instruction manuals, when using instrument configuration 3, comprising of DMK01 weatherproof outdoor microphone unit with PRE22 pre-amplifier, small windscreen for DMK01, Nose cone RA0208 and 10 metre extension cable RAL135, connected to the instrument's external microphone input socket.

With the microphone installed the level of self-generated noise on the most-sensitive level range was:

A: 17.9 dB*

* Under-range indicated on instrument display.

With the microphone replaced by an electrical input device with a similar capacitance to that of the electrical input device referred to in the manufacturer's instruction manual specified in this certificate, the levels of self-generated noise on the most-sensitive level range were:

A: 14.0 dB***
B: 13.2 dB**
C: 14.1 dB***
Z: 18.6 dB***

*indicates that the measured level exceeds the typical anticipated level of self-generated noise stated in the manufacturer's instruction manual.
** Under-range indicated on instrument display.

The environmental conditions in the laboratory at the end of the test were:
Static pressure 100.381 kPa, air temperature 23.7 °C, relative humidity 51.4 %.

Certificate Number: 02359/4 Date of Issue: 6 August 2015

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organization responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

The instrument failed to meet the requirements for the test of the electrical test of a frequency weighting at 250 Hz, 500 Hz and 1 kHz as the uncertainty of measurement exceed the maximum permitted value due to a significant contribution from data supplied by the manufacturer. If the manufacturer's uncertainty data were not included, the meter would meet the requirements of the Standard.

As the actual frequency response of the microphone was unavailable, the typical frequency response for the model of microphone has been used to correct the level differences determined in the electrical signal test of frequency weighting.

Instruments used in the verification procedure were traceable to *National Standards*. The electrostatic actuator- method was employed in the acoustical tests of a frequency weighting.

The uncertainty evaluation has been carried out in accordance with UKAS requirements. All measurement results are retained at the acoustic calibration laboratory for at least four years.

Fusion 2.

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, CM6 1HD, England
www.campbell-associates.co.uk
info@campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION

0789

Certificate number: U22590

Certificate of Calibration and Conformance

Test object:	**Sound Calibrator**
Manufacturer:	**01dB**
Type:	**Cal21**
Serial no:	**34254632**
Customer:	WSP Parsons Brinckerhoff
Address:	6 Devonshire Square, London. EC2M 4YE.
Contact Person:	Ben Reed.

Measurement Results:	Level	Level Stability	Frequency	Frequency Stability	Distortion
1:	93.98 dB	0.01 dB	1001.34 Hz	0.00 %	0.99 %
2:	93.98 dB	0.01 dB	1001.33 Hz	0.00 %	0.98 %
3:	93.98 dB	0.01 dB	1001.33 Hz	0.00 %	0.98 %
Result (Average):	**93.98 dB**	**0.01 dB**	**1001.33 Hz**	**0.00 %**	**0.98 %**
Expanded Uncertainty:	0.10 dB	0.02 dB	1.00 Hz	0.01 %	0.10 %
Degree of Freedom:	>100	>100	>100	>100	>100
Coverage Factor:	2.00	2.00	2.00	2.00	2.00

The stated level is relative to 20µPa. The level is traceable to National Standards.
The stated level is valid at reference conditions. The following correction factors have been applied during the measurement: Pressure: 0.000 dB/kPa Temperature: 0.000 dB/°C Relative humidity: 0.000 dB/%RH Load volume : 0.00072 dB/mm3
The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.
Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2016\01dBCAL21_34254632_M1.nmf

Environmental conditions:	Pressure:	Temperature:	Relative humidity:
Reference conditions:	101.325 kPa	23.0 °C	50 %RH
Measurement conditions:	101.743 ± 0.040 kPa	22.1 ± 0.1 °C	51.5 ± 0.9 %RH

Date received for calibration: 01/09/2016
Date of calibration: 06/09/2016
Date of issue: 06/09/2016
Engineer

Michael Tickner

Supervisor

Darren Batten TechIOA

Certificate number: U22590

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Measurements
The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Instruments and program
A complete list of equipment, hardware and software that has been used in this calibration is available from the calibration laboratory on request.

