Noise Impact Assessment

Hemerdon Mine

Drakelands Restoration Ltd

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Basis of Report

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Executive Summary

Drakelands Restoration Limited (DRL) commissioned SLR Consulting Limited (SLR) to update the noise assessment for the proposed recommencement of mineral processing activities at Hemerdon Mine, Devon, in support of the Environmental Permit variation application (pre-application reference EPR/AP3203ML/P001).

The assessment considers the phased restart of operations, including the Mobile Front End (MFE) and the long-term operation of the Minerals Processing Facility (MPF). The study was undertaken in accordance with Environment Agency requirements and relevant national guidance, including BS 4142:2014+A1:2019, BS 8233:2014, the National Planning Policy Framework (NPPF), the Noise Policy Statement for England (NPSE), and Condition 5 of the site's planning permission.

A comprehensive baseline noise survey was conducted over a consecutive seven-day period at nearby noise-sensitive receptors under suitable weather conditions. Using industry-standard noise modelling techniques, cumulative operational noise levels were predicted and assessed against representative background sound levels.

While the assessment predicts worst-case rating levels of up to 14 dB above background levels during both daytime and night-time periods, the overall operational noise impact is considered to be low to minor adverse when assessed in context. At the majority of noise-sensitive receptors, particularly those located further from the site, no perceptible impact is anticipated. At the closest receptors, operational noise would generally be unnoticeable or only just perceptible and is not expected to result in significant changes to behaviour, attitude, or quality of life.

The assessment also confirms that substantial embedded mitigation measures have been incorporated into the project design, ensuring operational noise has been reduced as far as reasonably practicable.

Importantly, predicted noise levels from the proposed operations remain comfortably below the daytime and night-time limits specified in Condition 5 of the site's planning permission.

Overall, the assessment concludes that the proposed operations can be carried out with acceptable noise impacts and are compliant with applicable planning and environmental noise requirements. Consequently, the findings support the proposed permit variation and phased recommencement of mineral processing activities at Hemerdon Mine.

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Acronyms and Abbreviations

dB (Decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure ($2x10^{-5}$ Pa).
dBA	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
L_{Aeq}	L_{Aeq} is defined as the notional steady sound level which, over a stated period of time, would contain the same amount of acoustical energy as the A-weighted fluctuating sound measured over that period.
L_{10} and L_{90}	If a non-steady noise is to be described, it is necessary to know both its level and the degree of fluctuation. The L_n indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L_{10} is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. It is common practice to use the L_{10} index to describe traffic noise. Similarly, L_{90} is the 'average minimum level' and is often used to describe the background noise.
$L_{Amax,F}$	$L_{Amax,F}$ is the maximum A-weighted sound pressure level recorded over the period stated. $L_{Amax,F}$ is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall L_{eq} noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.

1.0 Introduction

Drakelands Restoration Limited (DRL) has appointed SLR Consulting Limited (SLR) to update and amend a noise assessment of their proposed processing plant at Hemerdon Mine, Devon (the Site), to support the permit variation application (pre-application reference EPR/AP3203ML/P001).

The noise assessment has considered the operation of the Mobile Front End (MFE) as part of the phased recommencement of mineral processing activities at Hemerdon Mine and the operation of the Minerals Processing Facility (MPF).

It should be noted that the assessment does not consider the operation of the Inline Pressure Jigs (IPJs) as the operation of these are subject to a separate permit application.

It should also be noted that a previous noise assessment was submitted in November 2022 (SLR Ref: 403.064510.00001) and approved by the EA as part the MPF permit issued in June 2024. This document supersedes the 2022 assessment; however, reference is made to a number of technical inputs and assumptions within the previous assessment where it is considered applicable.

The updated assessment has been undertaken in accordance with the guidance contained in British Standard 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial sound* as required by the Environment Agency (EA) *Guidance Noise and vibration management: environmental permits*. British Standard 8233:2014 *Guidance on sound insulation and noise reduction for buildings* will also be referred to.

The assessment is based on updated background sound levels established from the results of sound surveys undertaken by SLR at locations representative of nearby noise-sensitive receptors.

Whilst reasonable effort has been made to ensure that this report is easy to understand, it is technical in nature; to assist the reader, a glossary of terminology is included in **Appendix A.**

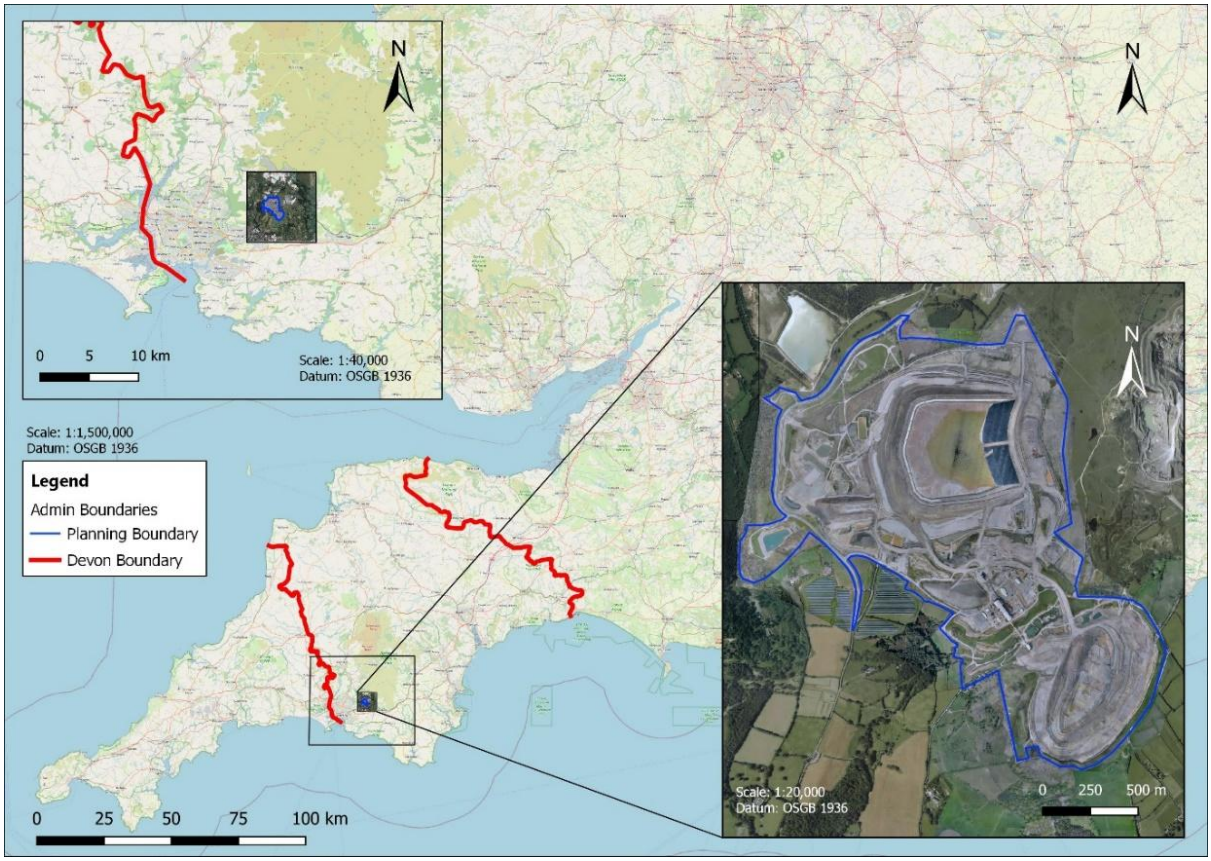
This noise assessment has been prepared by a Technical Director (Acoustics and Vibration) for SLR Consulting Limited who has over 21 years relevant industry experience, is a Corporate Member of the Institute of Acoustics (MIOA) and holds the I.o.A Diploma in Acoustics and Noise Control.

2.0 Site Description

2.1 Site Location

The Hemerdon Deposit is situated six miles northeast of the city of Plymouth in Devon, England (as show in Figure A). It is readily accessible via sealed roads and between August 2015 and October 2018 was acting as an operational mine site under previous ownership.

Figure A: Location of Hemerdon Mine



2.2 Site Operations

2.2.1 MPF

The facility will process ore to produce non-ferrous mineral concentrates. The concentrates will be exported overseas for subsequent processing into non-ferrous metal. The main activities to be undertaken at the Hemerdon MPF comprise the following:

- Primary, secondary and tertiary crushing and screening of mineral ore; and
- Processing of mineral ore to produce non-ferrous mineral concentrates.

Run of Mine (ROM) ore is crushed and then enters the MPF main process building.

The MPF is designed with a series of physical processes including X-Ray transmission ore sorting, dense media separation (DMS), Inline Pressure Jigs (IPJ)[1], fines gravity separation and froth flotation that reduces and separates the mineral to produce a mineral pre-

[1] IPJs not included within the assessment as they are subject to a separate permit application.

concentrate. The pre-concentrate then undergoes heat treatment (reduction) to enable the final magnetic separation into the different product streams (concentrate) as below.

The mineral concentrate produced by the facility includes two product streams:

- Tungsten: Wolframite $FeMnWO_4$ – approximately 62-65% WO_3; and
- Tin: Cassiterite SnO_2 – approximately 40-45% Sn.

Wastes from the processing plant will include emissions to air from fuel combustion, mineral drying, heat treatment and flue gas treatment (scrubbing). Solid wastes from mineral separation will be treated, thickened and managed via the MWF.

At times of low flow, water can be topped up from Tory Pond or Loughter Mill pumping station and at the MPF a Water Treatment Plant (WTP) will maintain the quality of the process water.

2.2.2 MFE

The MFE is a mobile mineral processing arrangement proposed to support the phased restart of operations at the Site. It comprises mobile crushing and screening plant, together with associated conveyors and skid-mounted in-line jigging equipment. The plant will process mineralised stockpiled material and, subsequently, run-of-mine ore from the open pit before feeding the existing Mineral Processing Facility for further concentration.

The MFE is required to provide an interim ore preparation route while construction and commissioning of the permanent primary and secondary crushing and screening circuits are completed.

It will enable the processing plant to be brought back into operation in a controlled and phased manner, at a lower throughput than the permanent configuration.

2.3 Operational Times

With regards to operational times the Site will operate on a 24/7 basis; however, the Site is restricted when certain operations can be undertaken as outlined below.

- 07:00 to 19:00 – All crushing and processing activities operational, including the MFE with the exception of the loading shovel on the ROM pad. Haul trucks from the pit to the ROM and directly tipping into the Primary Crusher.
- 19:00 to 22:00 - All crushing and processing activities operational including the MFE and the loading shovel on the ROM pad including the movement of dump trucks from the extraction area.
- 22:00 to 07:00 – All processing activities operational, including the MFE but no primary and secondary crushing activities or mobile plant movements.

2.4 Noise-Sensitive Receptors

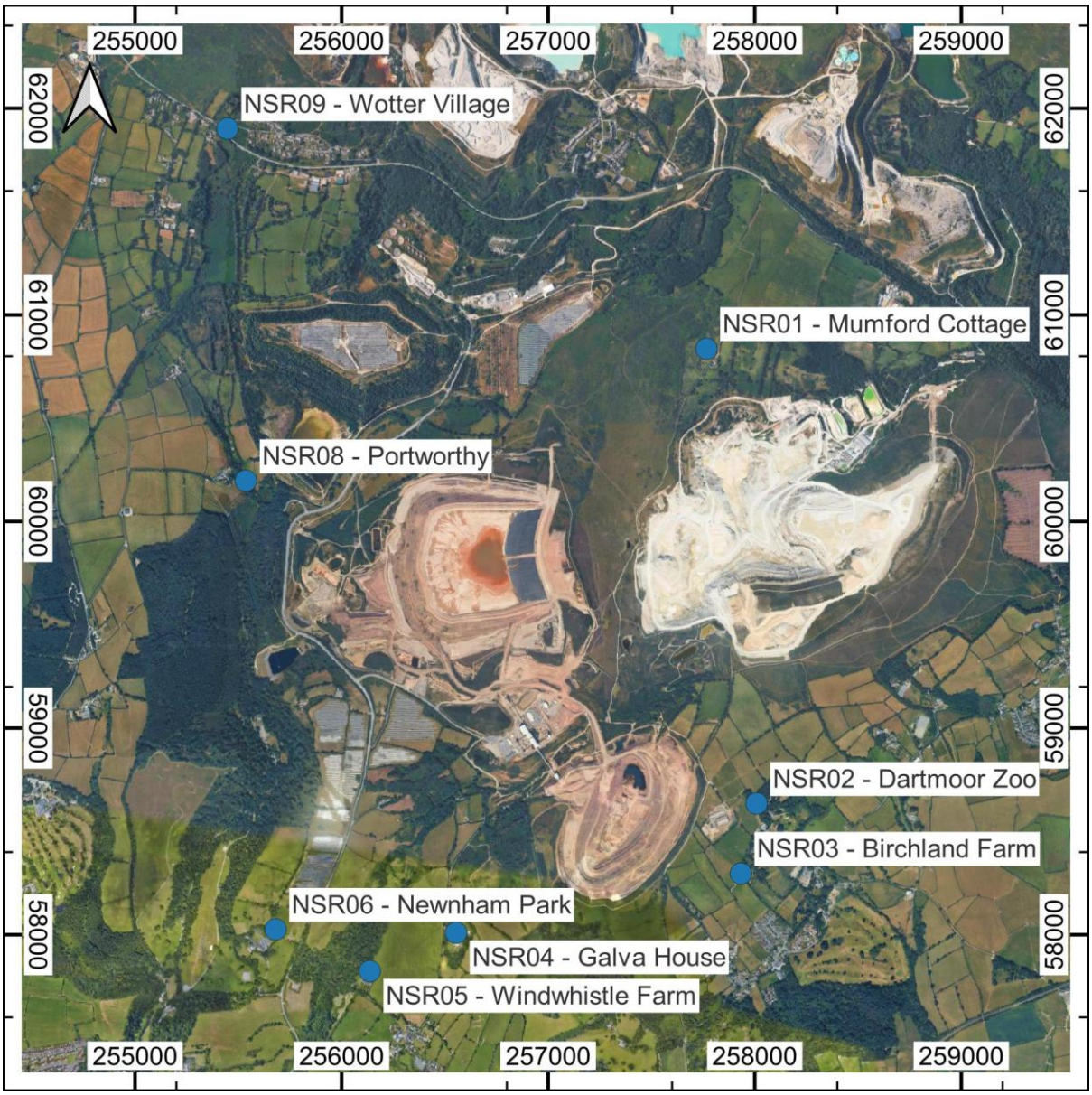
The following noise-sensitive receptors (NSRs) to the Site have been identified and are detailed in Table A and shown in Figure B.

Table A: Nearest Noise-Sensitive Receptors

Receptor	Description	Coordinates (BNG)	
		X	Y
NSR01	Mumford Cottage to the north-east of the Site.	257806	60743
NSR02	Dartmoor Zoo to the south-east of the Site.	258009	58636
NSR03	Birchland Farm to the south-east of the Site.	257925	58309
NSR04	Galva House to the south-west of the Site.	256559	57971
NSR05	Windwhistle Farm to the south-west of the Site.	256136	57825
NSR06	Newnham Park to the south-west of the Site.	255681	58027
NSR07	Boringdon Hall to the west of the Site.	253944	57859
NSR08	Portworthy to the north-west of the Site.	255536	60198
NSR09	Wotter Village to the north-west of the Site.	255447	61902

Wotter Village (NSR09) has been included at the request of the EA; however, as this request was made at a very late stage within the assessment timescales; it was not possible to undertake baseline monitoring at this receptor.

Figure B: Nearest Noise-Sensitive Receptors



3.0 Scope and Guidance

3.1 Noise and Vibration Management: Environmental Permits

The Environment Agency (EA) released the guidance document *Noise and vibration management: environmental permits* (NVM) in July 2021, replacing the previous guidance presented in *Horizontal Guidance for Noise (H3) parts 1 and 2*. An update to the guidance was released 31 January 2022[2]. The NVM details when a noise assessment is required, the competency required to undertake an assessment and how to carry out a noise impact assessment.

The NVM references BS 4142:2014 +A1:2019 *Methods for Rating and Assessing Industrial and Commercial Sound* (BS 4142) as the appropriate assessment methodology.

The NVM outlines how context should be taken into account in the assessment and notes that *"Whilst context allows you to interpret impact thresholds (to a degree), there are practical limits to the extent of the interpretation. It is unlikely you could adjust the assessment outcome beyond the next band (for example, modifying a BS 4142 outcome of more than 10 dB to be less than an 'adverse impact')."*

In determining the outcome of the assessment the following should be considered:

- Weekend and weekday periods;
- what the sound 'means' – meaningful sound is one that conveys an unpleasant meaning beyond its mere acoustic content, for example noise from an abattoir;
- time of day;
- the absolute sound level;
- where the sound occurs;
- new industry or new residences;
- intrinsic links between the source and receptor, for example the source is the resident's place of work;
- local attitudes;
- the residual acoustic environment;
- the land use at the receptor (for example, gardens rather than yards);
- the exceedance (traditional BS 4142); and
- whatever else might be particular to that individual situation.

Based on the results of the BS 4142 assessment the NVM has three distinct requirements as detailed in Table B.

[2] Noise and vibration management: environmental permits
https://www.gov.uk/government/publications/noise-and-vibration-management-environmental-permits/noise-and-vibration-management-environmental-permits

Table B: NVM Assessment

NVM Result	BS 4142 Descriptor	Next Stage
Unacceptable level of audible or detectable noise	The closest corresponding BS 4142 descriptor is 'significant adverse impact'	You must take further action or you may have to reduce or stop operations. The environment agencies will not issue a permit if you are likely to be operating at this level.
Audible or detectable noise	The closest corresponding BS 4142 descriptor is 'adverse impact'	Your duty is to use appropriate measures to prevent or, where that is not practicable, minimise noise. You are not in breach if you are using appropriate measures. But you will need to rigorously demonstrate that you are using appropriate measures.
No noise, or barely audible or detectable noise	The closest corresponding BS 4142 descriptor is 'low impact or no impact'	Low impact does not mean there is no pollution. However, if you have correctly assessed it as low impact under BS 4142, the environment agencies may decide that taking action to minimise noise is a low priority.

Further to the above summaries of BS 4142, other standards and guidance referred to in this assessment and details of the planning permission for the Site are outlined below.

3.2 BS 4142:2014+A1:2019

British Standard 4142:2014 +A1:2019 *Methods for Rating and Assessing Industrial and Commercial Sound* (BS 4142) notably describes methods for rating and assessing sound of an industrial or commercial nature. It has been referenced where required in policy and guidance documents to assess the potential impact of sound of an industrial and/or commercial nature, at existing and proposed noise-sensitive receptor locations within the context of the existing sound environment.

Certain acoustic features can increase the significance of impact from a comparison of the specific sound level to the background sound level where these features are likely to affect perception and response. Where such features are present at the assessment location, a character correction (or penalty) to the specific sound level is made to obtain the rating level. This can be approached from subjective, objective and reference methods.

- Tonality: A correction of 0 dB to +6 dB for sound ranging from not tonal to prominently tonal.
- Impulsivity: A correction of up to +9 dB can be applied for sound that is impulsive.
- Intermittency: A penalty of +3 dB can be applied if on/off conditions are readily distinctive within the reference time interval over the period of the greatest amount of on-time.
- Other characteristics: A penalty of +3 dB can be applied in the absence of all other defined characteristics, where the specific sound contains a distinctive feature in the residual acoustic environment.
- The rating sound level is equal to the specific sound level if there are no acoustic features present or expected to be present.

The significance of sound depends upon both the margin by which the rating level exceeds the background sound level and the context in which the sound occurs. An initial estimate of the impact of the specific sound is made by subtracting the measured background sound level from the rating level.