Traceability
The measured values are traceable to the following laboratories:
Sound Pressure Level: National Physical Laboratory, United Kingdom
Voltage: National Physical Laboratory, United Kingdom
Frequency: National Physical Laboratory, United Kingdom
Ambient Pressure: National Physical Laboratory, United Kingdom
Temperature & Relative Humidity: National Physical Laboratory, United Kingdom

Comment
Calibrated as received, no adjustments made.

Statement of conformance
As public evidence was available[1], from a testing organisation responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in annex A of BS EN IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of that BS EN IEC 60942:2003.

[1] This evidence is held on file at the calibration laboratory.

Notes:
The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in **BOLD** are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Sonitus House, 5b Chelmsford Road Industrial Estate, Great Dunmow, GB-CM6 1HD
Tel (+44) 01371 871030 Fax (+44) 01371 879106
email calibration@campbell-associates.co.uk

CERTIFICATE OF CALIBRATION

ISSUED BY AV CALIBRATION

Date of issue 26 August 2015 Certificate N° 08594

UKAS CALIBRATION
0653

AV Calibration
2 Warren Court
Chicksands, Shefford
Bedfordshire SG17 5QB
U.K.
Tel: +44 (0)1462 638600
Fax: +44 (0)1462 638601
Email: lab@avcalib.co.uk
www.avcalibration.co.uk
Acoustics Noise and Vibration Ltd trading as AV Calibration

Approved Signatory

G. Parry [ ] B. Baker [✓]

CLIENT	WSP Parsons Brinckerhoff WSP House 70 Chancery Lane London WC2A 1AF
F.A.O.	Graeme Littleford
ORDER No	20010181 Job No UKAS15/08218/01
DATE OF RECEIPT	17 August 2015
PROCEDURE	AV Calibration Engineer's Handbook section 3: verification of sound level meters to BS 7580:Part 1:1997
IDENTIFICATION	Sound level meter 01dB type Blue Solo (Premium) serial No 60531 connected via RAL122 10M & PeliCase internal wiring extension leads and preamplifier type PRE21S serial No 16422 to a half-inch microphone type MCE212 serial No 166401 fitted with a foam windshield type BAP21. Associated calibrator 01dB type Cal21 serial No 34213780(2011) with a one-inch housing and adapter type BAC21 for half-inch microphone.
CALIBRATED ON	26 August 2015
PREVIOUS CALIBRATION	Calibrated on 13 August 2013 Certificate No. 01453/2 issued by a UKAS accredited calibration laboratory No. 0801

CERTIFICATE OF CALIBRATION

UKAS ACCREDITED CALIBRATION LABORATORY No 0653

Certificate N° 08594

The sound level meter was set to frequency weighting A and adjusted to read 93.7 dB (corresponding to 93.7 dB at standard atmospheric pressure) in response to the sound calibrator supplied. This reading was derived from the Calibration Certificate No. 02229/1 supplied by a UKAS accredited calibration laboratory no. 0801 and manufacturers' information on the free-field response of the sound level meter when fitted with the windshield.

The sound level meter was then tested, and its overall sensitivity adjusted, in accordance with clause 5 of BS 7580:Part 1:1997 **

The acoustic calibration at 1kHz specified in subclause 5.6.1 of the standard was performed by application of a standard sound calibrator, whilst the tests at 125Hz and 8kHz (subclause 5.6.2) were performed by the electrostatic actuator method.

At the end of the test, the sound calibrator was reapplied to the sound level meter and the meter reading was recorded. The final sensitivity setting in calibration mode was -0.5 dB.

RESULTS

The sound level meter was found to conform to BS 7580:Part 1:1997 ** for a type 1 meter.

The self-generated noise recorded in the test specified in subclause 5.5.2 was:

10.1 dB (A)	9.4 dB (B)	10.8 dB (C)	15.1 dB (Lin)

The sound level meter reading obtained at the end of the test in response to the sound calibrator was 93.7 dB (corresponding to 93.7 dB at standard atmospheric pressure). This reading, corrected for ambient pressure, should be used henceforth to set up the sound level meter for field use.

The expanded level uncertainty of the Laboratory's 1 kHz sound calibrator used during this verification is ± 0.22 dB; that of the calibrator supplied with the sound level meter is ± 0.22 dB.

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor *k*=2, providing a level of confidence of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

All measurement data are held at AV Calibration for a period of at least six years.

The case reflection factors have been taken as zero, since an extension lead has been used for this verification.

The linearity range and primary indicator range have been obtained from the manufacturer, and are stated to cover the entire measurement range of the instrument, 20 - 137 dB, as given in the handbook (dated 18 June 2003). The maximum level for signals of crest factor 3 has been interpreted from the handbook as 130 dB(A).

The 01dB Solo sound level meter design has successfully undergone pattern evaluation at Physikalisch-Technische Bundesanstalt (PTB). It was found to meet the requirements of BS EN 60651* and BS EN 60804* and was granted pattern approval as a Type 1 sound level meter.

No component of uncertainty for manufacturer-specified corrections has been included in the uncertainty budget and, in accordance with Amendment No 1 to BS 7580:Part 1:1997 ** the measured values obtained during the verification have not been extended by any measurement uncertainty when assessing conformance to the standard.

CERTIFICATE OF CALIBRATION

UKAS ACCREDITED CALIBRATION LABORATORY No 0653

Certificate N° 08594

NOTES

*1 BS EN 60651:1994 and BS EN 60804:1994 were formerly numbered BS 5969:1981 and BS 6698:1986 respectively.

**2 BS 7580:Part 1:1997 was formerly numbered BS 7580:1992.

3 No suitable microphone frequency response information was supplied with the instrument. It was therefore measured by this laboratory using the electrostatic actuator method. This response in isolation is not UKAS accredited.

4 The instrument firmware version was V1.405 272A 01107

5 The verification was carried out in L_p / L_{eq} SLM mode only, and may not be valid for any other mode.

6 The frequency weighting designated Z in the meter has been taken as equivalent to *Lin* weighting of BS EN 60651:1994.

7 It should be noted that although the requirements of the standard were met, the overload indicator was triggered during the tests of time averaging at the specified signal levels.

8 The kit was labelled "SOLO 10"

Any opinions or interpretations which may be expressed in these notes are not UKAS Accredited.

END

Campbell Associates
SOUND & VIBRATION SOLUTIONS
www.campbell-associates.co.uk

Sonitus House, 5b Chelmsford Road Industrial Estate
Great Dunmow, Essex, CM6 1HD

Sales Tel: 01371 871033 Hire Tel: 01371 871037
Admin Tel: 01371 871030 Fax Tel: 01371 879106
E-Mail: info@campbell-associates.co.uk
Website: www.campbell-associates.co.uk

Technical Report

Customer: WSP Parson Brinckerhoff

Contact: Graeme Littleford/Ben Reed

Order No: 20030128

Technical log No: 10070

Report Date: 06 September 2016

Internal ref: 19483/WSP200E

Service Req'd: Calibration

Comments: UKAS Calibate B&K-4230 calibrator

Equipment ID:- B&K-4230.1558662 ✓

Service Request:- UKAS Calibrate (Broken and taped on receipt)

Report: UKAS calibration complete.

Certificate number: U22589 ✓

Accessories supplied: c/w adapter & leather case ✓ ✓

Technician:

Campbell Associates Ltd
5b Chelmsford Road Industrial Estate
GREAT DUNMOW, CM6 1HD, England
www.campbell-associates.co.uk
info@campbell-associates.co.uk
Phone 01371 871030 Facsimile 01371879106

CALIBRATION

0789

Certificate number: U22589

Certificate of Calibration

Test object:	**Sound Calibrator**
Manufacturer:	**Brüel and Kjær**
Type:	**4230**
Serial no:	**1558662**
Customer:	WSP Parsons Brinckerhoff
Address:	One Queens Drive, Birmingham. B5 4PJ.
Contact Person:	Ben Reed.

Measurement Results:	Level	Level Stability	Frequency	Frequency Stability	Distortion
1:	93.96 dB	0.01 dB	1000.10 Hz	0.00 %	0.74 %
2:	93.96 dB	0.01 dB	1000.10 Hz	0.00 %	0.78 %
3:	93.96 dB	0.01 dB	1000.09 Hz	0.00 %	0.67 %
Result (Average):	**93.96 dB**	**0.01 dB**	**1000.10 Hz**	**0.00 %**	**0.73 %**
Expanded Uncertainty:	0.10 dB	0.02 dB	1.00 Hz	0.01 %	0.13 %
Degree of Freedom:	>100	>100	>100	>100	23
Coverage Factor:	2.00	2.00	2.00	2.00	2.13