- Typically, the greater the difference, the greater the magnitude of the impact;

- A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context;
- A difference of around +5 dB is likely to be an indication of an adverse impact, depending on the context; and
- The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background level, it is an indication that the specific sound source has a low impact, depending on the context.

BS 4142 has stipulated that context is important when assessing the impact of sound of a commercial and/or industrial nature. Amongst a range of advocated considerations, this can include mitigation, residual sound levels, location and absolute sound levels in the consideration of context.

The scope of BS 4142 recognises that human response to sound can be subjective as affected by many factors, both acoustic and non-acoustic. The significance of its impact can depend on various factors such as the exceedance to the background level, its absolute level, time of day and change in environment, as well as local attitudes to the source of sound and character of the neighbourhood.

BS 4142 (Section 3) provides the following definitions:

- Ambient Sound: Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. NOTE: The ambient sound comprises the residual sound and the specific sound when present.
- Ambient Sound Level, $L_a = L_{Aeq,T}$: Equivalent continuous A-weighted sound pressure level of the totally encompassing sound in a given situation at a given time, usually from many sources near and far, at the assessment location over a given time interval, T.
- Background Sound Level, $L_{A90,T}$: A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given interval, T, measured using time weighting F and quoted to the nearest whole number of decibels (dB).
- Rating Level, $L_{Ar,Tr}$: Specific sound level plus any adjustment for the characteristic features of the sound.
- Specific Sound Level, $L_s = L_{Aeq,T}$: Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T.
- Specific Sound Source: Sound source being assessed.

3.3 BS ISO 9613-2:2024

BS ISO 9613-2:2024 *Acoustics - Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors* (BS ISO 9613-2) is intended to enable noise levels in the community to be predicted from sources of known sound emission. The method described in this part of BS ISO 9613 is general in the sense that it may be applied to a wide variety of noise sources, including some mechanisms of attenuation.

BS ISO 9613-2 specifies an engineering method for calculating the attenuation of sound during propagation outdoors in order to predict the levels of environmental noise at a distance from a variety of sources. The method predicts the equivalent continuous A-weighted sound pressure level (as described in parts 1 to 3 of ISO 2024) under meteorological conditions favourable to propagation from sources of known sound emission.

To apply the method in BS ISO 9613-2, several parameters need to be known with respect to the geometry of the source and of the environment, the ground surface characteristics, and the source strength in terms of octave-band sound power levels for directions relevant to the propagation.

3.4 Noise Policy Statement for England

The Noise Policy Statement for England (NPSE) was published in March 2010. It sets out the long-term vision of government noise policy, which is fundamentally to: *"Promote good health and good quality of life through the effective management and control of noise within the context of Government policy on sustainable development".* The vision is supported by three key aims:

- Avoid significant adverse impacts on health and quality of life;
- Mitigate and reduce to a minimum, other adverse impacts on health; and
- Where possible, contribute to the improvement of health and quality of life.

The NPSE should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise but does not apply to noise in the workplace. The NPSE has adopted the following concepts, to help consider whether noise is likely to have "significant adverse" or "adverse" effects on health and quality of life:

- SOAEL – Significant Observed Adverse Effect Level. This is the level above which significant adverse effects on health and quality of life occur.
- LOAEL – Lowest Observed Adverse Effect Level. This is the level above which adverse effects on health and quality of life can be detected.
- NOEL – No Observed Effect Level. This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

  "It is not possible to have a single objective noise-based measure that defines SOAEL that is applicable to all sources of noise in all situations. Consequently, the SOAEL is likely to be different for different noise sources, for different receptors and at different times. It is acknowledged that further research is required to increase our understanding of what may constitute a significant adverse impact on health and quality of life from noise. However, not having specific SOAEL values in the NPSE provides the necessary policy flexibility until further evidence and suitable guidance is available (Defra, 2010)."

3.5 National Planning Practice Guidance

Revised Planning Practice Guidance was released in March 2014 to support the NPPF and last updated in July 2019. The Guidance stipulates that Local Planning Authorities' plan making and decision making should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and
- Whether or not a good standard of amenity can be achieved.

The guidance has also provided the following noise exposure hierarchy table *"when noise could be a concern"*.

Table C: Planning Practice Guidance Noise Exposure Hierarchy Table

Response	Example of Outcomes	Increasing Effect Level	Action
NOEL – No observed effect level			
Not present	No effect	NOEL	No specific measures required
No observed adverse effect level			
Present and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
LOAEL – Lowest Observed Adverse Effect Level			
Present and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for sleep disturbance. Affects acoustic character of the area and creates a perceived change in quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
SOAEL – Significant Observed Adverse Effect Level			
Present and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Adverse Effect	Avoid
Present and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

3.6 BS 8233:2014

The impact of operational noise from the proposed development on residential receptors will also make reference to British Standard 8233:2014 *Guidance on sound insulation and noise reduction for buildings* (BS 8233).

BS 8233 provides guidance and recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate. However, it is considered the guidance values are useful for context to absolute noise levels. The standard suggests suitable internal noise levels within different types of buildings, including residential dwellings, as outlined below.

- An ambient daytime noise level of 35 dB $L_{Aeq,16hr}$ or less is suitable for daytime resting; and

- An ambient night-time noise level of 30 dB $L_{Aeq,8hr}$ or less is suitable for sleeping.

Section G.1 of Annex G within BS 8233:2014 states that:

> *"If partially open windows were relied upon for background ventilation, the insulation would be reduced to approximately 15 dB, resulting in the target levels being exceeded. (Footnote: Note that the level difference through a window partially open for ventilation can vary significantly depending on the window type and the frequency content of the external noise. If the specific details of the window and external noise are known the value for insulation may be adjusted accordingly)".*

3.7 Planning Permission

An extension to the planning permission for the Site was approved in February 2017 (ref DCC/3823/2015). Conditions 5 and 6 of the permission relates to noise and are relevant to the assessment of noise from the processing plant.

"5. Noise levels arising from the development shall not exceed the following limits at any noise sensitive property:

> *(i) Between the hours of 0700 and 1900 (daytime) Monday to Saturday 50 dB $L_{Aeq.\ 1\ hour}$ free field;*
>
> *(ii) Between the hours of 1900 and 2200 (evening) Monday to Saturday 45 dB $L_{Aeq.\ 1\ hour}$ free field;*
>
> *(iii) Between the hours of 2200 and 0700 (night-time) 42 dB $L_{Aeq.\ 1\ hour}$ free field;*
>
> *(iv) Between 0700 and 2200 on Sunday or on any Bank or Public Holiday (as defined by Condition 4) 45 dB $L_{Aeq.\ 1\ hour}$ free field.*

The limits stated above, apply when measured on a Type 1 sound level meter sited at least 3.5 metres from any reflective surface (other than the ground) and 1.2 – 1.5 m above the ground, in the garden amenity space of any lawfully existing residential premises.

Irrespective of the noise limits specified above the applicant should take all reasonable steps to minimise noise from the site especially noise containing significant tonal elements or peak and impulsive noise. Steps to reduce noise of this nature should be detailed in the noise management mitigation and monitoring scheme required by condition 6 below.

REASON: In the interests of controlling and limiting the effects on the local environment and community, and to comply with policies of the Development Plan: in particular policy MP41 of the Devon County Minerals Local Plan and Policy M23 of the adoption version of the Devon Minerals Plan.

6. The measurement and management of noise from this operation shall be carried out in accordance with a detailed noise management, mitigation and monitoring scheme which shall be submitted to and approved in writing by the MPA within 3 months of the date of this permission. Once approved the development shall be carried out in accordance with the proposals set out in this or any subsequent scheme as may have been submitted to and approved in writing by the MPA.

REASON: In the interests of controlling and limiting the effects on the local environment and community, and to comply with policies of the Development Plan: in particular policy MP41 of the Devon County Minerals Local Plan and Policy M23 of the adoption version of the Devon Minerals Plan."

4.0 Baseline Sound Survey

To establish the prevailing sound climate at the nearest NSRs to the Site, environmental sound surveys were undertaken between Thursday 13th August and Thursday 20th August 2026.

Full details of the survey equipment, methodology, subjective observations and relevant justifications of the measured levels are included in a separate *Baseline Sound Survey Report* (SLR Ref: 403.066596.00001.001), therefore this document only includes the representative background sound levels at each NSR during each relevant survey period which will be utilised as the basis of the BS 4142 assessment.

As previously outlined in Section 2.3 the Site is restricted to a number of operations constraints during certain time periods; therefore, the baseline levels shown in Table D reflect these periods.

4.1 Wotter Village

As noted in Section 2.4, inclusion of Wotter Village as an NSR was requested by the EA at a late stage of the assessment, it was not possible to undertake baseline monitoring at this receptor. Therefore, the monitoring results at the receptor location considered most representative of Wotter Village (i.e. NSR08 Portworthy) have been utilised.

4.2 Representative Baseline Sound Levels

Table D shows the representative baseline sound levels.

Table D: Representative Baseline Sound Levels, dB

Location	Period	Ambient Sound Level, dB $L_{Aeq,Tr}$	Background Sound Level, dB $L_{A90,Tr}$
NSR01 – Mumford Cottage	Weekday - Day	35	30
	Weekday - Evening	30	27
	Weekday - Night	25	23
	Weekend - Day	33	26
	Weekend - Evening	37	33
	Weekend - Night	34	34
NSR02[1] - Dartmoor Zoo	Weekday - Day	44	38
	Weekday - Evening	37	34
	Weekday - Night	29	26
	Weekend - Day	39	35
	Weekend - Evening	38	33
	Weekend - Night	29	26
NSR03 – Birchland Farm	Weekday - Day	35	31
	Weekday - Evening	32	29
	Weekday - Night	27	24
	Weekend - Day	30	26
	Weekend - Evening	37	33
	Weekend - Night	31	26

Location	Period	Ambient Sound Level, dB $L_{Aeq,Tr}$	Background Sound Level, dB $L_{A90,Tr}$
NSR04 – Galva House	Weekday - Day	38	34
	Weekday - Evening	36	31
	Weekday - Night	27	24
	Weekend – Day	31	25
	Weekend - Evening	34	30
	Weekend - Night	28	23
NSR05 – Windwhistle Farm	Weekday - Day	35	32
	Weekday - Evening	33	31
	Weekday - Night	28	26
	Weekend - Day	32	27
	Weekend - Evening	33	29
	Weekend - Night	26	24
NSR06 – Newham Park	Weekday - Day	37	33
	Weekday - Evening	34	29
	Weekday - Night	28	24
	Weekend - Day	35	29
	Weekend - Evening	32	29
	Weekend - Night	27	22
NSR07 – Boringdon Hall	Weekday - Day	40	36
	Weekday - Evening	38	34
	Weekday - Night	31	28
	Weekend - Day	36	33
	Weekend - Evening	35	31
	Weekend - Night	34	33
NSR08 – Portworthy	Weekday - Day	39	34
	Weekday - Evening	35	30
	Weekday - Night	33	30
	Weekend - Day	35	32
	Weekend - Evening	34	31
	Weekend - Night	35	32
NSR09 – Wotter Village	Weekday - Day	39	34
	Weekday - Evening	35	30
	Weekday - Night	33	30
	Weekend - Day	35	32
	Weekend - Evening	34	31
	Weekend - Night	35	32

5.0 Noise Model

The noise model has considered a *'mitigated scenario'* to reduce the operational noise levels from the processing plant at the nearest NSRs as far as reasonably practicable and incorporating best practice measures.

The general noise model assumptions, and details of the amendments and mitigation measures employed are detailed below.

5.1 General Noise Model Assumptions

The sound predictions in this assessment have been undertaken using a proprietary software-based noise model, Cadna, which implements the full range of UK calculation methods. The calculation algorithms set out in ISO 9613-2:2024 *Acoustics – Attenuation of sound during propagation outdoors – Part 2 General method of calculation* have been used, and the model has made the following general assumptions:

- A ground absorption factor of zero within the Site boundary itself and 0.8 outside of the Site boundary as the ground conditions between the source (processing area) and the receptors is either the existing quarry void or open farmland;
- 3 m/s downwind propagation between the source and the receiver.
- 70% humidity and a temperature of 10°C.
- A reflection factor of 3.
- All buildings having an external absorption coefficient of 0.05.
- Receiver heights of 4 m to reflect two storey dwellings, as a worst-case the 4 m receiver height applies to both the night-time and daytime (daytime resting).
- A receiver height of 7.5m at NSR06 (Newnham Park) as this has been identified as a three-storey building.
- Attenuation predicted for 500 Hz in accordance with BS ISO 9613-2:2024 when only A-weighted sound power levels are known.
- An internal absorption coefficient of 0.2 within all of the noise generating buildings (see 5.2.1).
- A 'Cdiffuse' value within the noise generating buildings of -5, to represent *'Large flat or long halls, many sources (average industrial building); Infront of reflecting surface'*
- The noise model incorporates both DEFRA's openly available LiDAR topographical data of the area and the Applicant's proposed topographical data for the proposed development.

5.2 Noise Sources

DUO Group (DUO) and Gekko has provided a comprehensive list of internal and external noise sources associated with the new processing frontend.

The noise levels for the operational plant have been sourced by DUO and Gekko from the manufacturers, who provided A-weighted sound power or pressure levels at a specified distance. SLR has converted the sound pressure levels to sound power levels for use in the modelling software. The full list of sources can be found in **Appendix B** with co-ordinates identifying the location of the item of plant on the Site, it must be noted that there a number of items of plant which will only operate on a 'standby' basis i.e. if other items of plant have a fault, therefore these have not been included in the noise model and are shown in in *Italics* in **Appendix B**.

It must be noted that hemispherical propagation has been assumed for all the external noise sources when equating an equivalent sound power level from measured sound pressure levels.

5.2.1 Noise Generating Buildings

The co-ordinates of the buildings on Site which house noise generating plant are detailed in Table E.

Table E: Noise Generating Buildings

Building Name	Easting and Northing of Building Corners			
	Corner 1	Corner 2	Corner 3	Corner 4
Main Processing Building	256883.03 59017.34	256955.84 58913.30	256938.36 58901.07	256859.09 59000.58
Primary Crusher Building	257061.55 59139.47	257083.07 59126.52	257076.28 59114.71	257054.79 59127.72
Secondary Screening Building	257101.32 59111.27	257114.87 59103.07	257109.86 59094.35	257096.30 59102.55
Secondary Crusher Building	257147.75 59081.01	257152.82 59077.94	257145.70 59065.58	257140.63 59068.66
Ore Sizing Building	257085.75 59033.37	257104.11 59029.75	257102.52 59020.69	257084.16 59024.34
Ore Sorting Building	257035.35 59008.10	257051.09 58986.29	257029.36 58970.90	257014.03 58992.78
Tertiary Crushing Building	257004.84 58970.16	257013.97 58957.02	257002.56 58948.97	256995.72 58963.83

5.2.1.1 Material Stockpile

A structure has been proposed over the stockpile of the material following the secondary crushing circuit; however, this has been omitted to provide a worst-case scenario for the sources that would be within this building (i.e. they are not covered). This has been done as the building is proposed to have no solid floor, which has the potential to introduce large uncertainties if modelled.

5.2.2 Cladding Systems to Buildings

5.2.2.1 Existing Cladding to Main Processing Building and Tertiary Crusher Building

The main processing building and tertiary crusher building are remaining in-situ as part of the updated proposals; with reference to Section 5.4.1 of the 2022 assessment the following was determined.

It has been confirmed that the existing cladding on the main process building and the tertiary crusher building is 24g 0.63-gauge steel.

The transmission loss of this cladding has been determined from a similar TATA Steel 24g 0.7 mm steel cladding system, which provides a sound reduction of approximately 22 dB at 500 Hz.

The technical specification document for this system is included in **Appendix C.**

The façade elements of the main process building and tertiary crusher building have therefore been modelled with a transmission loss of 22 dB based on the above for 500 Hz. Further to the above, it also should be noted that within Chapter 1 (Scope) of ISO 9613-2:2024 the following is stated:

'If only A-weighted power levels of the sources are known the attenuation for 500 Hz may be used to estimate the resulting attenuation.'

5.2.2.2 Cladding to New Buildings

The new buildings associated with the processing plant are as follows;

- The Primary Crusher Building.
- The Secondary Screening Building.
- The Secondary Crusher Building.
- The Ore Sizing Building; and
- The Ore Sorter Building.

It has been confirmed with DUO and Gekko that the majority of all the new buildings would be constructed using the cladding systems shown in Table F. The table also provides the sound reduction performance for the cladding in each frequency band.

The technical specification document for these systems is included in **Appendix C.**

Table F: Cladding Systems to New Buildings

Building/Area	Cladding System	Sound Reduction Index								
		R_w	Frequency (Hz)							
			63	125	250	500	1000	2000	4000	8000	8000
New Building – Walls	Kingspan – 8W KS1000 RW/40 + I + L	37	13	14	29	38	40	45	55	N/A	N/A
New Building – Roofs	Kingspan 2R – KS1000 RW/40 + I + L	41	8	17	32	43	48	54	60	N/A	N/A
New Building – Walls and Roofs	Pumice stone concrete - hollow block 240 mm	50	N/A	40	41	44	51	55	60	N/A	N/A

With reference to all of the above, the cladding construction build-ups for all the noise generating buildings is shown in Table G. For all build-ups, the lower of the R_W and 500 Hz SRI has been used as a conservative value where a single value is required.

Table G: Cladding Construction Build-ups

Building	Wall Build-up	Roof Build-up
T1 Primary Crushing Building	Kingspan – 8W KS1000	Kingspan 2R – KS1000
T2 Secondary Closing Screening Building	Concrete	Concrete

Building	Wall Build-up	Roof Build-up
T3 Secondary Crushing Building	Kingspan – 8W KS1000	Kingspan 2R – KS1000
T5 Ore Sizing Building	Concrete	Concrete
T6 Ore Sorting Building	Central portion - Concrete NE and SW extensions - Kingspan – 8W KS1000	Central portion - Concrete NE and SW extensions - Kingspan 2R – KS1000
Tertiary Crushing Building	Existing - Sheet steel	Existing - Sheet steel
Main Processing Building	Existing - Sheet steel	Existing - Sheet steel

5.2.3 Building Apertures/Openings

The main apertures/openings associated with the noise generating buildings are the roller shutter doors, access and maintenance doors, and the conveyor entries.

5.2.3.1 Roller Shutter Doors

The roller shutter doors, when closed, have been modelled to achieve a sound reduction performance equivalent to the surrounding building envelope, which is a condition in the current Permit for the Site, when open the roller shutter doors have been modelled with a sound reduction index of 0 dB.

5.2.3.2 Access and Maintenance Doors

With regards to normal human access doors, it has been assumed that these will remain shut, apart from when granting access and they will be constructed from Kingspan 8W (specification in Table F).

With regards to larger maintenance doors, again it has been assumed that these will remain closed, apart from when granting vehicle access. It has also been assumed they will be constructed from Kingspan 8W.

5.2.3.3 Conveyor Entries and Openings

The following conveyor entries and openings have been modelled with mitigation to achieve a 10 dB reduction. The exact details of the measures required to achieve the 10 dB reduction on the above openings will be determined at the detailed design stage of the development.

- Ore Sorting Building Conveyor Opening (SE façade)
- Area 130 CV04 Conveyor Opening
- Area 130 CV05 Conveyor Opening
- Area 130 CV05 Building Opening
- Area 130 Tramp Metal Chute

5.2.3.4 Internal Noise Levels

New Buildings

The internal noise levels within the new buildings have been based on:

- The operational noise levels for the plant to be housed within each building as provided by DUO and Gekko;

- The internal absorption coefficient for each building; and
- The surface area of each building.

Based on the above, the internal reverberant sound levels for each of the buildings has been calculated using the formula below:

$$L_i = PWL - 10\log\left(\frac{\alpha S}{m^2}\right) + 6\ dB$$

Where L_i is the resultant internal reverberant sound level, PWL is the logarithmic sum of the sound powers of the internal plant, α is the mean absorption coefficient of the room surfaces, and S is the surface area of the room.