The stated level is relative to 20µPa. The level is traceable to National Standards.
The stated level is valid at reference conditions. The following correction factors have been applied during the measurement: Pressure: 0.000 dB/kPa Temperature: 0.000 dB/°C Relative humidity: 0.000 dB/%RH Load volume : -0.0003 dB/mm3
The reported expanded uncertainty of measurements is based on a standard uncertainty multiplied by the coverage factor of k=2, providing a level of confidence of approximately 95%. Where the degrees of freedom are insufficient to maintain this confidence level, the coverage factor is increased to maintain this confidence level. The uncertainty has been determined in accordance with UKAS requirements.
Records: K:\C A\Calibration\Nor-1504\Nor-1018 CalCal\2016\BNK4230_1558662_M1.nmf

	Pressure:	Temperature:	Relative humidity:
Environmental conditions:	101.325 kPa	23.0 °C	50 %RH
Reference conditions:	101.746 ± 0.044 kPa	22.5 ± 0.2 °C	51.7 ± 1.5 %RH
Measurement conditions:			

Date received for calibration: 24/08/2016
Date of calibration: 06/09/2016
Date of issue: 06/09/2016
Engineer

Michael Tickner

Supervisor

Darren Batten TechIOA

Certificate number: U22589

Preconditioning
The equipment was preconditioned for more than 4 hours in the specified calibration environment.

Measurements
The calibrator has been tested as described in the following annexes to BS EN IEC60942:2003 Sound Calibrators; B3.4 for sound pressure level, B3.5 for frequency, B3.6 for total distortion and A4.4 for short term stability of the pressure level.

Method
Calibration has been performed as set out in the current version of CA Technical procedure TP01

Instruments and program
A complete list of equipment, hardware and software that has been used in this calibration is available from the calibration laboratory on request.

Traceability
The measured values are traceable to the following laboratories:
Sound Pressure Level: National Physical Laboratory, United Kingdom
Voltage: National Physical Laboratory, United Kingdom
Frequency: National Physical Laboratory, United Kingdom
Ambient Pressure: National Physical Laboratory, United Kingdom
Temperature & Relative Humidity: National Physical Laboratory, United Kingdom

Comment
Level adjusted from 93.77dB.

Notes:
The sound pressure level generated by the calibrator in its ½ inch configuration was measured five times and averaged by a WS2P working standard microphone for class 1 or 2 devices or a LS2P reference microphone for class 0 or LS devices as specified in the International Standard BS EN 61094-4. The results of three replications and the mean of the measurements obtained are given in the measurement results table of this certificate. The frequency and distortion were measured in a similar manner. The figures in **BOLD** are the final results; a small correction factor may need to be added to the sound pressure level quoted here if the device is used to calibrate a sound level meter that is fitted with a free field response microphone. See manufacturer's handbooks for full details of this and other corrections that may be applicable.

Sonitus House, 5b Chelmsford Road Industrial Estate, Great Dunmow, GB-CM6 1HD
Tel (+44) 01371 871030 Fax (+44) 01371 879106
email calibration@campbell-associates.co.uk

Calibration Certificate

Part Number: 714A0801
Description: BLASTMATE III
Serial Number: BA8004
Calibration Date: May 24, 2016
Calibration Equipment: 718A1501

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: _____
Vipulan Mathi

Instantel

Calibration Certificate

Part Number: 714A0301
Description: STANDARD TRANSDUCER BM III
Serial Number: BG7029
Calibration Date: May 24, 2016
Calibration Equipment: 714J7401

Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications

Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.

The environment in which this product was calibrated is maintained within the operating specifications of the instrument.

Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard. Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.

Calibrated By: _____
Vipulan Mathi

Instantel

Brecon survey: measurement location positioning and notes

Position: Log 1
Notes: Noise from waste transfer and processing plant and vehicles

Position: Log 2
Notes: Noise from waste transfer, processing plant and vehicles, including close range on weighbridge

Position: Log 3
Notes: Noise from waste transfer and processing plant and vehicles (distant)

Position: Inside processing shed
Notes: Mainly processing noise

Position: In vehicle manoeuvring area
Notes: Mainly loader noise (inc reverse alarm) and processing noise

Brecon survey: measurement equipment calibration certificates

CERTIFICATE OF CALIBRATION

UKAS CALIBRATION
7623

Date of Issue: 10 January 2017

Certificate Number: UCRT17/1010

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

M. Breslin [ ] K. Mistry [✓] J. Harriman [ ]

Customer	WSP Environmental Ltd 3rd floor Kings Orchard 1 Queen Street Bristol BS2 0HQ
Order No.	20038807
Description	Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification

Manufacturer	*Instrument*	*Type*	*Serial No. / Version*
Rion	Sound Level Meter	NL-52	01021291
Rion	Firmware		1.8
Rion	Pre Amplifier	NH-25	21333
Rion	Microphone	UC-59	04347
Rion	Calibrator	NC-74	35125825
	Calibrator adaptor type if applicable		NC-74-002

Performance Class 1

Test Procedure TP 2.SLM 61672-3 TPS-49

Procedures from IEC 61672-3:2006 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003

Date Received 09 January 2017 ANV Job No. UKAS17/01002

Date Calibrated 10 January 2017

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	15 January 2015	17762	Campbell Associates

CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 7623

Certificate Number
UCRT17/1010

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52	
SLM instruction manual ref / issue		11-03	
SLM instruction manual source		Manufacturer	
Internet download date if applicable		N/A	
Case corrections available		Yes	
Uncertainties of case corrections		Yes	
Source of case data		Manufacturer	
Wind screen corrections available		Yes	
Uncertainties of wind screen corrections		Yes	
Source of wind screen data		Manufacturer	
Mic pressure to free field corrections		Yes	
Uncertainties of Mic to F.F. corrections		Yes	
Source of Mic to F.F. corrections		Manufacturer	
Total expanded uncertainties within the requirements of IEC 61672-1:2002		Yes	
Specified or equivalent Calibrator		Specified	
Customer or Lab Calibrator		Customers Calibrator	
Calibrator adaptor type if applicable		NC-74-002	
Calibrator cal. date		10 January 2017	
Calibrator cert. number		UCRT17/1008	
Calibrator cal cert issued by		7623	
Calibrator SPL @ STP	93.99	dB	Calibration reference sound pressure level
Calibrator frequency	1001.92	Hz	Calibration check frequency
Reference level range	25 - 130	dB	

Accessories used or corrected for during calibration - Wind Shield WS-10
Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	22.92	22.92	± 0.20 °C
Humidity	36.4	35.1	± 3.00 %RH
Ambient Pressure	100.02	100.07	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.1	dB	Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±				0.10	dB

Self Generated Noise — This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A			C			Z		
	10.4	dB	UR	15.3	dB	UR	21.0	dB	UR
Uncertainty of the electrical self generated noise ±							0.12	dB	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k =2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

..... END .....

Calibrated by: A Patel

R 1

Additional Comments
None

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 18 January 2018 **Certificate Number: UCRT18/1045**

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

J. Harriman

Customer	WSP 3rd floor Kings Orchard 1 Queen Street Bristol BS2 0HQ			
Order No.	20060836			
Test Procedure	Procedure TP 1 Calibration of Sound Calibrators			
Description	Acoustic Calibrator			
Identification	*Manufacturer* Rion	*Instrument* Calibrator	*Model* NC-74	*Serial No.* 35125825

The calibrator has been tested as specified in Annex B of IEC 60942:2003. As public evidence was available from a testing organisation (PTB) responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2003.

ANV Job No.	UKAS18/01034	
Date Received	17 January 2018	
Date Calibrated	18 January 2018	
Previous Certificate	*Dated*	10 January 2017
	Certificate No.	UCRT17/1008
	Laboratory	7623

Measurements

The sound pressure level generated by the calibrator in its WS2 configuration was measured five times by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below. It is corrected to the standard atmospheric pressure of 101.3 kPa (1013 mBar) using original manufacturers information.

Test Microphone	*Manufacturer*	*Type*
	Brüel & Kjær	4134

Results

The level of the calibrator output under the conditions outlined above was

93.97 ± 0.10 dB rel 20 µPa

Functional Tests and Observations

The frequency of the sound produced was	1002.00 Hz	±	0.13 Hz
The total distortion was	1.17 %	±	6.8 % of Reading

During the measurements environmental conditions were

Temperature	21	to	22	°C
Relative Humidity	39	to	48	%
Barometric Pressure	98.9	to	99.1	kPa

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

..... END .....