This methodology has been chosen as it matches the Cadna/A internal method; however doing so in Cadna involves this calculation across all frequency bands and then selecting solely the 500 Hz band (for an overall A-weighted level) in the sources associated with the building, increasing the risk of error.

These calculated internal reverberant sound levels are shown in Table H.

Table H: Internal Reverberant Sound Levels within New Buildings

Building	Average Internal Reverberant Sound Level, dB(A)
Primary Crushing Building	103.8
Secondary Screening Building	101.7
Secondary Crushing Building	99.3
Ore Sizing Building	85.1
Ore Sorting Building	NE extension – 92.3 Main building and SW extension – 102.0
Tertiary Crushing Building	89.5
Main Processing Building	84.3

With regards to the main process building, the calculated internal level assumes that the following three sources have been mitigated so a 10 dB reduction in their sound power levels has been achieved:

- 10 dB mitigation to Primary mill, resultant 108.0 dB L_{WA};
- 10 dB mitigation to Off gas scrubber baghouse, resultant 105.2 dB L_{WA};
- 10 dB mitigation to Concentrate regrind mill, resultant 98.0 dB L_{WA}.

In addition, the calculated internal levels shown in Table H are considered to provide a conservative approach for the following reasons.

- The upper exposure action value for noise exposure contained in 'The Control of Work Regulations 2005' is 85 dBA; it can be seen that the internal noise levels within all of the noise generating buildings are similar or above this level.
- From SLR's experience of internal noise levels within industrial/processing buildings, it is considered unlikely that the internal reverberant sound levels within buildings of the size and nature associated with the Site would be 100 dBA or above.

5.2.4 Primary crusher and Crushing Operations

The primary crusher is located within the Primary Crushing building (location shown in Table E). The operational noise level of the primary crusher has been determined from

measurements of a comparable crusher by Wolf Minerals in 2018 and included in an SLR memo report (Ref: 422.01939.00070.M01, dated 19th June 2018) which is included in **Appendix D.**

From the measurements it has been determined that the operational sound power level of the Metso LT305 crusher was 119.0 dBA.

Further to the above it has been confirmed that the crusher will be housed within a building with the material being tipped into the structure from the top of the rock face above. With reference to this the primary crusher building has been modelled as vertical area sources which have included the attenuation provided by the cladding described in Table G.

With regards to the top (roof) of the primary crusher building this has been modelled as two area sources:

- Area Source One - covering the vast majority of the roof including the attenuation provided by the cladding described in Table G.
- Area Source Two – measuring approximately 7.2m long by 1.2m wide with a sound reduction index of zero (no attenuation), this represents the gap in the bin at the top of the primary crusher building where the material passes through to the crusher below.

The top of the primary crusher building also includes a three sided ‘hood’ with a height of 9.4 m above the top of the crusher building, with the north-west façade open to allow the tipping of material into the building.

DUO have also confirmed that crushing operations would not be undertaken during the night-time; therefore, the following noise sources have not been included within the night-time assessment.

- The Primary Crushing building.
- The Secondary Screening building.
- The Secondary Crushing building.
- Operation of the Komatsu 785 rigid dump truck and Komatsu WA700 Loading Shovel (see Section 5.2.6); and
- All conveyors and conveyor motors associated with the crushing area, up to and including the secondary crusher product stockpile feed conveyors.

5.2.5 Conveyors

SLR has considered all the conveyors associated with the Site within the noise model and operational noise levels have has been based on the following;

- The conveyor motors have been modelled as point sources at their relevant elevations (which were provided by DUO).
- The operational sound power levels for the conveyor ‘belts and rollers’ (80.5 dBA per metre) have been determined with reference to Item 23 in Table C.10 of BS 5228:2009+A1:2014.

5.2.6 Mobile Plant

DRL have confirmed that the following mobile plant would be associated with the operations within the processing area:

- Komatsu 785 90T rigid dump truck with an operational sound power level of 114.0 dB[3]
- Komatsu WA700 loading shovel with an operational sound power level of 114.0 dB[4]

With regards to the locations of the mobile plant the Komatsu 785 will directly tip material from the Mine into the primary crusher feed bin and the Komatsu 700 will reclaim feed from ROM pad to primary crusher feed bin.

DRL have also confirmed that in a worst-case hour the Komatsu 785 will make 15-movements in an hour and the Komatsu 700 will make 43-movements.

5.2.7 Mobile Front End

The operational noise levels from the MFE have either been determined through an operational survey of a similar facility located at Aberdo Quarry in north Wales, or of the MFE itself; this is due to the fact that not all the noise sources associated with the MFE were operating at the time of the drafting of this assessment.

The description of the noise sources and the results of the survey are shown in Table I which also includes 1/3 octave band data.

[3] Noise level based on Item 25 of Table C6 of BS5228:2009:+A1:2014

[4] Operational Level provided by the Client.

Table I: MFE Operational Noise levels

Noise Source	Measurement Dist (m)	Approx Height (m)	L_{Aeq}	25 Hz	31.5 Hz	40 Hz	50 Hz	63 Hz	80 Hz	100 Hz	125 Hz	160 Hz	200 Hz	250 Hz	315 Hz	400 Hz	500 Hz	630 Hz	800 Hz	1 kHz	1.25 kHz	1.6 kHz	2 kHz	2.5 kHz	3.15 kHz	4 kHz	5 kHz	6.3 kHz	8 kHz	10 kHz
Aberdo Quarry Measurements																														
Log washer	1	6	82.1	78.2	67.8	72.5	67.4	79.5	68.8	73.7	74.8	72.4	73.5	73.1	71.2	69.5	70.0	71.2	72.1	74.5	72.1	72.3	71.5	70.0	70.5	68.8	68.5	66.2	64.0	61.9
Mobile Crusher	1.5	3	92.0	67.2	72.3	75.5	75.5	79.9	79.7	78.7	78.3	77.9	78.4	81.5	81.0	81.9	83.1	82.1	83.3	83.0	83.3	83.6	81.3	80.1	80.0	77.5	75.4	72.9	71.4	65.5
360 excavator loading aggregate into operational trommel	10	2	86.3	64.4	69.2	76.3	73.5	85.0	78.3	75.2	76.1	76.7	76.7	77.2	76.6	76.4	76.3	77.4	78.5	77.1	77.1	78.4	75.5	74.0	73.7	71.2	69.3	66.4	63.4	59.7
Aggregate falling into bay	15	2	65.9	76.1	74.6	71.6	69.0	72.5	68.2	67.1	66.1	65.9	61.8	60.3	57.3	55.0	57.7	58.8	56.8	56.3	54.6	54.1	54.1	53.2	53.0	52.7	52.0	50.7	48.8	46.7
MFE Measurements																														
Rinser Screener	9.5 (average)	6	72.0	-	-	-	68.8	72.6	68.1	65.1	67.8	66.7	63.1	62.9	64.5	66.4	66.5	66.1	64.1	61.1	59.8	59.6	59.2	56.7	53.5	51.5	48.2	45.8	44.3	37.6
Dewater Screen	7 (average)	6	68.9	-	-	-	81.7	82.3	76.1	71.9	72.7	70.5	66.9	64.1	62.8	63.2	59.9	58.8	59.8	56.5	56.2	53.8	53.6	54.1	50.6	48.4	46.9	42.8	41.6	52.2
Telestacker motor	7	1	74.9	-	-	-	64.6	70.2	60.5	53.4	62.9	62.9	72.3	69.2	60.8	70.0	68.8	68.8	67.6	64.5	63.5	61.3	56.1	55.1	54.1	51.1	47.9	46.5	42.0	36.8

It should be noted that the MFE noise levels have been calibrated in the noise model so that the predicted noise levels at the operational measurement locations match the measured levels within +/- 3 dB.

5.2.7.1 MFE Conveyors

It has been assumed that all the conveyors associated with the MFE would have the same noise levels as those associated with the main processing area as described in Section 5.2.5. With regards to the conveyor motors, it has also been assumed that these will have an operational sound power level of 71dB(A) which is consistent with the conveyor motors associated with the main processing area.

5.2.7.2 MFE Mitigation

Screen Enclosures

It has been confirmed that the screen decks will be vented and each screen will be housed in a steel-plate enclosure. This was a requirement with regards to Low Frequency Noise (LFN), though it is considered that the enclosure will also provide mitigation for audible noise.

As these enclosures were not in-situ at the time of the operational surveys, a sound reduction of -15 dB has been applied to the screens to account for the enclosures. This is considered to be a conservative estimate, compared to the 22 dB attenuation that 24 g 0.63-gauge steel provides.

Earth Bunds

It has been confirmed that a 6 m high earth bund (the base of which is relative to the level of the pad on which the MFE is sited) will be located on the southern boundary of the MFE, which has been included within the noise model.

An additional 4 m high earth bund will also be located on the MFE pad to the north of the trommels and associated excavator.

5.2.8 Plant On-times

It has been assumed that all the external plant and plant contributing to the internal levels set out in Table H are operating with 100% on-time, though the crushing activities will be limited to the daytime period only as outlined in Section 5.2.4.

With regards to the roller shutter doors, it has been assumed that these would be open for 50% of the time during the daytime and evening periods and 10% of the time during the night-time period, i.e., they would be shut for 90% of the time during the night-time period. These have been modelled as vertical area sources accounting for the internal sound level, sound reduction index of the roller shutter door and positive corrections to account for the time percentage open.

5.3 Predicted Specific Sound Levels

The predicted specific sound levels are shown in Table J below for the daytime, evening and night-time periods at a receptor height of 4 m, representing first floor windows at all locations, with the exception of at Newnham Park, where predictions have been made to a height of 7.5m as this receptor is three storeys high and predictions have made to the ‘dormer’ windows.

In conjunction with the requirements of BS 4142:2014+A1:2019, the predictions have been rounded to the nearest decibel.

Table J: Predicted Specific Sound Levels at Noise-sensitive Receptors, dBA.

Receptor	Period	Predicted Specific Sound Level $L_{Aeq,Tr}$
NSR01 – Mumford Cottage	Daytime	34
	Evening	35
	Night-time	31
NSR02 – Dartmoor Zoo	Daytime	31
	Evening	33
	Night-time	28
NSR03 – Birchland Farm	Daytime	35
	Evening	37
	Night-time	32
NSR04 – Galva House	Daytime	36
	Evening	37
	Night-time	34
NSR05 – Windwhistle Farm	Daytime	34
	Evening	35
	Night-time	31
NSR06 – Newham Park	Daytime	32
	Evening	33
	Night-time	30
NSR07 – Boringdon Hall	Daytime	29
	Evening	30
	Night-time	27
NSR08 – Portworthy	Daytime	35
	Evening	35
	Night-time	32
NSR09 – Wotter Village	Daytime	33
	Evening	33
	Night-time	31

6.0 Noise Impact Assessment

6.1 Acoustic Character Corrections

BS 4142:2014+A1:2019 requires corrections to be applied to the specific level to determine the rating level. These corrections relate to the perception of the sound externally at the receptor location. Due to the relatively large separation distances between the noise generating activities and the receptor locations it is considered that determining potential penalties for individual activities is not required. Instead, the determination of corrections has been applied to the Site as a whole.

A description of the character corrections can be found in Section 3.0 of this report. Table K details the corrections to be applied to the specific sound level at the nearest noise-sensitive receptors.

Table K: Acoustic Character Corrections at the Receptors

Feature	Penalty Range	Comment	Correction Applied
Tonality	0 – 6 dB	The screens which have the potential to produce tonal noise are being housed in buildings to mitigate low frequency noise (LFN) and it is considered that these buildings would also attenuate any potential tonal content. In addition, with regards to the other noise sources on the Site it is SLRs experience that these would not generate tonal noise therefore, no tonal correction is considered applicable.	0 dB
Impulsivity	0 – 9 dB	The operation of the processing plant is not considered to generate impulsive sounds. Although occasionally audible, the broadband reversing alarms are also not considered impulsive and therefore no correction has been applied.	0 dB
Intermittency	0 – 3 dB	With regards to the main processing plant and processes although there are occasional downtimes when the plant does not operate fully there are not definitive on/off times with generally continuous operations, therefore no correction is considered applicable. With regards to mobile plant this will only be operational during the daytime, and it is considered that there would be continuous steady movements within the worst-case one-hour reference period therefore no correction is considered applicable.	0 dB

Feature	Penalty Range	Comment	Correction Applied
Other Sound Characteristic	0 – 3 dB	In the daytime and night-time it is considered that the specific noise levels generated by the processing facility would be readily audible/readily distinctive against the residual acoustic environment at a number of the NSRs depending on the predicted specific level and the measured baseline levels. Having analysed these it is considered that a 3 dB correction would apply at the NSRs and periods listed in the adjacent column.	NSR01 weekday all periods and weekend daytime and evening. NSR02 weekday and weekend night-time. NSR03 all periods. NSR04 all periods. NSR05 all periods. NSR06 weekday evening and night-time and weekend all periods. NSR08 weekday all periods and weekend daytime and evening. NSR09 weekday evening and night-time and weekend daytime and evening.

6.2 Assessment Objective Results

The corrections described in Table K have been added to the predicted specific sound levels shown in Table J to derive the rating levels at each of the nearest NSRs.

The rating levels have then been compared to the derived background sound levels and assessed accordingly.

The results of the BS 4142 assessment are shown in Table L and Table M during the midweek and weekend period respectively. It must be noted that the rating levels and the representative background sound levels have been rounded to the nearest decibel.

Table L: BS 4142 Assessment Midweek, dB

Receptor	Period	Predicted Specific Sound Level $L_{Aeq,Tr}$	Predicted Rating Level, $L_{Ar,Tr}$	Representative Background Sound Level $L_{A90,T}$	Difference
NSR01 – Mumford Cottage	Daytime	34	37	30	+7
	Evening	35	38	27	+11
	Night-time	31	34	23	+11
NSR02 – Dartmoor Zoo	Daytime	31	31	38	-7
	Evening	33	33	34	-1
	Night-time	28	31	26	+5
NSR03 – Birchland Farm	Daytime	35	38	31	+7
	Evening	37	40	29	+11
	Night-time	32	35	24	+11
NSR04 – Galva House	Daytime	36	39	34	+5
	Evening	37	40	31	+9
	Night-time	34	37	24	+13
NSR05 – Windwhistle Farm	Daytime	34	37	32	+5
	Evening	35	38	31	+7
	Night-time	31	34	26	+8
NSR06 – Newnham Park	Daytime	32	32	33	-1
	Evening	33	36	29	+7
	Night-time	30	33	24	+9
NSR07 – Boringdon Hall	Daytime	29	29	36	-7
	Evening	30	30	34	-4
	Night-time	27	27	28	-1
NSR08 - Portworthy	Daytime	35	38	34	+4
	Evening	35	38	30	+8
	Night-time	32	35	30	+5
NSR09 – Wotter Village	Daytime	33	33	34	-1
	Evening	33	36	30	+6
	Night-time	31	34	30	+4

Table M: BS 4142 Assessment Weekend, dB

Receptor	Period	Predicted Specific Sound Level $L_{Aeq,Tr}$	Predicted Rating Level, $L_{Ar,Tr}$	Representative Background Sound Level $L_{A90,Tr}$	Difference
NSR01 – Mumford Cottage	Daytime	34	37	26	+11
	Evening	35	38	33	+5
	Night-time	31	31	34	-3
NSR02 – Dartmoor Zoo	Daytime	31	31	35	-4
	Evening	33	33	33	0
	Night-time	28	31	26	+5
NSR03 – Birchland Farm	Daytime	35	38	26	+12
	Evening	37	40	33	+7
	Night-time	32	35	26	+9
NSR04 – Galva House	Daytime	36	39	25	+14
	Evening	37	40	30	+10
	Night-time	34	37	23	+14
NSR05 – Windwhistle Farm	Daytime	34	37	27	+10
	Evening	35	38	29	+9
	Night-time	31	34	24	+10
NSR06 – Newnham Park	Daytime	32	35	29	+6
	Evening	33	36	29	+7
	Night-time	30	33	22	+11
NSR07 – Boringdon Hall	Daytime	29	29	33	-4
	Evening	30	30	31	-1
	Night-time	27	27	33	-6
NSR08 - Portworthy	Daytime	35	38	32	+6
	Evening	35	38	31	+7
	Night-time	32	32	32	0
NSR09 – Wotter Village	Daytime	33	36	32	+4
	Evening	33	36	31	+5
	Night-time	31	31	32	-1

6.3 Analysis of Objective Results

6.3.1 NSR01 - Mumford Cottage

It can be seen from Table L and Table M that at Mumford Cottage the predicted rating levels are between 3 dB below and 11 dB above the representative background sound levels.

In conjunction with BS 4142, where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a *'low'* impact, a difference of around +5 dB is likely to be an indication of an *'adverse'* impact, and a difference of around

+10 dB or more is likely to be an indication of a '*significant adverse'* impact, depending on the context. In view of this an assessment of context is described in Section 6.4.

Consequently, it is considered that at Mumford Cottage there would be a '*low'* impact during the weekend night-time period, an *'adverse impact'* during the weekday daytime and weekend evening periods, and a '*significant adverse impact'* during the weekday evening and night-time and weekend daytime periods; depending on context. Therefore, a further contextual assessment has been undertaken within Section 6.4.

With reference to the NVM assessment results, a '*low'* impact in conjunction with BS 4142 is defined as '*No noise, or barely audible or detectable noise'* and subsequently the environment agencies may decide that taking action to minimise noise is a low priority. An '*adverse'* impact in conjunction with BS 4142 is defined as '*Audible or detectable noise'* and subsequently it's the operator's duty to use appropriate measures to prevent or, where that is not practicable, minimise noise.

A *'significant adverse' impact'* in conjunction with BS 4142 is defined as '*Unacceptable level of audible or detectable noise'* and subsequently the operator must take further action or may have to reduce or stop operations.

6.3.2 NSR02 - Dartmoor Zoo

It can be seen from Table L and Table M that at Dartmoor Zoo the predicted rating levels are between 7 dB below and 5 dB above the representative background sound levels.

In conjunction with BS 4142, where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a *'low'* impact and a difference of around +5 dB is likely to be an indication of an *'adverse'* impact, depending on the context. In view of this an assessment of context is described in Section 6.4.

Consequently, it is considered that at Dartmoor Zoo there would be a *'low'* impact during the weekday daytime and evening, and the weekend daytime and evening periods, and an '*adverse impact*' during the weekday and weekend night-time periods, depending on context. Therefore, a further contextual assessment has been undertaken within Section 6.4.

With reference to the NVM assessment results, a '*low'* impact in conjunction with BS 4142 is defined as '*No noise, or barely audible or detectable noise'* and subsequently the environment agencies may decide that taking action to minimise noise is a low priority. An '*adverse'* impact in conjunction with BS 4142 is defined as '*Audible or detectable noise'* and subsequently it's the operator's duty to use appropriate measures to prevent or, where that is not practicable, minimise noise.

6.3.3 NSR03 - Birchland Farm

It can be seen from Table L and Table M that at Birchland Farm the predicted rating levels are between 7 dB and 12 dB above the representative background sound levels.

In conjunction with BS 4142 a difference of around +5 dB is likely to be an indication of an *'adverse'* impact and a difference of around +10 dB or more is likely to be an indication of a '*significant adverse'* impact, depending on the context. In view of this an assessment of context is described in Section 6.4.

Consequently, it is considered that at Birchland Farm, there would be an *'adverse impact'* during the weekday daytime and weekend evening periods, and a *'significant adverse impact'* during the weekday evening and night-time and weekend daytime and night-time periods, depending on context. Therefore, a further contextual assessment has been undertaken within Section 6.4.

With reference to the NVM assessment results, an '*adverse'* impact in conjunction with BS 4142 is defined as '*Audible or detectable noise'* and subsequently it's the operator's duty

to use appropriate measures to prevent or, where that is not practicable, minimise noise. A *'significant adverse'* impact in conjunction with BS 4142 is defined as '*Unacceptable level of audible or detectable noise'* and subsequently the operator must take further action or may have to reduce or stop operations

6.3.4 NSR04 - Galva House

It can be seen from Table L and Table M that at Galva House the predicted rating levels are between 5 dB and 14 dB above the representative background sound levels.

In conjunction with BS 4142 a difference of around +5 dB is likely to be an indication of an '*adverse'* impact and a difference of around +10 dB or more is likely to be an indication of a '*significant adverse'* impact, depending on the context. In view of this an assessment of context is described in Section 6.4.

Consequently, it is considered that at Galva House there would be an *'adverse impact'* during the weekday daytime, and a '*significant adverse impact* 'during the weekday evening and night-time and weekend daytime, evening, and night-time periods, depending on context. Therefore, a further contextual assessment has been undertaken within Section 6.4.

With reference to the NVM assessment results an *'adverse'* impact in conjunction with BS 4142 is defined as *'Audible or detectable noise*' and subsequently it's the operator's duty to use appropriate measures to prevent or, where that is not practicable, minimise noise. A *'significant adverse'* impact in conjunction with BS 4142 is defined as '*Unacceptable level of audible or detectable noise'* and subsequently the operator must take further action or may have to reduce or stop operations.

6.3.5 NSR05 – Windwhistle Farm

It can be seen from Table L and Table M that at Windwhistle Farm the predicted rating levels are between 5 dB and 10 dB above the representative background sound levels.

In conjunction with BS 4142 a difference of around +5 dB is likely to be an indication of an '*adverse'* impact and a difference of around +10 dB or more is likely to be an indication of a '*significant adverse'* impact, depending on the context. In view of this an assessment of context is described in Section 6.4.

Consequently, it is considered that at Windwhistle Farm there would be an *'adverse impact'* during the weekday daytime, evening, and night-time periods, and a *'significant adverse'* impact during the weekend daytime, evening, and night-time periods, depending on context. Therefore, a further contextual assessment has been undertaken within Section 6.4.

With reference to the NVM assessment results an '*adverse'* impact in conjunction with BS 4142 is defined as '*Audible or detectable noise'* and subsequently it's the operator's duty to use appropriate measures to prevent or, where that is not practicable, minimise noise. A *'significant adverse'* impact in conjunction with BS 4142 is defined as '*Unacceptable level of audible or detectable noise'* and subsequently the operator must take further action or may have to reduce or stop operations.

6.3.6 NSR06 – Newnham Park

It can be seen from Table L and Table M that at Newnham Park the predicted rating levels are between 1 dB below and 11 dB above the representative background sound levels.

In conjunction with BS 4142, where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a *'low'* impact, a difference of around +5 dB is likely to be an indication of an *'adverse'* impact, and a difference of around +10 dB or more is likely to be an indication of a '*significant adverse'* impact, depending on the context. In view of this an assessment of context is described in Section 6.4.

Consequently, it is considered that at Newham Park there would be a *'low'* impact during the weekday daytime period, an *'adverse impact'* during the weekday evening and weekend daytime and evening periods, and a *'significant adverse'* impact during the weekday and weekend night-time periods, depending on context. Therefore, a further contextual assessment has been undertaken within Section 6.4.

With reference to the NVM assessment results, a '*low'* impact in conjunction with BS 4142 is defined as '*No noise, or barely audible or detectable noise'* and subsequently the environment agencies may decide that taking action to minimise noise is a low priority. An '*adverse'* impact in conjunction with BS 4142 is defined as '*Audible or detectable noise'* and subsequently it's the operator's duty to use appropriate measures to prevent or, where that is not practicable, minimise noise. A '*significant adverse'* impact in conjunction with BS 4142 is defined as '*Unacceptable level of audible or detectable noise'* and subsequently the operator must take further action or may have to reduce or stop operations.

6.3.7 NSR07 – Boringdon Hall

It can be seen from Table L and Table M that at Boringdon Hall the predicted rating levels are between 1 dB and 7 dB below the representative background sound levels.

In conjunction with BS 4142, where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a '*low'* impact, depending on the context.

Consequently, it is considered that there would be a *'low'* impact during all the time periods assessed at Boringdon Hall; however, a further contextual assessment has been undertaken within Section 6.4.

With reference to the NVM assessment results a '*low'* impact in conjunction with BS 4142 is defined as '*No noise, or barely audible or detectable noise'* and subsequently the environment agencies may decide that taking action to minimise noise is a low priority.

6.3.8 NSR08 – Portworthy

It can be seen from Table L and Table M that at Portworthy the predicted rating levels are between equal to and 8 dB above the representative background sound levels.

In conjunction with BS 4142, where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a *'low'* impact, a difference of around +5 dB is likely to be an indication of an *'adverse'* impact, and a difference of around +10 dB or more is likely to be an indication of a '*significant adverse'* impact, depending on the context. In view of this an assessment of context is described in Section 6.4.

Consequently, it is considered that at Portworthy there would be a *'low'* impact during weekday daytime and weekend night-time periods, an *'adverse impact'* during the weekday night-time and weekend daytime periods, and a *'significant adverse'* impact during the weekday and weekend evening periods, depending on context. Therefore, further contextual assessment has been undertaken within Section 6.4.

With reference to the NVM assessment results, a '*low'* impact in conjunction with BS 4142 is defined as '*No noise, or barely audible or detectable noise'* and subsequently the environment agencies may decide that taking action to minimise noise is a low priority. An '*adverse'* impact in conjunction with BS 4142 is defined as '*Audible or detectable noise'* and subsequently it's the operator's duty to use appropriate measures to prevent or, where that is not practicable, minimise noise. A *'significant adverse'* impact in conjunction with BS 4142 is defined as '*Unacceptable level of audible or detectable noise'* and subsequently the operator must take further action or may have to reduce or stop operations.

6.3.9 NSR09 – Wotter Village

It can be seen from Table L and Table M that at Wotter the predicted rating levels are between 1 dB below and 6 dB above the representative background sound levels.

In conjunction with BS 4142, where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a *'low'* impact and a difference of around +5 dB is likely to be an indication of an *'adverse'* impact, depending on the context. In view of this an assessment of context is described in Section 6.4.

Consequently, it is considered that at Wotter Village there would be a *'low'* impact during the weekday daytime and weekend night-time periods, and an *'adverse impact'* during the weekday evening and night-time and weekend daytime and evening periods, depending on context. Therefore, a further contextual assessment has been undertaken within Section 6.4.

With reference to the NVM assessment results, a '*low'* impact in conjunction with BS 4142 is defined as '*No noise, or barely audible or detectable noise'* and subsequently the environment agencies may decide that taking action to minimise noise is a low priority. An '*adverse'* impact in conjunction with BS 4142 is defined as '*Audible or detectable noise'* and subsequently it's the operator's duty to use appropriate measures to prevent or, where that is not practicable, minimise noise.

6.4 Context Considerations

The assessment has shown that the predicted daytime and night-time rating levels at all receptors considered, with the exception of at NSR07 (Boringdon Hall), give an indication of '*adverse*' or '*significant adverse'* impacts, depending on the context.

In view of the above, a context assessment has been undertaken.

6.4.1 Embedded Mitigation Measures

It must be noted that the Site has already implemented a number of mitigation measures relating to noise. These measures were determined within the previous noise assessment and are also included within the approved Noise Management Plan (NMP) for the Site (Ref: 70108756, Dated October 2023).

The embedded mitigation measures implemented are described in Table N.

Table N: Embedded Mitigation Measures Implemented

Area of Site/Source	Imbedded Mitigation
Noise Generating Buildings	Enhanced cladding to new buildings (Kingspan and concrete).
	24 g 0.63-gauge steel to the existing main process building to the floor.
Conveyor Openings	Noise attenuating mitigation to be applied to specific conveyor entries and openings to achieve a 10 dB reduction.
Roller Shutter Doors	Open for a maximum of 30-minutes in any given hour in the daytime and 2.5 minutes in any given 15-minute period during the night-time.
Crushers	These are now housed within buildings with enhanced cladding which was required as part of the LFN assessment.
MFE	Screeners contained steel plate enclosures.

Area of Site/Source	Imbedded Mitigation
	6 m earth bund located on the southern boundary of the MFE and 4m earth bund located on the northern boundary of the MFE.
Processing Plant	Noise attenuating mitigation to be applied to specific items of processing plant to achieve a 10 dB reduction.

With reference to all of the above it is considered that the Site operator has implemented appropriate measures to minimise noise as far as reasonably practicable.

6.4.2 Comparison Between Previous and Revised Operations

It must be noted that extraction and processing operations historically operated at the Site from September 2015 to October 2018 and therefore the receptors have previously been subject to noise of an industrial nature during the daytime, evening and night-time periods.

However, the revisions to the operations described in Section 2.2.2 has had the effect of moving a number of noise generating operations further away from the most effected NSRs (Birchland Farm and Galva House) than during the historical operations. For example, the primary and secondary crushing activities which were associated with Area 110 located on the northern boundary of the extraction area, will no longer be operational.

These crushing operations have been moved north-east into the processing area and further away from the nearest NSRs as shown in Figure C.

Figure C: Crushing Locations



In addition, the main processing building originally housed the majority of the screening plant; however, a number of the screens have now been housed in new buildings that benefit from the noise attenuation provided by the enhanced cladding.

With reference to the above, it is considered that the noise generated by the proposed processing operations will be a betterment when compared to the noise historically generated by the original processing plant.

6.4.3 Existing Soundscape

With reference to Table I '*Summary of Baseline Sound Environment'* within the *Baseline Sound Survey Report* (SLR Ref: 403.066596.00001.001), the existing soundscape at a number of the receptor locations contained noise sources of an industrial or commercial nature.

The above applies at NSR01 (Mumford Cottage) and NSR08 (Portworthy), where both the Imerys and Sibelco sites were audible during the daytime, evening and night-time periods. At NSR01, the noise from the Sibelco Site was the dominant source during the weekend evening and night-time periods and contributed to the increased baseline levels during these periods.

At NSR03 (Birchland Farm) and NSR04 (Galva House), the Imerys Site was again audible, albeit at a lower perceivable level and only during the evening and night-time periods.

It is also considered that the character of the noise observed from both the Imerys and Sibleco Sites i.e. mobile plant, mid-frequency 'hum', would be similar to that produced by the processing plant.

At NSR06 (Newnham Park), the noise from a substation associated with the receptor was audible during the daytime and a distant 'pump' was audible during the night-time.

Though it is acknowledged that these sources are audible at varying degrees during the different time periods and that noise from the processing operations may or may not be a more audible source of an industrial nature at these receptors; this has to be taken into account when considering context.

6.4.4 Contribution of Extraction Noise and Future Soundscape

It is considered that one of the main contextual aspects to the potential impacts is that, during the daytime and evening periods, the future ambient noise climate at all the receptor locations is very likely to include a significant contribution of noise from the extraction operations which are permitted from 07:00 to 22:00 seven-days a week. It also should be noted that the noise limits for extraction operations are higher at all the receptor locations than the predicted specific levels from the processing operations (see Section 6.4.7).

The noise from extraction operations i.e. use of mobile extraction plant, loading of material and transportation using dump trucks, will be very similar to the type of noise associated with processing operations. For example, with reference to the noise model, one of the most dominant noise sources associated with the processing operations at NSR04 Galva House is the 360-excavator loading material into the operational trommel as part of the MFE operations.

It should also be noted that four of the receptor locations identified are located closer to the main extraction area than to the main processing area. Therefore, the prevailing soundscape during the daytime and evening at these NSRs is more likely to be heavily influenced by extraction operations.

6.4.5 Night-time Absolute Noise Levels

BS 4142:2014+A1:2019 states:

"Where background sound levels and rating levels are low, absolute levels might be as, or more, relevant than the margin by which the rating level exceeds the background. This is especially true at night."

The standard does not indicate at what level background and rating levels are low but the previous version of BS 4142:1997 stated:

"The method is not suitable for assessing the noise measured inside buildings or when the background and rating noise levels are both very low.

NOTE. For the purposes of this standard, background noise levels below about 30 dB and rating levels below about 35 dB are considered to be very low."

It also should be noted that numerous studies by Moorhouse, Berry and Flindell for the Health Protection Agency and for Defra (referenced within the Further Reading Section of BS 4142) and supported by the recent Association of Noise Consultants (ANV) Working Group report on BS 4142 application conclude that impacts at rating levels below 35 dBA are unlikely.

With reference to Table D, it can be seen that the representative background sound levels measured are low, especially during the night-time where background sound levels were measured at 30 dB or below at all of the receptors during either during a midweek or weekend period.



With reference to Table L and Table M, it can also be seen that during the night-time, the predicted rating levels are equal to or below 35 dB $L_{Ar,Tr}$ at all the receptor locations with the exception of at NSR04 (Galva House) where the night-time predicted rating level is 37 dB $L_{Ar,Tr.}$

With reference to the above, it is considered that once context is taken into account, the predicted rating levels would have a *'low'* impact at the receptor locations during the more sensitive night-time period.

6.4.6 Internal Noise Levels

It could be expected that residents may choose to leave windows open, where, as a conservative approach, a level difference of approximately 9 dB[5] would be expected inside the dwellings through a partially open window. The nearest NSRs have not been noted to contain any sound insulation provisions that allow residences to keep windows closed (e.g. mechanical ventilation) therefore an open window assessment has been considered appropriate in context.

At all receptors, the predictions should be considered in the context of internal noise levels for which BS 8233:2014 states that it is desirable that the internal ambient noise level does not exceed the following guideline values for steady state sources:

- an ambient daytime noise level of 35 dB $L_{Aeq,16hr}$ or less is suitable for daytime resting; this also covers the assessed evening period.
- an ambient night-time noise level of 30 dB $L_{Aeq,8hr}$ or less is suitable for sleeping.

The highest predicted daytime or evening absolute noise level (the specific level from the Site logarithmically added to the lowest average existing ambient level) is 40 dBA at Dartmoor Zoo; taking into account the attenuation provided by a partially open window this would equate to an internal level of 31 dBA, which is below the internal daytime and evening ambient noise limit of 35 dB $L_{Aeq,16hr}$. The highest predicted night-time absolute noise level is 36 dBA at Portworthy, which would result in an internal level of 27 dBA, which is below the internal night-time ambient noise limit of 30 dB $L_{Aeq,8hr}$.

It is acknowledged that common guidance documents describing internal ambient noise levels within dwellings, such as those within BS 8233:2014, are normally based upon population responses against anonymous sources, such as road traffic. There has been no standard available that can be applied to absolute sounds of a specific industrial character as has been considered within this report. It also should be noted that Annex A of BS 4142:2014+A1:2019 contains worked examples (Ref: A.6.1 and A.6.3) that include the use of BS 8233:2014 to inform the assessment of context which includes reference to internal levels and the attenuation provided an open window.

Notwithstanding, it has been demonstrated that internal sound levels would relate to residual sound comprising of extraneous sources including other sources of an industrial nature, road traffic noise and natural sounds, as opposed to any reasonable contribution from the proposed development.

Where any industrial or commercial sound remains audible, then it has been considered that this would have a minor level of effect with regards to internal noise levels within the NSRs.

[5] Section 4.1.7 of the '*Guide to Demonstrating Compliance with the Noise Requirements of Approved Document 0'* produced by the Association of Noise Consultants (ANV) and the Institute of Acoustics (I.o.A) states *"Based on typical assumptions the resulting outside-to-inside level difference for window openings necessary to satisfy the simplified method of AD-O are expected to be approximately 9 dB for 'medium' risk locations."*

6.4.7 Condition 5 of the Planning Permission

In conjunction with the EA's Noise and Vibration Management: Environmental Permits document, the assessment has been undertaken in conjunction with BS 4142:2014+2019.

However, Condition 5 of the planning permission for the Site contains operational noise limits for the Site as shown below. It is considered that the limits below are deemed by Devon County Council to be the SOAEL for the receptors.

5. Noise levels arising from the development shall not exceed the following limits at any noise sensitive property:

(i) Between the hours of 0700 and 1900 (daytime) Monday to Saturday 50 dB $L_{Aeq.\ 1\ hour}$ free field;

(ii) Between the hours of 1900 and 2200 (evening) Monday to Saturday 45 dB $L_{Aeq.\ 1\ hour}$ free field;

(iii) Between the hours of 2200 and 0700 (night-time) 42 dB $L_{Aeq.\ 1\ hour}$ free field;

(iv) Between 0700 and 2200 on Sunday or on any Bank or Public Holiday (as defined by Condition 4) 45 dB $L_{Aeq.\ 1\ hour\ free\ field.}$

The predicted specific noise levels from the Site at the nearest NSRs are contained in Table J and show that the noise being generated by the Site is well below the above limits during the daytime, evening, and night-time periods at all the NSRs considered.

6.4.8 Summary of the Context Assessment

In summary the context assessment has shown that:

- Site operator has implemented appropriate measures to minimise noise as far as reasonably practicable.
- Due to the relocation of crushing activities and screens associated with the revised Site layout, it is considered that the noise generated by the proposed processing operations will be a betterment when compared to the noise historically generated by the original processing plant at number of the nearest NSRs.
- The existing daytime, evening and night-time soundscape at a number of the NSRs already contains noise of an industrial or commercial nature, therefore the noise from the Site would not be out of context with the prevailing soundscape.
- During the daytime and evening periods the future soundscape at the NSRs is likely to be influenced by the noise from extraction operations from plant working within the quarry void which are subject to higher noise limits than the predicted rating levels.
- The background sound levels (L_{A90}) during the night-time are considered to be very low and therefore the night-time absolute levels have been considered.
- The night-time rating levels are also considered low and are equal to or below 35dB $L_{Ar,Tr}$ at all the receptor locations with the exception of at one NSR and numerous studies have concluded that impacts at rating levels below 35 dBA are unlikely.
- When the attenuation provided by a partially open window is considered, the daytime, evening and night-time internal levels within all of the nearest NSRs are below the relevant internal limits contained in BS 8233:2014.
- The predicted daytime, evening and night-time specific levels are below the noise limits specified in Condition 5 of the planning permission for the Site at all the NSRs considered.

Further to the above, the evaluated noise impacts in this report should be mindful of the National Planning Policy Framework and Noise Policy Statement for England that define policy and decision-making requirements for planning and noise.

It has been provided within Section 3.0 of this report, that the NPSE suggests noise levels above the SOAEL should be avoided and that if noise levels fall between the LOAEL and SOAEL all reasonable steps should be taken to minimise and mitigate adverse effects, while considering guiding principles of sustainable development.

The range of noise impacts for the proposed development have been deemed acceptable with respect to overarching requirements for planning and noise and once the context of the noise generated by the site has been considered the resulting impacts have been anticipated between the NOEL and LOAEL thresholds of the NPSE.

It has been expected that the noise from the Site will have no effect at distant NSRs. In the worst-case and closest receptors, it would be largely unnoticeable, or just perceptible during the most noise sensitive periods of assessment. If it is possible for the sound to be audible, it is expected to cause limited change in behaviour or attitude. The development could affect the acoustic character of the area but not to the extent that there is a perceived change in quality of life.

It also should be noted that for the reasons outlined in Section 6.4.2, the noise generated by the proposed processing operations will be a betterment when compared to the noise historically generated by the original processing plant.

To conclude the consideration of context relevant to the assessed sound sources has been viewed to support the notion of a *“low impact,*” or at worst *‘minor adverse’* impacts at the NSRs in accordance with BS 4142, whereby the possible adverse effects have been considered in context.

7.0 Statement of Uncertainty

7.1 Uncertainties Relating to the Baseline Survey

The uncertainties relating to the baseline survey are included within the separate Baseline Survey Report (SLR Ref: 403.066596.00001.001).

7.2 Uncertainties Relating to Noise Sources and Predicted Noise Levels

BS 4142:2014+A1:2019 requires consideration of uncertainty associated with the operational levels of the various noise sources utilised in the assessment.