Note:

Calibrator adjusted prior to calibration?	NO	
Initial Level	N/A	dB
Initial Frequency	N/A	Hz

Additional Comments

None

Calibrated by: B. Bogdan

R 2

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 14 June 2017

Certificate Number: UCRT17/1490

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

K. Mistry

Customer

WSP Environmental Limited
3rd Floor Kings Orchard
1 Queen Street
Bristol
BS2 0HQ

Order No. 20047350

Description Sound Level Meter / Pre-amp / Microphone / Associated Calibrator

Identification

Manufacturer	*Instrument*	*Type*	*Serial No. / Version*
Rion	Sound Level Meter	NL-52	01021290
Rion	Firmware		1.8
Rion	Pre Amplifier	NH-25	21332
Rion	Microphone	UC-59	04346
Rion	Calibrator	NC-74	34536109
	Calibrator adaptor type if applicable		NC-74-002

Performance Class 1

Test Procedure TP 2.SLM 61672-3 TPS-49

Procedures from IEC 61672-3:2006 were used to perform the periodic tests.

Type Approved to IEC 61672-1:2002 YES Approval Number 21.21 / 13.02

If YES above there is public evidence that the SLM has successfully completed the applicable pattern evaluation tests of IEC 61672-2:2003

Date Received 13 June 2017 ANV Job No. UKAS17/06279

Date Calibrated 14 June 2017

The sound level meter submitted for testing has successfully completed the class 1 periodic tests of IEC 61672-3:2006, for the environmental conditions under which the tests were performed. As public evidence was available, from an independent testing organisation responsible for approving the results of pattern evaluation tests performed in accordance with IEC 61672-2:2003, to demonstrate that the model of sound level meter fully conformed to the requirements in IEC 61672-1:2002, the sound level meter submitted for testing conforms to the class 1 requirements of IEC 61672-1:2002.

Previous Certificate	*Dated*	*Certificate No.*	*Laboratory*
	15 June 2015	TCRT15/1165	ANV Measurement Systems

CERTIFICATE OF CALIBRATION

UKAS Accredited Calibration Laboratory No. 0653

Certificate Number UCRT17/1490

Sound Level Meter Instruction manual and data used to adjust the sound levels indicated.

SLM instruction manual title	Sound Level Meter	NL-42 / NL-52
SLM instruction manual ref / issue		11-03
SLM instruction manual source		Manufacturer
Internet download date if applicable		N/A
Case corrections available		Yes
Uncertainties of case corrections		Yes
Source of case data		Manufacturer
Wind screen corrections available		Yes
Uncertainties of wind screen corrections		Yes
Source of wind screen data		Manufacturer
Mic pressure to free field corrections		Yes
Uncertainties of Mic to F.F. corrections		Yes
Source of Mic to F.F. corrections		Manufacturer
Total expanded uncertainties within the requirements of IEC 61672-1:2002		Yes
Specified or equivalent Calibrator		Specified
Customer or Lab Calibrator		Lab Calibrator
Calibrator adaptor type if applicable		NC-74-002
Calibrator cal. date		07 June 2017
Calibrator cert. number		UCRT17/1460
Calibrator cal cert issued by		0653
Calibrator SPL @ STP	94.03	dB Calibration reference sound pressure level
Calibrator frequency	1001.87	Hz Calibration check frequency
Reference level range	25 - 130	dB

Accessories used or corrected for during calibration - Wind Shield WS-10

Note - if a pre-amp extension cable is listed then it was used between the SLM and the pre-amp.

Environmental conditions during tests	Start	End	
Temperature	23.21	23.35	± 0.20 °C
Humidity	47.5	46.5	± 3.00 %RH
Ambient Pressure	100.61	100.55	± 0.03 kPa

Response to associated Calibrator at the environmental conditions above.

Initial indicated level	94.1	dB		Adjusted indicated level	94.0	dB
The uncertainty of the associated calibrator supplied with the sound level meter ±					0.10	dB

Self Generated Noise — This test is currently not performed by this Lab.