The vast majority of the operational noise levels utilised within the noise model were sourced by DUO from manufacturer data of each individual item of plant.

The internal noise levels associated with the noise generating buildings have been based on manufactures' data, the dimensions of each building and the internal absorption coefficient. Whilst there is an element of uncertainty associated with the manufactures data, the calculated internal levels for these buildings are considered very conservative and in reality, the internal noise levels within these buildings are likely to be lower for the reasons outlined in Section 5.2.3.4.

The noise level of the primary crusher was determined through operational noise surveys undertaken by Wolf Minerals in 2018. The use of measured rather than using manufacturers' data is a robust approach and reduces uncertainty.

The noise levels of the conveyor belts have been based on data provided within BS 5228-1. The spectrum data from this has been allocated to the conveyors associated with the Site; as stated above the use of referenceable rather than using manufacturers' data is a robust approach and reduces uncertainty.

With regards to the MFE a number of the operational noise levels have been determined through an operational survey of a similar facility located at Aberdo Quarry in north Wales, as not all the noise sources associated with the MFE were operating at the time of the drafting of this assessment. It is acknowledged that this does provide an element of uncertainty.

However, the levels at the Aberdo quarry were measured by a qualified acoustician whilst the plant was operating normally processing material with no noise mitigation and are therefore considered as robust as reasonably practicable. In addition, as more of the plant associated with the MFE becomes operational and the enclosers around the screens are also installed further monitoring will be undertaken to determine operational noise levels and therefore the assessment can subsequently be updated.

As no octave band data was available for the majority of the noise sources associated with the proposed processing plant, all the predictions and subsequent mitigation measures have been based on the 500 Hz band. It is acknowledged that this is a limitation of the assessment and therefore enhances the amount of uncertainty. However, it must be noted that with regards to the tonal content of the sound being generated by the Site, separate investigations have been conducted for LFN and are presented in reports submitted alongside this noise assessment.

It is acknowledged that there is a degree of uncertainty relating to the 10 dB noise reduction for the openings mitigated; however, the uncertainties will be taken into account during the detailed design of the development and all practicable measures would be applied so that the assumptions described in this report are achieved.



Finally, it must be noted that as all sources have been considered in the noise model operating 100% of the time, noting that the crushing activities will be limited to the daytime and evening periods only as outlined in Section 5.2.4.

The cumulative source level is therefore conservative and unlikely to be significantly impacted by uncertainty for individual items of plant.

7.2.1 Predicted Noise Levels

Based on the accuracy of the prediction methodology (i.e. ISO 9613-2, the uncertainty of the CadnaA model accuracy, i.e. contour data, barrier corrections for buildings, etc.), it is considered that the results of the assessment are as accurate as reasonably practicable; with downwind propagation and 100% on-time for all but the opening of the roller shutter doors (and the operation of the crushing activities during the night-time). It is likely to result in conservative predictions.

7.3 Impact of all Uncertainties

The uncertainties regarding the baseline sound survey and subsequent predicted noise levels have been discussed in the separate Baseline Survey Report and Section 7.2 of this document.

With reference to these sections, it is considered that the uncertainties have been kept to a minimum as far as reasonably practicable.

In general, it is considered the uncertainties would result in a reduction in the rating levels for noise from Site. However, if there was a minor increase in rating levels being relative to background sound levels, it is considered that absolute levels would remain low.

8.0 Conclusions

Drakelands Restoration Limited (DRL) has appointed SLR Consulting Limited (SLR) to update and amend a noise assessment of their proposed processing plant at Hemerdon Mine, Devon (the Site), to support the permit variation application (pre-application reference EPR/AP3203ML/P001).

The noise assessment has considered the operation of the Mobile Front End (MFE) as part of the phased recommencement of mineral processing activities at Hemerdon Mine and the operation of the Minerals Processing Facility (MPF).

The updated assessment has been carried out in accordance with the guidance contained in British Standard 4142:2014+A1:2019 *Methods for rating and assessing industrial and commercial* sound as required by the Environment Agency (EA) *Guidance Noise and vibration management: environmental permits.* British Standard 8233:2014 *Guidance on sound insulation and noise reduction for buildings*, the NPPF, the NPSE and Condition 5 of the planning permission for the Site were also referred to.

The assessment is based on the results of a baseline sound survey undertaken at nearby noise-sensitive receptors during periods of appropriate weather.

Cumulative sound rating levels have been predicted at nearest sensitive receptors using noise modelling techniques and industry standard methods.

The numerical assessment in Section 6.2 has predicted the worst-case rating levels would be 14 dB above the representative background sound levels during the daytime and night-time periods; however, predicted operational noise impacts have been supported as low or minorly adverse when considering the context of the noise generated by the Site.

It has been established that development sound will have no effect at distant NSRs. In the worst-case and closest receptors, it would be largely unnoticeable, or just perceptible. If it is possible for the sound to be audible, it is not expected to cause significant change in behaviour or attitude. The development could affect the acoustic character of the area but not to the extent that there is a perceived change in quality of life.

Significant embedded mitigation measures already provided for by the Applicant have been outlined, demonstrating that noise levels from the proposed operations have been mitigated as far as reasonably practicable.

It has been concluded from the findings of this assessment that the range of noise impacts for the proposed development are acceptable with respect to overarching and local requirements for planning and noise.

The assessment has also shown noise being generated by the Site is well below the limits contained in Condition 5 of the planning permission for the Site during the daytime and night-time periods.

8.1 Noise Management Plan

This assessment will be subsequently accompanied by a detailed updated Noise Management Plan (NMP). The NMP would demonstrate competence and commitment to controlling noise pollution and the systems in place to manage the risks effectively.

Appendix A Glossary of Terminology

Noise Impact Assessment

Hemerdon Mine

Drakelands Restoration Ltd

SLR Project No.: 403.066596.00001

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In order to assist the understanding of acoustic terminology and the relative change in noise, the following background information is provided.

The human ear can detect a very wide range of pressure fluctuations, which are perceived as sound. In order to express these fluctuations in a manageable way, a logarithmic scale called the decibel, or dB scale is used. The decibel scale typically ranges from 0 dB (the threshold of hearing) to over 120 dB. An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A-1: Sound Levels Commonly Found in the Environment

Sound Level	Location
0 dBA	Threshold of hearing
20 to 30 dBA	Quiet bedroom at night
30 to 40 dBA	Living room during the day
40 to 50 dBA	Typical office
50 to 60 dBA	Inside a car
60 to 70 dBA	Typical high street
70 to 90 dBA	Inside factory
100 to 110 dBA	Burglar alarm at 1 m away
110 to 130 dBA	Jet aircraft on take off
140 dBA	Threshold of Pain

Appendix B Noise Sources and Locations

Noise Impact Assessment

Hemerdon Mine

Drakelands Restoration Ltd

SLR Project No.: 403.066596.00001

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Appendix B Plant Sound Power Levels

B.1 T1 Primary Crushing Building

Table 1: T1 Primary Crushing Building Internal Plant Sound Power Levels

Plant ID and Name	Sound Power Level, dB L_{WA}
115-BN-01 Dump Hopper 200m3 Part 1	98
115-CH-01 Dump Hopper 200m3 Part 2	98
115-CH-05 Grizzly Underpan/ Bypass Chute	98
115-CH-06 Jaw Crusher Product Chute	98
115-CR-01 Primary Crusher	119
115-CV-XX Apron Feeder Dribble Conveyor	71
115-DC-01 Dust Suppression Building 1	83
115-FE-XX Apron Feeder	71
115-GZ-01 Grizzly Feeder	93
115-HT-01 Gantry Crane	71
115-MG-01 Primary Crusher Discharge Conveyor Belt Magnet	71
115-PP-01 B1 Ground Pump	71
115-RB-01 Rock Breaker	120
115-SU-01 B1 Ground Sump	48

B.2 T2 Secondary Closing Screen Building

Table 2: T2 Secondary Closing Screen Building Internal Plant Sound Power Levels

Plant ID and Name	Sound Power Level, dB L_{WA}
115-CH-08 Primary Collection Conveyor Discharge Chute	98
115-CH-09 Secondary Crusher Closing Screen Oversize Chute	98
115-CH-10 Secondary Crusher Closing Screen Underpan	98
115-DC-02 Dust Suppression Building 2	83
115-PP-02 B2 Ground Pump	71
115-SN-01 Secondary Crusher Closing Screen	118
115-SU-02 B2 Ground Sump	48

B.3 T3 Secondary Crushing Building

Table 3: T3 Secondary Crushing Building Internal Plant Sound Power Levels

Plant ID and Name	Sound Power Level, dB L_{WA}
115-BN-03 Secondary Crusher Feed Bin	98
115-CH-07 Secondary Crusher Product Chute	98
115-CR-XX Secondary Crusher	115
115-DC-03 Dust Suppression Building 3	83
115-HT-02 Maintenance Hoist (T3)	71
115-PP-03 B3 Ground Pump	71
115-SU-03 B3 Ground Sump	48

B.4 T5 Ore Sizing Screen Building

Table 4: T5 Ore Sizing Screen Building Internal Plant Sound Power Levels

Plant ID and Name	Sound Power Level, dB L_{WA}
120-PP-03 Washing and Screening Area Sump Pump (T5)	88
125-CH-03 Ore Sorter Sizing Screen Underpan	98
125-CV-22 Cobble Transfer conveyor 1	71
125-CV-24 Pebble Transfer conveyor 1	71
125-PP-01 Ore Sorter Sizing Screen U/S transfer pump	78
125-PP-10 Ore Sorter Sorters Area Spillage pump	71
120-SN-11 Ore Sorter Sizing Screen	93
125-CH-01A Stockplie Reclaim Conveyor Head Chute	98

B.5 T6 Ore Sorting Building NE extension

Table 5: T6 Ore Sorting Building NE Extension Internal Plant Sound Power Levels

Plant ID and Name	Sound Power Level, dB L_{WA}
125-BN-01 Pebble Ore Sorter Bin 1	83
125-BN-02 Pebble Ore Sorter Bin 2	83
125-BN-03 Pebble Ore Sorter Bin 3	83
125-BN-04 Cobble Ore Sorter Bin 1	83
125-BN-05 Cobble Ore Sorter Bin 2	83
125-BN-06 Cobble Ore Sorter Bin 3	83
125-CH-04 Ore Sorter Sizing Screen Cobble Feed Chute	98

Plant ID and Name	Sound Power Level, dB L_{WA}
125-CH-05 Ore Sorter Sizing Screen Pebble Feed Chute	98
125-CH-07 Pebbles Shuttle Feed Chute	98
125-CH-08 Cobbles Shuttle Feed Chute	98
125-CH-09 Pebbles Ore Sorter Bin 1 Discharge Chute	98
125-CH-10 Pebbles Ore Sorter Bin 2 Discharge Chute	98
125-CH-11 Pebbles Ore Sorter Bin 3 Discharge Chute (Standby)	*98 – Not Included*
125-CH-12 Cobbles Ore Sorter Bin 1 Discharge Chute	98
125-CH-13 Cobbles Ore Sorter Bin 2 Discharge Chute	98
125-CH-14 Cobbles Ore Sorter Bin 3 Discharge Chute (Standby)	*98 – Not Included*
125-CV-02 Cobble Shuttle conveyor	71
125-CV-03 Pebble Shuttle conveyor	71
125-CV-23 Cobble Transfer conveyor 2	71
125-CV-25 Pebble Transfer conveyor 2	71
125-FE-01 Pebble Ore Sorter 1 Feeder	66
125-FE-02 Pebble Ore Sorter 2 Feeder	66
125-FE-03 Cobble Ore Sorter 1 Feeder	66
125-FE-04 Cobble Ore Sorter 2 Feeder	66

B.6 T6 Ore Sorting Building

Table 6: T6 Ore Sorting Building Internal Plant Sound Power Levels

Plant ID and Name	Sound Power Level, dB L_{WA}
120-PP-01 Washing and Screening Area Sump Pump 1 - T6	88
120-PP-02 Washing and Screening Area Sump Pump 2 - T6	88
120-PP-04 Washing and Screening Area Sump Pump 3 - T6	88
125-AC-01 Ore Sorter Air Compressor 1	83
125-AC-02 Ore Sorter Air Compressor 2	83
125-AC-03 Ore Sorter Air Compressor 3	83
125-AD-01 Ore Sorter Pebble Air dryer 1	80
125-AD-02 Ore Sorter Pebble Air dryer 2	80
125-AD-03 Ore Sorter Pebble Air dryer 3	80

Plant ID and Name	Sound Power Level, dB L_{WA}
125-AD-04 Ore Sorter Cobble Air dryer 1	80
125-AD-05 Ore Sorter Cobble Air dryer 2	80
125-AD-06 Ore Sorter Cobble Air dryer 3	80
125-CH-15 Cobble Polishing Screen 1 Underpan	68
125-CH-16 Cobble Polishing Screen 2 Underpan	68
125-CH-17 Cobble Polishing Screen 3 Underpan (Standby)	*68 – Not Included*
125-CH-18 Pebble Polishing Screen 1 Underpan	68
125-CH-19 Pebble Polishing Screen 2 Underpan	68
125-CH-20 Pebble Polishing Screen 3 Underpan (Standby)	*68 – Not Included*
125-CH-21 Cobble Sorter 1 Reject Chute	98
125-CH-22 Cobble Sorter 2 Reject Chute	98
125-CH-23 Cobble Sorter 3 Reject Chute (Standby)	*98 – Not Included*
125-CH-24 Pebble Sorter 1 Reject Chute	98
125-CH-25 Pebble Sorter 2 Reject Chute	98
125-CH-26 Pebble Sorter 3 Reject Chute (Standby)	*98 – Not Included*
125-CH-27 Cobble Sorter 1 Accept Chute	98
125-CH-28 Cobble Sorter 2 Accept Chute	98
125-CH-29 Cobble Sorter 3 Accept Chute (Standby)	*98 – Not Included*
125-CH-30 Pebble Sorter 1 Accept Chute	98
125-CH-31 Pebble Sorter 2 Accept Chute	98
125-CH-32 Pebble Sorter 3 Accept Chute (Standby)	*98 – Not Included*
125-OS-01 Pebble Ore Sorter 1	114
125-OS-02 Pebble Ore Sorter 2	114
125-OS-03 Cobble Ore Sorter 1	114
125-OS-04 Cobble Ore Sorter 2	114
125-OS-05 Pebble Ore Sorter 3 (Standby)	*114 – Not Included*
125-OS-06 Cobble Ore Sorter 3 (Standby)	*114 – Not Included*
125-PP-03 Cobble Ore Sorter Dewatering screen sump pump	70
125-PP-04 Pebble Ore Sorter Dewatering screen sump pump	70
125-PP-10 Ore Sorter Sorters Area Spillage Pump	71
125-SN-01 Pebble Ore Sorter 1 dewatering screen	93

Plant ID and Name	Sound Power Level, dB L_{WA}
125-SN-02 Pebble Ore Sorter 2 dewatering screen	93
125-SN-03 Cobble Ore Sorter 1 dewatering screen	93
125-SN-04 Cobble Ore Sorter 2 dewatering screen	93
125-SN-05 Pebble Ore Sorter 3 dewatering screen (Standby)	*93 – Not Included*
125-SN-06 Cobble Ore Sorter 3 dewatering screen (Standby)	*93 – Not Included*
125-SU-01 Sorter Undersize Sump 1	48
125-SU-02 Sorter Undersize Sump 2	48
125-SU-03 Sorter Undersize Sump 3	48
125-CH-33 ore Sorter Accepts Transfer Conveyor Head Chute	98

B.7 Tertiary Crushing Building

Table 7: Tertiary Crushing Internal Plant Sound Power Levels

Plant ID and Name	Sound Power Level, dB L_{WA}
130-BN-02 Tertiary crusher surge bin	93
130-CH-02 Tertiary crusher feed conveyor head chute	78
130-CH-03 Tertiary crusher 1 feed chute	78
130-CH-04 Tertiary Crusher 1 Discharge Chute	78
130-CR-03 Tertiary crusher 1	108
130-CR-04 Tertiary Crusher 2 (Standby)	*108 – Not Included*
130-FE-01 Tertiary crusher 1 feeder	98
130-FE-02 Tertiary Crusher 2 Feeder (Standby)	*98 – Not Included*
130-CV-04 Tertiary Crusher Feed Conveyor	71
130-HT-01 Tertiary crusher crane	88

B.8 Main Processing Building

Table 8: Main Processing Building Internal Plant Sound Power Levels

Plant ID and Name	Sound Power Level, dB L_{WA}
130-CH-07 Tertiary Crusher Discharge Conveyor Head Chute	78
130-CV-05 Tertiary crusher discharge conveyor	71
130-SN-12 Tertiary Crusher Sizing Screen	93
135-CH-04 IPJ TAILINGS TRANSFER CONVEYOR HEAD CHUTE	68

Plant ID and Name	Sound Power Level, dB L_{WA}
135-CV-30 IPJ TAILINGS TO DMS FEED TRANSFER CONVEYOR	71
140-CH-05 DMS Feed Preparation Screen Feed Chute	78
140-CH-16 Secondary DMS Screen Feedbox	73
140-CH-17 Secondary DMS Screen Underpan	68
140-CH-19 DMS Feed preparation screen underpan	68
140-CH-50 Secondary and scavenger DMS Medium distribution launder	48
140-CH-67 DMS Floats bin 1 gate 2	48
140-CV-08 DMS Feed Conveyor	71
140-CV-11 DMS Floats bin feed conveyor	71
140-CY-03 Secondary DMS cyclone cluster	78
140-CY-05 DMS Effluent Dewatering Cyclone Cluster	78
140-HP-11 DMS Effluent hopper	78
140-HT-01 Wet Plant Maintenance Crane	88
140-PP-09 DMS Effluent pump 1	81
140-PP-19 DMS Area Sump Pump	73
140-SN-06 Secondary DMS Screen	93
150-CH-01 Primary Mill Sizing Screen Feed Chute	58
150-CH-02 Primary Mill Sizing Screen Upper Deck Oversize Chute	58
150-CH-03 Primary Mill Sizing Screen Lower Deck Oversize Chute	58
150-CH-04 Primary Mill Sizing Screen Underpan	48
150-CH-05 Primary Mill feed box	48
150-CH-06 Primary Mill Trommel Undersize Chute	58
150-CH-07 Primary Mill Trommel Oversize Chute	58
150-HP-01 Primary mill discharge hopper	78
150-HP-02 DMS Fines Hopper	78
150-ML-01 Primary Mill	118
150-PP-01 Primary Mill Discharge pump 1	78
150-PP-02 Primary Mill Discharge Pump 2 (standby)	*0 – Not Included*
150-PP-04 DMS Fines Pump 1	74
150-PP-04a DMS Fines Pump 2 (Standby)	*74 – Not Included*
150-PP-05 Primary Mill Area Sump Pump	71

Plant ID and Name	Sound Power Level, dB L_{WA}
150-SN-01 Primary Mill sizing screen	95
160-CH-04 Fine Rougher Spirals Distributor	58
160-CH-05 Rougher Spirals Discharge Launder	58
160-CH-06 Middling Spirals Discharge Launder	58
160-CH-07 Fine Cleaner Spirals Discharge Launder	58
160-CH-16 Primary Hydrosizer Boil Box	58
160-CY-01 Deslime Cyclone Cluster 1	78
160-CY-07 Primary Hydrosizer Overflow Dewatering Cyclone	78
160-GC-03 Coarse Rougher Spirals	48
160-GC-04 Coarse Middlings Spirals	48
160-GC-05 Fine Cleaner Spirals	48
160-GC-06 Fine Rougher Spirals Bank 1	48
160-GC-07 Fine Rougher Spirals Bank 2	48
160-GC-08 Fine Middlings Spirals	48
160-GC-09 Coarse Cleaner Spirals	48
160-HP-01 Fine Spirals Feed Hopper	73
160-HP-02 Fines Tailings Hopper	78
160-HP-03 Multi-Spigot Hydrosizer Feed Hopper	73
160-HP-04 Fine Middlings Tables Middlings and Tailings Hopper	73
160-HP-06 Table Concentrate Hopper	68
160-HP-07 Coarse & Medium Middlings Tables Middlings and Tails Hopper	73
160-HP-09 Coarse Rougher Spirals Feed Hopper	78
160-HP-10 Coarse Spirals Middlings Hopper	73
160-HT-01 Fines Area Crane	88
160-HY-01 Primary Hydrosizer	48
160-HY-02 Multi-Spigot Hydrosizer	48
160-PP-03 Coarse spirals feed pump 1	81
160-PP-04 Course Rougher Spirals Feed Pump 2 (Standby)	*81 – Not Included*
160-PP-05 Fine spirals feed pump 1	78
160-PP-06 Fine Rougher Spirals Feed Pump 2 (Standby)	*78 – Not Included*
160-PP-07 Spirals tailings pump 1	71
160-PP-08 Fine Tailings Pump 2 (Standby)	*71 – Not Included*
160-PP-09 Multi-spigot hydrosizer feed pump 1	71

Plant ID and Name	Sound Power Level, dB L_{WA}
160-PP-10 Multi-Spigot Hydrosizer Feed Pump 2 (Standby)	*71 – Not Included*
160-PP-11 Fine Middlings & Tailings Pump 1	66
160-PP-12 Fine Middlings and Tailings Pumps 2 (Standby)	*66 – Not Included*
160-PP-13 Coarse & Medium Middlings & Tailings Pump 1	66
160-PP-14 Coarse and Medium Middlings and Tailings Pump 2 (Standby)	*66 – Not Included*
160-PP-15 Table Concentrate Pump 1	66
160-PP-16 Table Concentrate Pump 2	*0 – Not Included*
160-PP-17 Fines Gravity Area Sump Pump	71
160-PP-18 Coarse Spirals Middlings Pump 1	71
160-PP-20 Multi-Spigot Hydrosizer Teeter Pump	66
160-TB-01 Coarse Rougher Table 1	73
160-TB-02 Medium Rougher Table 1	73
160-TB-03 Fine Rougher Table 1	73
160-TB-04 Fine Rougher Table 2	73
160-TB-05 Fines cleaner table	73
160-TB-06 Medium Middlings Table	73
160-TB-07 Coarse rougher table	73
160-TB-08 Medium Rougher Table 1	73
160-TB-09 Fine Rougher Table 1	73
160-TB-10 Fine Rougher Table 2	73
160-TB-11 Coarse mids table	73
160-TB-12 Fine mids table	73
165-GC--- Pilot Falcon	93
165-MT--- Pilot Slon	83
180-AG-01 Flotation Conditioning Tank Agitator	64
180-AR-01 Concentrate filtrate receiver	58
180-CH-04 DMS Concentrate Feeder Discharge Chute	48
180-CH-07 Concentrate Regrind Mill Trommel Oversize Chute	58
180-CH-08 Concentrate regrind mill trommel undersize chute	58
180-CH-11 Concentrate Filter Discharge Chute	48
180-CY-01 Flotation Feed Dewatering Cyclone	78
180-CY-02 Flotation Area Clean up Cyclone	78



Plant ID and Name	Sound Power Level, dB L_{WA}
180-FC-01 Flotation cell 1	64
180-FC-02 Flotation cell 2	64
180-FC-03 Flotation cell 3	64
180-FE-11 DMS Concentrate Feeder	52
180-FE-12 Concentrate Filter Discharge Feeder	52
180-FR-01 Concentrate Filter	51
180-HP-01 Concentrate regrind mill discharge hopper	73
180-HP-02 DMS Concentrate storage hopper	73
180-HP-03 Flotation tailings hopper	78
180-HP-04 Flotation feed hopper	73
180-ML-02 Concentrate regrind mill	108
180-PP-01 Concentrate Regrind Mill Discharge Pump 1	66
180-PP-02 Concentrate Regrind Mill Discharge Pump 2 (Standby)	*66 – Not Included*
180-PP-03 Flotation Feed Pump 1	71
180-PP-04 Flotation Feed Pump 2 (Standby)	*71 – Not Included*
180-PP-05 Flotation Tailings pump 1	71
180-PP-06 Flotation Tailings Pump 2 (Standby)	71 – Not Included
180-PP-07 Flotation area sump pump	71
180-PP-08 Concentrate Filtrate Pump	61
180-PP-09 Concentrate filter vacuum pump	93
180-SN-01 Concentrate Regrind Sizing Screen	88
180-TK-02 Flotation and filtration constant density tank	48
200-AG-01 Reaction tank 1 agitator	52
200-AG-02 Reaction tank 2 agitator	52
200-BD-01 Concentrate Handling & Reagents Area Switchroom	62
200-BE-01 Kiln feed bucket elevator	61
200-BE-02 LIMS Feed bucket elevator	61
200-BE-03 Tungsten blending bucket elevator	61
200-BE-04 Concentrate scavenger bucket elevator	61
200-BN-01 Tungsten concentrate storage bin	28
200-BN-02 Tin concentrate storage bin	28
200-CH-01 LIMS Feeder Feed Chute	28
200-CH-02 LIMS Feed Chute	28

Plant ID and Name	Sound Power Level, dB L_{WA}
200-CH-03 Tin concentrate filter discharge chute	28
200-CH-08 Tin concentrate filter feed launder	28
200-CH-09 Concentrate pre dryer discharge chute	28
200-CH-10 LIMS magnetic chute	28
200-CH-11 LIMS non-magnetic chute	28
200-CH-12 Concentrate Distributor	28
200-CH-13 Coarse HIMS 1 Non Mags Discharge Chute	28
200-CH-14 Coarse HIMS 2 Non Mags Discharge Chute	28
200-CH-15 Coarse HIMS 3 Non Mags Discharge Chute	28
200-CH-16 Coarse HIMS 4 Non Mags Discharge Chute	28
200-CH-17 Fine HIMS 1 Non Mags Discharge Chute	28
200-CH-18 Fine HIMS 2 Non Mags Discharge Chute	28
200-CH-19 Fine HIMS 3 Non Mags Discharge Chute	28
200-CH-20 Fine HIMS 4 Non Mags Discharge Chute	28
200-CH-21 Fine HIMS 5 Non Mags Discharge Chute	28
200-CH-22 Tin tailings sampler feed box	28
200-CH-23 Concentrate scavenger drum tipping chute	28
200-CH-24 Fine tin table feed box	48
200-CH-25 Coarse Tin Table Feed Box	48
200-CH-26 Tungsten Blending Distributor Chute	28
200-CH-27 Tungsten Blending Drum Tipping Chute	28
200-CH-28 Concentrate Scavenger Distributor Chute	28
200-CH-30 Concentrate Reduction Kiln Feed Chute	28
200-CH-31 Concentrate Reduction Kiln Discharge Chute	28
200-CH-32 Tungsten Blending Bin 1 Discharge Chute	28
200-CH-33 Tungsten Blending Bin 2 Discharge Chute	28

Plant ID and Name	Sound Power Level, dB L_{WA}
200-CH-34 Tungsten Blending Bin 3 Discharge Chute	28
200-CH-35 Tungsten Concentrate Sampler Feed Chute	28
200-CH-36 Tungsten Concentrate Sampler Discharge Chute	28
200-CH-37 Tungsten Concentrate Sampler Sample Chute	28
200-CH-39 Tin Concentrate Sampler Discharge Chute	28
200-CH-40 Tin Concentrate Sampler Sample Chute	28
200-DC-01 Concentrate Pre Dryer Baghouse	82
200-DC-02 Tin Dryer Baghouse	82
200-DC-03 Tungsten Blending Dust Collector	82
200-DC-04 Concentrate scavenger dust collector	82
200-DC-05 Off gas scrubber baghouse	116
200-DC-06 Concentrate area dust collector	82
200-DR-01 Concentrate pre dryer	83
200-DR-01a Concentrate Pre Dryer Burner 1	80
200-DR-01b Concentrate Pre Dryer Burner 2	80
200-DR-01c Concentrate Pre Dryer Burner 3	80
200-DR-02 Tin Concentrate Dryer	83
200-DR-02a Tin Concentrate Dryer Burner 1	71
200-DR-02b Tin Concentrate Dryer Burner 2	71
200-FA-02 Off-gas scrubber exhaust fan 1	90
200-FA-05 Reduction kiln incinerator fan	83
200-FA-06 Concentrate area dust collector fan	83
200-FE-01 Concentrate pre-dryer feed screw feeder	98
200-FE-02 Concentrate pre dryer discharge screw feeder	98
200-FE-03 Reduction kiln feed screw feeder	98
200-FE-04 Reduction kiln discharge screw feeder	98
200-FE-05 LIMS Feeder	87
200-FE-06 Fine tin concentrate feeder	87
200-FE-07 Coarse tin concentrate feeder	87
200-FE-08 Tungsten Blending Feeder	87
200-FE-09 Tin Dryer Screw Feeder	87

Plant ID and Name	Sound Power Level, dB L_{WA}
200-FE-11 LIMS Feed tube feeder	87
200-FE-13 Reduction kiln discharge screw feeder 2	98
200-FR-01 Tin concentrate filter	57
200-HP-01 Fine tin concentrate hopper	58
200-HP-02 Coarse tin concentrate hopper	58
200-HP-05 Tin table tailings hopper	73
200-HP-06 Reduction kiln feed hopper	28
200-HP-07 Concentrate pre dryer feed hopper	28
200-KN-01 Concentrate reduction kiln	83
200-KN-01a Reduction Kiln Burner 1	82
200-KN-01b Reduction Kiln Burner 2	82
200-KN-01c Reduction Kiln Burner 3	82
200-KN-01d Reduction Kiln Burner 4	80
200-KN-01e Reduction Kiln Burner 5	80
200-KN-01f Reduction Kiln Burner 6	80
200-KN-01g Reduction kiln incinerator	82
200-MT-01 Low Intensity Magnetic Separator	78
200-MT-02 Fine HIMS 1	93
200-MT-03 Fine HIMS 2	93
200-MT-04 Fine HIMS 3	93
200-MT-05 Fine HIMS 4	93
200-MT-06 Fine HIMS 5	93
200-MT-07 Coarse HIMS 1	93
200-MT-08 Coarse HIMS 2	93
200-MT-09 Coarse HIMS 3	93
200-MT-10 Coarse HIMS 4	93
200-PP-01 Reduction kiln diesel pump	51
200-PP-02 Off gas scrubber stage 1 recirculation pump 1	64
200-PP-04 Arsenic precipitate pump 1	88
200-PP-06 Fine tin concentrate pump 1	66
200-PP-08 Coarse tin concentrate pump 1	66
200-PP-12 Tin tailings pump 1	66
200-PP-13 Tin Tailings Pump 2 (Standby)	*66 – Not Included*
200-PP-14 Tin Filtrate Pump	61
200-PP-15 Tin Filter Vacuum Pump	80

Plant ID and Name	Sound Power Level, dB L_{WA}
200-PP-17 Concentrate area sump pump	71
200-PP-20 Off gas scrubber stage 2 recirculation pump 1	61
200-PP-22 Off gas scrubber cooler recirculation pump	66
200-RV-03 Reduction Kiln Discharge Rotary Valve	52
200-RV-04 Tungsten concentrate rotary valve	52
200-RV-05 Tin concentrate rotary valve	52
200-RV-06 Tin Dryer Rotary Valve	51
200-RV-08 Blending Bin 1 Rotary Valve	52
200-RV-09 Blending Bin 2 Rotary Valve	52
200-RV-10 Blending Bin 3 Rotary Valve	52
200-RV-12 Reduction kiln feed rotary valve	52
200-RV-13 Tungsten Blending Drum Tipping Chute Rotary Valve	52
200-RV-14 Concentrate scavenger drum tipping chute rotary valve	52
200-RV-15 Off gas scrubber baghouse discharge rotary valve	52
200-RV-16 Concentrate Area Dust Collector Rotary Valve	51
200-SN-01 Concentrate sizing screen	88
200-TB-01 Fine tin table	73
200-TB-02 Coarse tin table	57
200-TK-06 Tin filtration constant density tank	73
360-AG-01 Ferrosilicon Mixing Tank Agitator (Standby)	*51 – Not Included*
360-AG-04 Xanthate Mixing Tank Agitator	51
360-AG-05 Lime Mixing and Storage Tank Agitator	61
360-AG-07 Copper Sulphate Mixing Tank Agitator	51
360-DC-01 Ferrosilicon dust collector	82
360-DC-03 Xanthate Dust Collector	82
360-FE-01 Ferrosilicon Screw Feeder (Standby)	*82 – Not Included*
360-HT-01 Ferrosilicon Bag Hoist	82
360-HT-03 Lime Bag Hoist	82
360-PP-01 Dense medium ferrosilicon pump	71
360-PP-04 Xanthate Dosing Pump 1	78
360-PP-05 Xanthate Dosing Pump 2 (Standby)	*78 – Not Included*
360-PP-06 Lime Recirculation Pump 1	78

Plant ID and Name	Sound Power Level, dB L_{WA}
360-PP-09 Copper Sulphate Dosing Pump 1	68
360-PP-10 Copper Sulphate Dosing Pump 2 (Standby)	*68 – Not Included*
360-PP-11 Frother dosing pump	68
360-PP-14 Xanthate Area Sump Pump	89
360-PP-15 Copper Sulphate Area Sump Pump	89
360-PP-16 Lime Area Sump Pump	89
420-AB-01 Flotation Blower 1	58
420-AC-01 High Pressure Air Compressor 1	81
420-AC-02 High Pressure Air Compressor 2	81
420-AC-03 High Pressure Air Compressor 3	81
420-AD-01 Air Drier	84

B.9 Modelled Openings in Buildings

Table 9: Modelled Openings in Buildings

Building	Opening Reference and Facade	Attenuation	% Time Open	Sound Power Level, dB L_{WA}
Primary Crushing	Access Door – Southern	37	0%	65.1
	Roller Shutter Door – Northern	37	50%	93.0 – daytime and evening
	Tipping Opening (area source)	0	100%	108.2
	Conveyor Opening – Southeast	0	100%	106.2
Secondary Closing Screen	Maintenance Door - Southern	37	0%	70.5
	Access Door - Northern	37	0%	62.5
	Access Door - Southern	37	0%	62.5
	Conveyor Opening - Southeast	0	100%	104.0
	Conveyor Opening – Northwest - Higher	0	100%	101.2
	Conveyor Opening – Northwest - Lower	0	100%	102.7
Secondary Crushing	Conveyor Opening – Northwest - Lower	0	100%	103.0
	Conveyor Opening – Northwest - Higher	0	100%	99.6
	Roller Shutter Door - Northwest	37	50%	87.5 – Daytime and Evening
Ore Sizing Building	Access Door - North	37	0%	46.0
	Maintenance Door - North	37	0%	53.9

Building	Opening Reference and Facade	Attenuation	% Time Open	Sound Power Level, dB L_{WA}
	Maintenance Door - Southern	37	0%	51.5
	Conveyor Opening - Western	0	100%	85.0
	Conveyor Opening - Southern	0	100%	88.1
	Access Door - Western	37	0%	45.9
	Access Door - Western	37	0%	45.2
Ore Sorter Building	Conveyor Opening x6 – Northeast	0	100%	97.0
	Conveyor Opening x2 – Northeast (Higher)	0	100%	87.2
	Conveyor Opening -Southern	10	100%	87.0
	Conveyor Opening - Northern	0	100%	97.0
	Access Door x6 Northern/Southern	37	0%	62.9
	Maintenance Door - Southern	37	0%	66.1
Tertiary Crushing	Roller Shutter Door - Southern	22	50% - Daytime, Evening 10% - Night-time	92.5 – Daytime and Evening 85.7 – Night-time
	Roller Shutter Door - Northeastern	22	50% - Daytime, Evening 10% - Night-time	92.4 – Daytime and Evening 85.6 – Night-time
	Tramp Metal Chute - Southern	10	100%	78.2
	Conveyor Opening – Southwest - Higher	10	100%	84.0
	Conveyor Opening – Southwest Lower	10	100%	87.2
	Conveyor Opening – Southwest Lower	10	100%	85.0
	Access Door - Southern	22	0%	66.0
	Access Door - Northern	22	0%	65.9
Main Processing	Conveyor Opening – Northeastern - Higher	0	100%	89.9
	Conveyor Opening – Northeastern - Lower	0	100%	89.9
	Access Door x3 - Northeastern	22	0%	60.3
	Roller Shutter Door - Northeastern	22	50% - Daytime, Evening	88.5 – Daytime and Evening

Building	Opening Reference and Facade	Attenuation	% Time Open	Sound Power Level, dB L_{WA}
			10% - Night-time	81.7 – Night-time
	Roller Shutter Door - Northeastern	22	50% - Daytime, Evening 10% - Night-time	86.5 – Daytime and Evening 79.7 – Night-time
	Roller Shutter Door - Northern	22	50% - Daytime, Evening 10% - Night-time	85.8 – Daytime and Evening 79.0 – Night-time
	Access Door - Northern	22	0%	58.9
	Conveyor Opening - Northern	0	100%	85.3
	Roller Shutter Door - Southwestern	22	50% - Daytime, Evening 10% - Night-time	85.9 – Daytime and Evening 79.1 – Night-time
	Access Door - Southwestern	22	0%	59.8
	Roller Shutter Door - Southwestern	22	50% - Daytime, Evening 10% - Night-time	87.2 – Daytime and Evening 80.4 – Night-time
	Conveyor Opening - Southwestern	0	100%	89.1
	Roller Shutter Door - Southwest	22	50% - Daytime, Evening 10% - Night-time	86.3 – Daytime and Evening 79.5 – Night-time
	Roller Shutter Door - Southwest	22	50% - Daytime, Evening 10% - Night-time	85.4 – Daytime and Evening 78.6 – Night-time
	Access Door x 5 - Southwest	22	0%	59.5 – 61.3
	Roller Shutter Door - Southwest	22	50% - Daytime, Evening	87.7 – Daytime and Evening

Building	Opening Reference and Facade	Attenuation	% Time Open	Sound Power Level, dB L_{WA}
			10% - Night-time	80.9 – Night-time
	Conveyor Opening - Southwest	0	100%	89.9

B.10 External Sources

Table 10: External Sources

Plant ID and Name	Sound Power Level, dB L_{WA}	Location		
		Easting	Northing	Height (Absolute unless stated)
115-BD-01 New Primary & Secondary Crushing Switch Room	73	257099.42	59088.02	166.80
115-CV-16 Primary Crusher module transfer conveyor	71	257090.54	59112.82	172.17
115-CV-17 Secondary crusher module feed conveyor	71	257129.06	59089.73	172.91
115-CV-18 Secondary Crusher product stockpile feed conveyor 1	71	257098.15	59109.17	168.61
115-CV-19 Secondary crusher discharge conveyor	71	257127.39	59086.99	172.95
115-CV-20 Secondary Crusher product stockpile feed conveyor 2	71	257025.72	59040.92	194.04
115-FE-01 Secondary crusher product stockpile reclaim feeder 1	93	257019.21	59042.16	1 (relative)
115-FE-02 Secondary crusher product stockpile reclaim feeder 2	93	257023.71	59041.30	1 (relative)
115-FE-03 Secondary crusher product stockpile reclaim feeder 3	93	257026.23	59040.81	1 (relative)
115-FE-04 Secondary crusher product stockpile reclaim feeder 4	93	257030.70	59039.94	1 (relative)
115-MCC-01 New Primary & Secondary Crushing MCC	83	257096.49	59088.64	166.80
115-MG-02 Secondary Crusher Closing Screen Oversize Conveyor Magnet	71	257121.38	59094.29	170.86
115-PF-01 New Primary & Secondary Crushing Power Factor Correction	68	257093.92	59090.18	166.80
115-PN-01 New Primary & Secondary Crushing Switch Room Communication Panel	58	257096.49	59088.64	166.80
115-TX-10 New Primary & Secondary Crushing Transformer	56	257106.77	59082.44	166.79