Microphone installed (if requested by customer) = Less Than	N/A	dB	A Weighting
Uncertainty of the microphone installed self generated noise ±	N/A	dB	

Microphone replaced with electrical input device - UR = Under Range indicated

Weighting	A			C			Z		
	11.7	dB	UR	16.4	dB	UR	21.7	dB	UR
Uncertainty of the electrical self generated noise ±							0.12	dB	

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

For the test of the frequency weightings as per paragraph 12. of IEC 61672-3:2006 the actual microphone free field response was used.

The acoustical frequency tests of a frequency weighting as per paragraph 11 of IEC 61672-3:2006 were carried out using an electrostatic actuator.

END

Calibrated by: A Patel

Additional Comments

Nono

R 1

CERTIFICATE OF CALIBRATION

0653

Date of Issue: 01 June 2017 **Certificate Number: UCRT17/1430**

Issued by:
ANV Measurement Systems
Beaufort Court
17 Roebuck Way
Milton Keynes MK5 8HL
Telephone 01908 642846 Fax 01908 642814
E-Mail: info@noise-and-vibration.co.uk
Web: www.noise-and-vibration.co.uk
Acoustics Noise and Vibration Ltd trading as ANV Measurement Systems

Approved Signatory

J. Harriman

Customer	WSP Environmental Ltd 3rd Floor Kings Orchard 1 Queen Street Bristol BS2 0HQ			
Order No.	20046851			
Test Procedure	Procedure TP 1 Calibration of Sound Calibrators			
Description	Acoustic Calibrator			
Identification	*Manufacturer*	*Instrument*	*Model*	*Serial No.*
	Rion	Calibrator	NC-74	01020510

The calibrator has been tested as specified in Annex B of IEC 60942:2003. As public evidence was available from a testing organisation (PTB) responsible for approving the results of pattern evaluation tests, to demonstrate that the model of sound calibrator fully conformed to the requirements for pattern evaluation described in Annex A of IEC 60942:2003, the sound calibrator tested is considered to conform to all the class 1 requirements of IEC 60942:2003.

ANV Job No.	UKAS17/05253	
Date Received	31 May 2017	
Date Calibrated	01 June 2017	
Previous Certificate	*Dated*	20 June 2016
	Certificate No.	UCRT16/1203
	Laboratory	7623

Measurements

The sound pressure level generated by the calibrator in its WS2 configuration was measured five times by the Insert Voltage Method using a microphone as detailed below. The mean of the results obtained is shown below. It is corrected to the standard atmospheric pressure of 101.3 kPa (1013 mBar) using original manufacturers information.

Test Microphone	*Manufacturer*	*Type*
	Brüel & Kjær	4134

Results

The level of the calibrator output under the conditions outlined above was

94.02 ± 0.10 dB rel 20 µPa

Functional Tests and Observations

The frequency of the sound produced was	1001.10 Hz	±	0.13 Hz
The total distortion was	1.13 %	±	6.8 % of Reading

During the measurements environmental conditions were

Temperature	23	to	23	°C
Relative Humidity	47	to	53	%
Barometric Pressure	101.0	to	101.1	kPa

The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a coverage probability of approximately 95%. The uncertainty evaluation has been carried out in accordance with UKAS requirements.

The uncertainties refer to the measured values only with no account being taken of the ability of the instrument to maintain its calibration.

A small correction factor may need to be applied to the sound pressure level quoted above if the device is used to calibrate a sound level meter which is fitted with a free-field response microphone. See manufacturers handbook for details.

..... END .....

Note:

Calibrator adjusted prior to calibration?	NO	
Initial Level	N/A	dB
Initial Frequency	N/A	Hz