Plant ID and Name	Sound Power Level, dB L_{WA}	Location		
		Easting	Northing	Height (Absolute unless stated)
120-TX-03 Scrubber and Fines area Transformer	56	257045.69	58997.91	170.50
125-AC-04 Ore Sorter Air Compressor 4	83	257019.50	58977.23	172.76
125-AC-05 Ore Sorter Air Compressor 5	83	257016.73	58981.19	172.76
125-AC-06 Ore Sorter Air Compressor 6	83	257013.95	58985.16	172.76
125-BD-01 Screening & Ore Sorters Switch Room	73	257041.80	59006.00	1 (relative)
125-CH-01A Stockpile Reclaim Conveyor Head Chute	98	257084.93	59029.86	175.28
125-CH-33 Ore Sorter Accepts Transfer Conveyor Head Chute	98	257038.00	58976.00	174.07
125-CH-34 Ore Sorter Reject Conveyor 1 Discharge Chute	98	257003.04	59021.00	174.40
125-CV-04 Ore Sorter Product Conveyor 2	71	256978.61	58937.00	176.00
125-CV-05 Ore Sorter Product Conveyor 1	71	257043.12	58975.12	175.00
125-CV-06 Aggregates Stockpile Feed Conveyor	71	256930.11	59131.00	176.00
125-CV-21 Ore Sorter Sizing Feed Conveyor	71	257082.47	59030.35	180.00
125-CV-28 Ore Sorter Reject Conveyor motor	71	257012.95	59015.23	1 (relative)
125-CV-29 Ore Sorter Product Conveyor 1 motor	71	257043.00	58974.80	1 (relative)
125-DC-01 Dust Suppression Building 4	83	257026.31	59041.74	195.31
125-HP-01 Ore Sorter Fines Transfer Hopper	48	257040.08	59008.76	1 (relative)
125-MCC-11 Screening & Ore Sorters MCC	83	257040.08	59008.76	1.5 (relative)
125-MG-01 Ore Sorter Sizing Feed Conveyor Magnet	88	257068.75	59030.87	171.59
125-PF-01 Screening & Ore Sorters Power Factor Correction	68	257038.12	59009.13	1 (relative)
125-PN-01 Screening & Ore Sorters Switch Room Communication Panel	58	257038.81	59009.00	1 (relative)
125-PP-07 B4 Stockpile Tunnel Rear Ground Pump	71	256999.78	59046.92	1 (relative)
125-PP-08 B4 Stockpile Tunnel Exit Ground Pump	71	257047.40	59035.27	1 (relative)
125-ST-01 Crusher Ore Stockpile	83	257029.24	59040.21	172.14

Plant ID and Name	Sound Power Level, dB L_{WA}	Location		
		Easting	Northing	Height (Absolute unless stated)
125-ST-02 Ore Sorter Reject Stockpile	83	256926.82	59127.62	176.00
130-MG-01 Tertiary crusher magnet	88	256956.53	58918.75	172.25
130-PP-01 Tertiary crusher area sump pump	71	257013.25	58960.89	170.00
130-TX-02 Tertiary Crusher Area Transformer	56	256989.71	58960.90	170.13
140-BD-01 DMS & Milling Area Switchroom	70	256887.34	58948.54	173.43
140-BN-04 DMS Floats Bin 1	68	256810.90	59130.90	189.00
140-CH-01 DMS Bin Feed Conveyor 1 Head Chute	78	256880.04	58882.08	184.17
140-CH-02 DMS Bin Feed Conveyor Transfer Chute	78	256880.26	58882.40	181.64
140-CH-03 DMS Bin Feed Conveyor 2 Head Chute	78	256848.40	58927.74	191.63
140-CH-04 DMS Feeder Discharge Chute	68	256848.63	58927.89	171.44
140-CH-60 DMS Floats Bin Bidirectional Conveyor Head Chute 1	58	256808.55	59124.99	191.81
140-CH-62 DMS Floats Bin 1 Cast In Chute	48	256806.20	59124.37	171.20
140-CH-64 DMS Floats Bin 1 Loading Gate Feed Chute	48	256807.59	59124.55	169.50
140-CH-66 DMS Floats Bin 1 Loading Gate 1 Discharge Chute	48	256809.59	59125.95	169.54
140-CV-06 DMS Feed Conveyor	71	256926.23	58914.69	172.09
140-CV-07 DMS Bin Feed Conveyor 2	71	256883.70	58884.63	183.49
140-CV-12 DMS Floats Bin Bidirectional Conveyor	71	256807.10	59127.36	192.11
140-GT-02 DMS Floats Bin 1 Loading Gate Hydraulic Oil Pump	84	256798.56	59126.96	165.22
140-PP-20 DMS Floats Bin Area Sump Pump	71	256804.74	59130.94	165.58
140-PP-21 DMS Feed Bin Area Sump Pump	66	256843.20	58921.90	1 (relative)
140-TX-04 DMS Area Transformer	56	256877.19	58941.25	171.38
150-CH-09 DMS Fines Non Magnetics Discharge Launder	48	256921.00	58900.00	184.00
160-AG-01 Fines Storage Tank Agitator	81	256926.26	58903.58	185.95
160-PP-31 Deslime Cyclone Feed pump 1	83	256933.83	58897.67	170.27



Plant ID and Name	Sound Power Level, dB L_{WA}	Location		
		Easting	Northing	Height (Absolute unless stated)
160-PP-32 Deslime cyclone feed pump 2 (standby)	*81 – Not Included*	*256936.60*	*58899.98*	*170.64*
160-TX-01 Fines Storage Tank	58	256926.00	58903.00	170.00
200-PP-18 Diesel Supply Pump 1	87	256864.05	58969.66	170.45
200-PP-19 Diesel Supply Pump 2 (standby)	*87 – Not Included*	*256865.81*	*58971.93*	*172.55*
210-CH-01 Tailings thickener feed box	48	256930.63	58952.29	177.63
210-CH-02 Final tailings sampler feed box	48	256942.99	58976.74	173.00
210-HP-01 Tailings Thickener Underflow Hopper	78	256943.62	58978.71	171.80
210-PP-01 Tailings disposal pump 1A	81	256942.49	58981.63	169.91
210-PP-03 Tailings disposal pump 1B	81	256940.02	58980.23	169.91
210-PP-05 Tailings area sump pump	71	256950.44	58975.66	171.35
210-TH-01 Tailings thickener	48	256943.42	58961.28	176.86
360-AG-02 Flocculant Mixing Agitator 1	61	256943.22	58943.98	170.99
360-AG-03 Flocculant Mixing Agitator 2	52	256941.65	58942.81	171.22
360-FE-02 Flocculant Screw Feeder	90	256942.31	58944.80	172.76
360-HT-02 Flocculant Bag Hoist	82	256944.90	58945.25	176.64
360-PP-02 Flocculant Dosing Pump 1	93	256939.25	58941.03	169.35
360-PP-03 Flocculant Dosing Pump 2 (standby)	*93 – Not Included*	*256939.18*	*58940.80*	*169.52*
360-PP-07 Flocculant Dosing Pump 3	93	256938.44	58940.46	169.35
360-PP-13 Flocculant area sump pump	71	256943.99	58947.14	170.00
360-PP-17 Water Treatment Plant Reagents Sump Pump	89	256965.83	58945.17	169.65
370-TX-07 33 kV / 11 kV Site Transformer	76	256986.88	58987.15	172.33
390-PP-03 Raw water pump 1	65	256922.91	58994.42	169.78
390-PP-04 Raw Water Pump 2 (standby)	*78 – not included*	*256923.20*	*58993.16*	*169.87*
390-PP-05 Gland water pump 1	71	256913.75	58989.64	169.93
390-PP-06 Gland Water Pump 2 (standby)	*72 – not included*	*256913.47*	*58989.41*	*169.80*
390-PP-07 Process water pump 1	85	256919.32	58993.16	170.17
390-PP-08 Process water pump 2	85	256918.27	58992.20	170.17
390-PP-09 Process water pump 3 (standby)	*85 – not Included*	*256916.89*	*58991.38*	*170.17*

Plant ID and Name	Sound Power Level, dB L_{WA}	Location		
		Easting	Northing	Height (Absolute unless stated)
390-PP-19 Tailings gland seal water pump 1	66	256912.72	58988.94	169.93
390-PP-20 Tailings Gland Seal Water Pump 2 (standby)	*79 – not included*	*256912.42*	*58988.74*	*169.82*
390-PP-21 Water treatment plant transfer pump 1	65	256930.68	58992.62	169.79
390-PP-22 Water Treatment Plant Transfer Pump 2 (standby)	*73 – not included*	*256929.21*	*58992.54*	*169.83*
390-PP-23 Water Treatment Plant Area Sump Pump	71	256959.88	58937.15	170.50
390-TK-02 Raw water tank	78	256925.92	58995.76	173.50
390-TK-03 Gland water tank	68	256914.45	58987.63	170.73
390-TK-04 Process water tank	78	256926.48	58980.00	174.00
395-AG-01 WTP Arsenic Oxidation Tank Stage 1 Agitator	57	256955.77	58931.42	173.35
395-AG-02 WTP Arsenic Oxidation Tank Stage 2 Agitator	57	256958.63	58933.37	173.35
395-AG-03 WTP Flocculation Tank Stage 3 Agitator	57	256961.49	58935.64	173.20
395-AG-04 WTP Flocculation Tank Stage 4 Agitator	57	256963.64	58936.17	173.20
395-AG-05 WTP Flocculation Tank Stage 5 Agitator	57	256964.69	58937.88	173.20
395-AG-06 WTP Flocculant Suspension Agitator 1	57	256966.25	58939.81	173.05
395-AG-07 WTP Flocculant Suspension Agitator 2	57	256966.91	58938.89	173.05
395-AG-09 WTP Sludge Holding Tank Agitator 1	57	256971.69	58946.35	172.35
395-AG-10 WTP Sludge Holding Tank Agitator 2	57	256973.34	58943.99	172.35
395-PP-01 Clarifier Underflow Pump 1	78	256969.90	58940.51	170.35
395-PP-03 Treated Water Forwarding Pump 1	71	256964.81	58941.85	169.99
395-PP-05 WTP Filter Press Feed Pump	89	256971.11	58947.95	169.73
395-PP-06 WTP Filtrate Forwarding Pump	61	256977.75	58948.02	170.63
395-PP-09 Hydrogen Peroxide Dosing Pump 1	68	256960.96	58942.15	171.85
395-PP-11 Ferric Sulphate Dosing Pump 1	68	256962.25	58942.99	171.85

Plant ID and Name	Sound Power Level, dB L_{WA}	Location		
		Easting	Northing	Height (Absolute unless stated)
395-PP-12 Ferric Sulphate Dosing Pump 2 (standby)	*68 – not included*	*256963.24*	*58943.65*	*171.85*
395-PP-13 Sulphuric Acid Dosing Pump	68	256960.06	58943.61	171.85
395-PP-14 Flocculant Dosing Pump 1	93	256961.02	58944.24	171.85
395-PP-15 Flocculant Dosing Pump 2 (standby)	*93 – not included*	*256962.06*	*58944.99*	*171.85*
395-RK-01 WTP Lamella Clarifier Rake Drive	52	256967.78	58940.03	173.05
430-BD-03 Plant Control room	55	256915.32	58930.76	181.61
430-TX-06 Mining Contractor Area Transformer	56	256979.58	59107.19	180.00
430-TX-08 Administration Area Transformer	56	256841.19	58884.94	170.00
440-BD-01 Workshop & Stores	58	256904.82	59049.89	174.87

Appendix C Technical Specification of Cladding Systems

Noise Impact Assessment

Hemerdon Mine

Drakelands Restoration Ltd

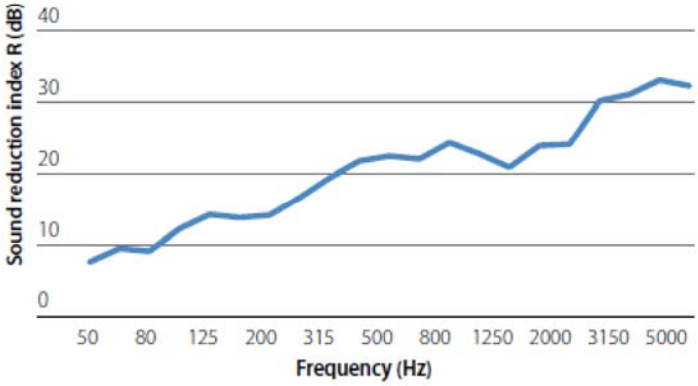
SLR Project No.: 403.066596.00001

11 September 2026

Effect of construction on acoustic performance

Single skin systems

Figure 9. Sound reduction index for 0.7 mm single skin construction



Key

Key	Construction	Single figure rating Rw
	0.7 mm single skin 32/1000 profile	24 dB

Figure 10. Cross section of single skin construction

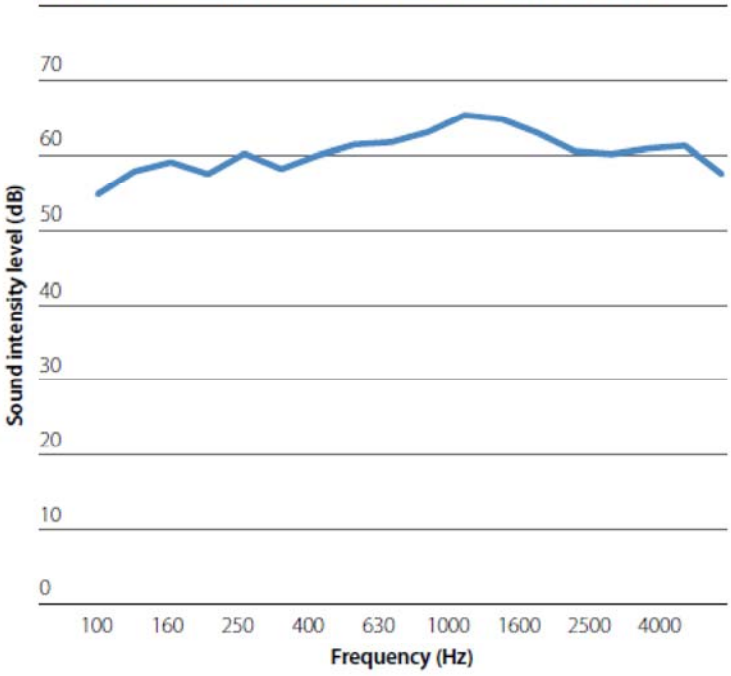


A single skin construction, has relatively low mass and the internal surface is effectively directly coupled with the external surface. For airborne noise, there will be very little energy absorption and the majority of sound reduction will be due to internal reflection.

Increasing the gauge of the cladding, the profile or the purlin spacing will slightly alter the stiffness and the resonant frequency of the panel, which will change the position of the coincident dip.

Rain impact noise will also be directly transmitted through the single skin andinternal rain noise levels will be high.

Figure 11. Rain impact noise for a single skin construction



Key	Construction
	0.7 mm single skin 32/1000 profile

Cl/SfB (37) Hh2
UK June 2005

Acoustic Performance Guide

Insulated Roof, Wall & Facade Systems



Insulated Panels to the Power of Kingspan®

Insurer Approved FIRE*safe* Systems


(((OdB(A))))
Threshold of audibility











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Foreword

Kingspan has worked with Sound Research Laboratories (SRL) to compile a comprehensive set of acoustic test data, based on measured results, in an accredited Laboratory.

The guide reports performance information and practical advice on achieving the standards relevant to different building types. It is intended to be useful to the Acoustic Consultant and also to help Architects and Design Teams.

The guide also includes useful new advice on the control of rainfall noise. This is based on data from SRL's rainfall test rig.



Guide Introduction

This guide gives the fundamentals of acoustics and how these apply to different categories of building. It demonstrates how the Kingspan range of Insulated Roof, Wall and Facade Systems can be used to help achieve acoustic requirements.

Most buildings need some form of acoustic control to meet various guidelines and statutory requirements. Kingspan panels offer external cladding solutions for roof and walls within the building. These provide acoustic control of the environment within the building giving:

- Sound insulation for the building envelope to control noise break-in to the building or noise breakout from the building.
- Effective flanking noise control, where internal partitions meet the building envelope.
- Acoustic absorption when used in conjunction with profiled perforated steel liners or absorbent suspended ceilings.
- Effective control of rain noise when used in conjunction with roof tiles, profiled perforated steel liners or absorbent suspended ceiling combinations.

Applications of Kingspan panels in terms of sound insulation, sound absorption and rain noise control are given for each classification of building type in this document.

The guide reports performance information with practical advice on achieving the standards relevant to different building types. It is intended to be useful to the Acoustic Consultant and also to help Architects and Design Teams.

The guide also includes useful new advice on the control of rainfall noise, based on data from SRL's rainfall test rig. Detailed flanking tests reveal the full potential of the products.

Details of laboratory test results are given in the Appendices, as follows:

Appendix A
Sound insulation tests on Kingspan insulated wall and facade systems

Appendix B
Sound insulation tests on Kingspan insulated roof systems

Appendix C
Flanking sound insulation tests on Kingspan insulated roof, wall and facade systems

Appendix D
Sound absorption tests on lined and unlined Kingspan insulated roof, wall and facade systems

Appendix E
Rain noise tests on Kingspan roof systems

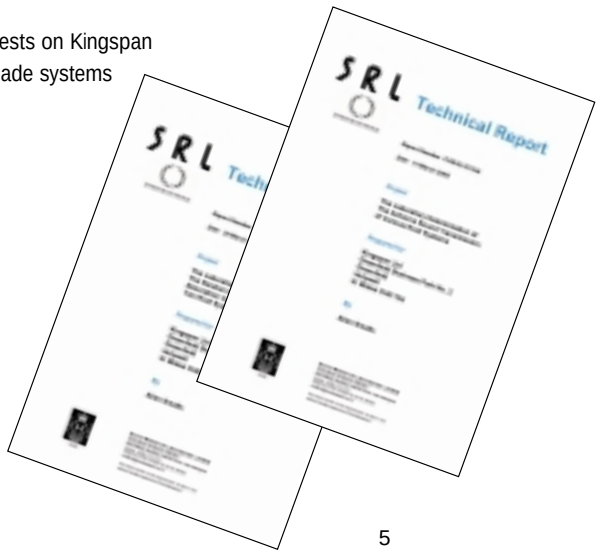
Appendix F
Shows typical flanking construction

The assessments in this document have made various assumptions regarding room sizes, external noise spectra and installed internal partition performances. The advice is based on specific situations and cannot be used as general advice. Each project must be assessed on a case by case basis.

No account has been taken of any degradation of the noise flanking or noise break-in performances of the panels due to windows or other penetrations.