Additional Comments

None

Calibrated by: B. Bogdan

Appendix E

UNCERTAINTY CONTROL MEASURES

Uncertainty Control Measures

	Applicable?	Adopted?/Comments
Measurement		
Only use in-calibration class 1 equipment and check (and record) calibration level before and after measurements.	✓	Yes
Take measurements using the time and frequency weighting specified by the relevant standard.	✓	Yes
Make detailed notes, including details of the equipment, weather, survey positions (including approximate distances), contributing noise sources, presence of screening etc.	✓	Yes
Take photographs, and record survey locations using GPS if possible.	✓	Yes
Avoid standing waves/interference – listen for effects, take spatial average from several locations or conduct a sweep.	×	N/A
Take measurements at different distances to establish propagation.	✓	Yes
Take measurements at different heights where relevant.	×	N/A
Don't just measure at the 'noisiest' parts of site, but establish how 'quiet' it is, too, where relevant to the assessment.	✓	Yes
Measure under different operating conditions relevant to the assessment / adopt worst case if known.	✓	Yes
Measure more than one cycle/ event (ideally at least three).	✓	Yes
Determine state of repair of any associated source, where relevant	✓	Yes
Use a windshield and avoid windy conditions (i.e. gusts regularly exceeding 5 m/s).	✓	Yes
Avoid wet conditions (particularly in terms of rain on the windshield/mic and on neighbouring surfaces).	✓	Yes
Avoid electrical and electromagnetic interference (such as from power cables and radio transmitters).	✓	Yes
Avoid extreme temperatures – traffic conditions can be different in freezing conditions, whilst meters can overheat and fail in a case when in direct sunlight during the summer.	✓	Yes
Make measurements during different weather conditions (particularly relevant in terms of wind direction for sites affected by aircraft movements), but also for sites affected by other distant, but significant, sources of noise, in different directions.	✓	Yes
Where one source is dominant (such as a main road), as a minimum, measure during conditions favourable to propagation (i.e. when wind direction is within +/-45^{o} of the line between the source and receiver or during temperature inversion, such as on clear calm nights).	✓	Yes

	Applicable?	Adopted?/Comments
Avoid tree/leaf (movement) sound where possible – ideally take measurements the same distance from sources of such sound as any receptors of interest.	✓	Yes, for attended measurements. Logged data necessarily taken in treeline, but minimal foliage apparent due to time of year, and influence on levels checked using audio recordings
Avoid dawn chorus sound where possible – ideally take measurements the same distance from trees and bushes as any receptors of interest.	×	N/A
Measure outside the receptor in question where possible; however, it is worst case typically to measure under free-field conditions and apply 1-3 dB adjustment to convert to 'façade' where applicable – for most planning assessments free-field is preferable.	✓	Free-field measurements used throughout receptor surveys
Where it is not possible to install a meter outside the receptor in question, install a meter elsewhere and undertake additional attended measurements, either outside the receptor or at a representative location (when not adequately covered by the installed meter)	✓	Yes
Avoid atypical traffic conditions (such as during school holidays and road works – road traffic incidents can significantly affect flows, but which can't be predicted and their occurrence can't always be established after the survey – check the data for anomalies)	✓	Yes
Avoid presence of operator and/or the microphone resulting in atypical conditions (e.g. people stopping to talk, workers on site adjusting their way of working, etc.)	✓	Yes
Data handling		
Download data immediately after survey and process promptly whilst details are fresh in the mind.	✓	Yes
Use digital transfer methods wherever possible, double check data read-off manually.	✓	Yes
Look at the time-history (in as fine a resolution as possible) for any unexpected events.	✓	Yes
If removing any data (due to an atypical event, for example), 'save as' a new file and provide a note to the data within the corresponding file.	✓	Yes
Prediction		
Use measurements at different heights to verify screening effects, where relevant.	×	N/A
Use propagation calculation procedure relevant to source and distance.	✓	Yes
Use detailed traffic flow data applicable to the assessment methodology.	✓	Traffic numbers provided by Powys Council design team
Use detailed sound source data (including octave-bands levels), accounting for size, height and directivity, where known.	✓	Yes
Use detailed topographical data and base mapping.	✓	Natural Resources Wales LiDAR 2m data

	Applicable?	Adopted?/Comments
Identify different ground types.	✓	Yes
Apply an order of reflections of at least one.	✓	Yes: 1st order applied (mostly open propagation)
Predictions at ground floor may overestimate attenuations due to absorptive ground effects – first floor predictions often give more representative worst-case results.	✓	Predictions made at 1.5 m height: site ground considered reflective, and outdoor noise levels predicted at receptors
Use 3D view feature of the modelling software to check the accuracy of the model.	✓	Yes
Produce contour plots as a further means of identifying any abnormalities or errors in the model.	✓	Yes
All calculation models should undergo rigorous QA checking using a defined checklist relevant to the type of model.	✓	Yes

Kings Orchard
1 Queen Street
Bristol
BS2 0HQ

wsp.com