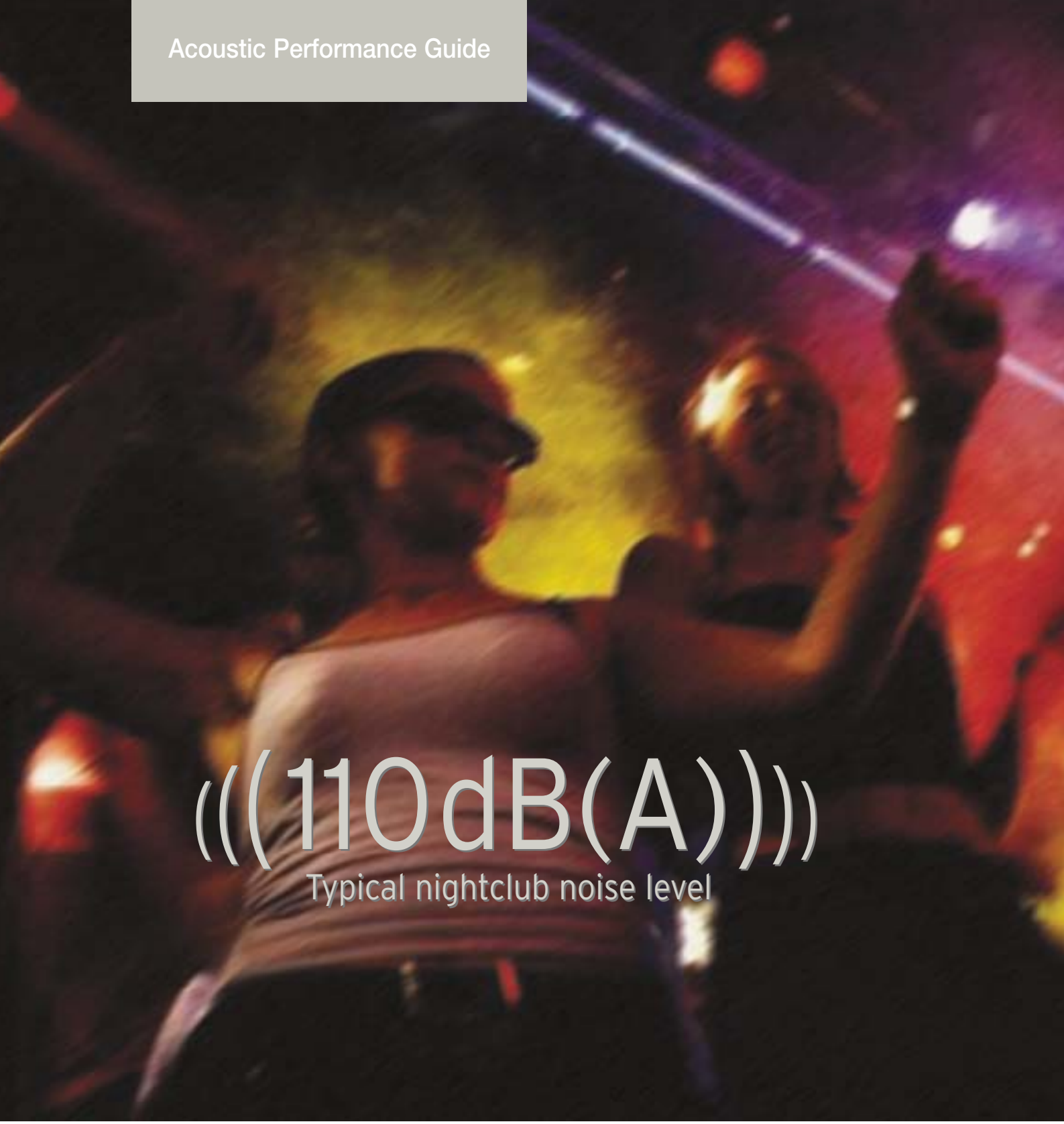
Appendix G
Acoustic terminology used in this document are explained





SRL
Sound Research Laboratories Limited

Kingspan®



Testing and Standards

Tests were done in SRL's Laboratory in Suffolk, to determine the following;

- the random incidence sound absorption coefficients of wall systems in accordance with BS EN 20354:1993, ISO 354:1985.
- the airborne flanking sound transmission of various roof and wall systems with fire stop in accordance with BS EN ISO 140-3:1995.
- the sound reduction index of various roof systems in accordance with BS EN ISO 140-3:1995.
- the rain generated impact sound transmission of various roof systems in accordance with working draft International Standard ISO/CD 140-18.

Other test results referred to in this report include testing done by AIRO, BRE and Salford University.
All tests conducted by SRL, excluding those done in the rain test rig, were UKAS accredited.



Sound Insulation in Buildings

The sound insulation of a material is its ability to resist the passage of airborne and impact sound. From schools to hospitals and from dwellings to offices, sound insulation is important. It provides acoustic separation between rooms and between the outside world and the building interior.

All materials have different sound insulation properties that depend on their weight and physical build up. It is important to select the right material for the right application, and then construct the building to minimise weaknesses. Then the maximum sound insulation of the material can be realised. Often the degree of sound insulation achieved is limited by the paths that sound can travel to by-pass the material. This is called “flanking” and is shown as route B in Figure 1 on page 8.

The sound insulation needed is determined by industry guidelines and statutory requirements. Appropriate sound insulation for various building types is discussed in more detail in the sections which follow.

The Kingspan range of Insulated Roof, Wall and Facade Systems with appropriate internal linings and detailing can give high levels of sound insulation. Flanking around compartment/partition walls and intermediate floors can also be effectively controlled with the appropriate internal drylining solutions.

The results of laboratory sound insulation tests on Kingspan Insulated Roof, Wall and Facade Systems with various treatments are given in Appendices A and B respectively. Appendix C gives results of sound insulation tests using Kingspan Insulated Roof, Wall and Facade Systems as flanking constructions. The results apply to the thickness of materials tested, however, little variation was seen as a result of panel thickness increase or decrease.

The parameters used to describe sound insulation are different for each standard, and can be confusing. It is important they are not used interchangeably, as they do not mean the same thing. They include R_w, D_w, $D_{nT,w}$, $D_{nT,w} + C_{tr}$, $D_{nT,w(Tmf,max)}$. These are standardised terms that take account of different conditions, and are described in more detail in the Terminology, Appendix G.

Rain noise on roofs is an aspect of sound insulation, against environmental sources, that is dealt with in a separate section in this document in more detail.

Sound Insulation in Buildings Cont'd

The following diagrams show the various airborne sound transmission paths we need to consider.

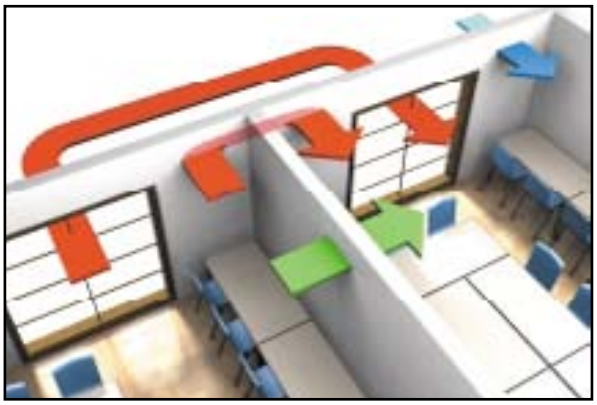
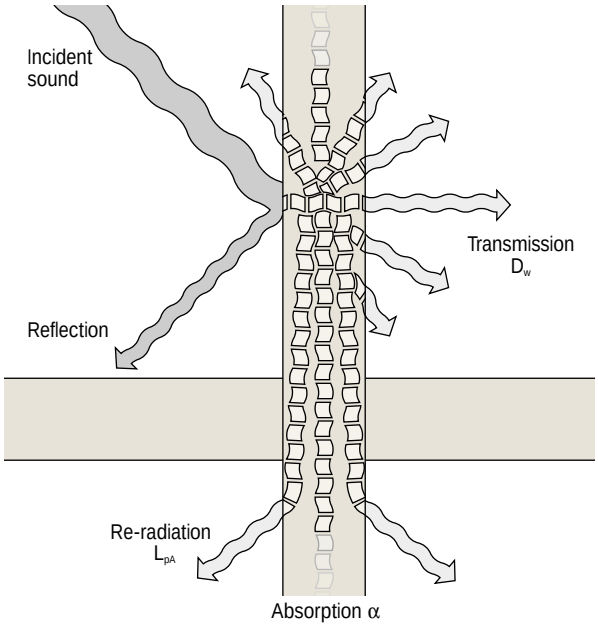


Figure 1: Sound transmission paths

A = Direct route through partition between two rooms

B = Noise flanking paths around ends of partitions and floors through joints and flanking constructions

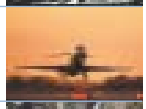
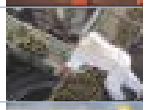
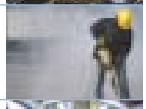
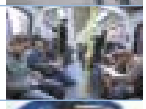
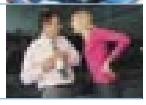
C = Direct route from outside through building external walls and roofs

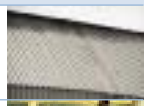
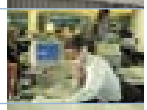
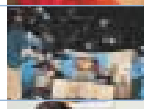


External noise levels depend on the environmental noise sources in an area. Road traffic noise is a common source of noise which affects many buildings of all types in and around built up areas.

Maximum noise levels for short term events may also need be taken into account. This depends on the building type and the relevant acoustic criteria.

The correct noise insulation needs to be selected to achieve the break-in noise requirements for different building types. Often windows and other penetrations provide the weakest points in facades, but the overall performance needs to be assessed. This is dealt with in each specific section.

Sound Pressure Level dB(A) re 2 x 10^{-5} Pa	Typical Example	
140	Threshold of Pain	
130	Racing Engine Test Cell	
120	Jet Take Off at 50m	
100	Noisy Bottling Factory	
90	Pneumatic Drill in Operation at 3m	
85	Exposure limit for noise over 8 hours	
80	Inside Sports Car	
70	Raised Voice at 1m	

Sound Pressure Level dB(A) re 2 x 10^{-5} Pa	Typical Example	
65	Heavy Rain on Metal Roof with Ceiling Tiles	
60	Normal Voice in Open Plan Office at 1m	
40-45	Private Office	
35-40	Residential Area at Night	
30	Whispering at 1m	
15-20	TV studio background	
0	Threshold of Hearing (Young People - 1KHz)	

Reverberation and Sound Absorption

Sound absorption materials are often used in rooms to improve the perceived acoustic quality of the room and speech intelligibility. The materials are used to reduce the amount of noise which bounces around a room causing unwanted echoes. The study of these effects is commonly known as Room Acoustics.

Sound Pressure Level in a Room

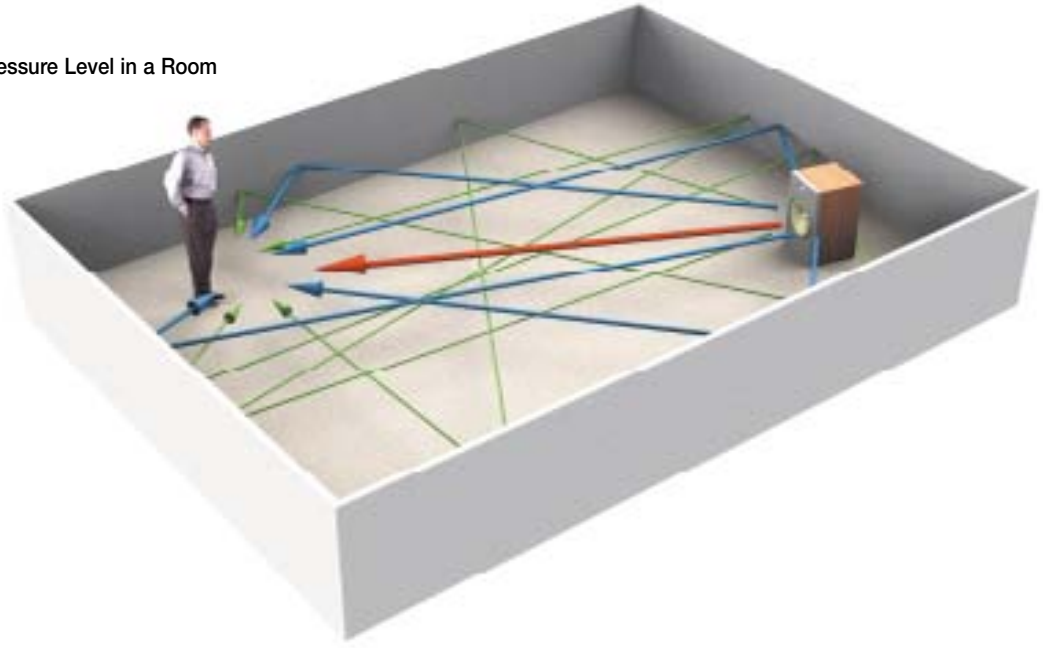


Figure 2 - Reverberation and the Sound Field in a Room

The way of objectively assessing the echoic nature of rooms is by measuring or predicting the reverberation time (often represented by RT or T_{60}). This is defined as the time taken in seconds for a noise to decay in level by 60dB once it is turned off.

The reverberation in a room is controlled by using sound absorption, which is objectively expressed in terms of α, α_w, NRC or absorption class. These are different ways of expressing the ratio of the amount of noise absorbed by a material to the total amount of noise incident on the material (See Appendix G for definitions).

The higher the absorption coefficient the more the absorption. An absorption coefficient of 1 means total absorption while an absorption coefficient of 0 means total reflection. Absorbers can also be defined by absorption classes, in line with EN ISO 11654. Class A are the best absorbers while Class E are the poorest, as shown in Figure 3 below.

It is a requirement in many buildings to meet specified reverberation times in different rooms, this is dealt with later in the guide. Materials providing absorption come in many forms ranging from soft wall panels, through mineral fibre ceiling tiles to perforated steel liners for profiled roof and wall applications with insulation behind. Appendix D gives absorption information for unperforated profiled liners in conjunction with the KS1000 RW panels and for the same panels with a 30% free area profiled perforated liner with 50mm insulation behind the perforations. The latter is classified as a Class A absorber, and provides a good alternative to ceiling tiles, and other finishes for reverberation control in many situations.

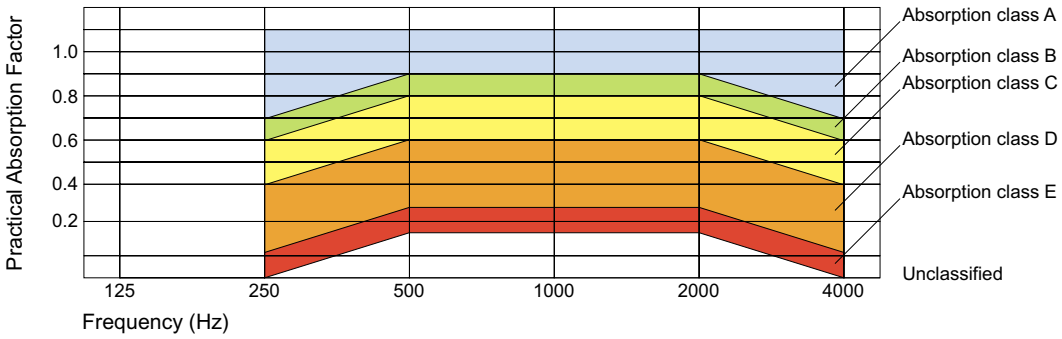


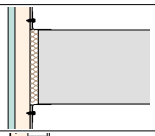
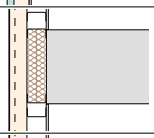
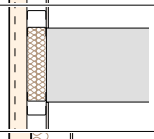
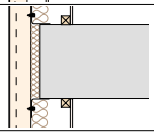
Figure 3: Absorption Classifications according to EN ISO 11654, with Class A providing the most absorption.



Healthcare Buildings

NHS Estates Health Technical Memorandum HTM2045 deals with Acoustics in healthcare buildings, HTM2045 is currently under review although its contents are still relevant. It sets standards for noise break-in from external sources, sound insulation between different rooms and reverberation times. This is the recommended approach for achieving good acoustics for the finished building until the HTM is revised. To take account of non-acoustic constraints, derogations to HTM2045 are often sought. A practical outcome is that internal partitions in hospitals generally fall into 4 categories for sound insulation. To achieve these performances -

The Typical Flanking Constructions are:

Category A R_w 47 e.g. Toilets		5F*
Category B R_w 52 e.g. Wards		9F*
Category C R_w 57 e.g. Interview Rooms		9F*
Category D R_w 62 e.g. Labour Delivery Room		6F*

In order to achieve the necessary site performance the flanking limits of the facade must be typically 5dB greater than these values in each case. *The data in Appendix C (entries 5F, 6F and 9F) show that high flanking results can be achieved using any thickness of Kingspan panel system with plasterboard linings, as per the details shown in the figures in Appendix F.

For example, to achieve Category C performance requirements requires the flanking R_w to be 62dB. This could be achieved with a construction similar to 9F in Appendix C which is Kingspan 1000FL/70 panels internally lined with 12.5mm plasterboard on 'Z' channels. A Category D performance could be achieve by a construction similar to that described in 6F.

The requirement to internally line walls and roofs also provides effective acoustic control for noise break-in on all but the very noisiest sites.

The use of a perforated liner tray has been shown to provide excellent absorption that can be classified as a class A absorber. This rivals ceiling tiles as an option and can be useful when controlling reverberation time in hospital spaces (especially large circulation areas where other surfaces are often reflective to sound).

Hygiene requirements may require the mineral fibre to be bagged by a material that prevents fibre migration, and this may degrade the high frequency performance offered. It must be remembered that using a perforated liner tray that passes across the top of partitions (without careful design) will significantly reduce the sound insulation performance of the partition. Specialist advice should be sought to provide appropriate head detailing.





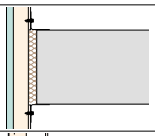
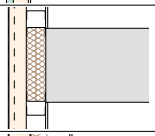
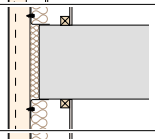
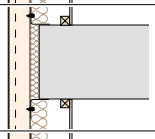
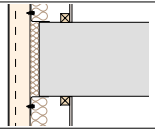


Education Buildings

All new school buildings are now controlled under the requirements of the Building Regulations. The normal way of satisfying Requirement E4 of the Building Regulations Approved Document E 2003 Edition is to demonstrate that all the acoustic performance standards in DfES Building Bulletin 93 (BB93) have been met. These standards cover sound insulation between classrooms of different activity, noise break in, room acoustics and speech intelligibility. A requirement to consider rain noise is also contained, in Section 3 of BB93 and also dealt with on page 20 of this guide.

Internal partitions in schools generally fall into 5 categories for sound insulation. To achieve these performances -

The Typical BB93 Flanking Constructions are:

Category A R_w ≤45 e.g. Science laboratories		5F
Category B R_w 50 e.g. Classrooms		9F
Category C R_w 55 e.g. Dance studio		6F
Category D R_w 60 e.g. Music practice		6F*
Category E R_w 65 e.g. Music recital		6F*

* See notes on right

In order to achieve the necessary site performance the flanking limits of the facade must be typically 5dB greater than these values in each case, assuming a high quality of workmanship and approved detailing. The data in Appendix C (6F and 9F) show that high flanking results are achievable with Kingspan insulated roof, wall and facade systems. These performances can be maintained using any thickness panel lined with plasterboard as per the details shown in the figures in Appendix F.

**To achieve the higher performance categories D and E would require additional measures such as increasing the thickness of plasterboard and supporting the plasterboard independent of the panels.*

For example, Category C performance (R_w 55dB) requirements can be achieve with a construction similar to 9F in Appendix C that is the Kingspan AWP/70 panels internally lined with 12.5mm plasterboard on 'C' channels.

The requirement to internally line walls and roof also provides effective noise control for noise break-in on all but the very noisiest sites.

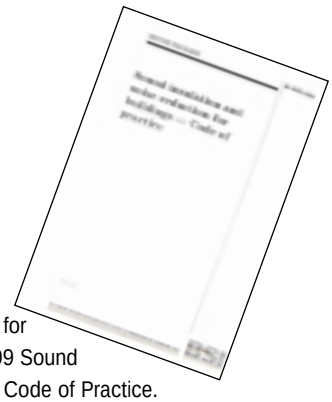
The use of a profiled perforated steel liner has been shown to provide excellent absorption (classified as a class A absorber). This rivals ceiling tiles as an option and can be useful when controlling reverberation time in sports halls, all classroom types and corridors.



Using a profiled perforated steel liner that passes across the top of partitions (without careful design) will significantly reduce the sound insulation performance of the partition. Result 10F in Appendix C shows that R_w 37dB is the flanking limit. Specialist advice should be sought to provide appropriate head detailing.


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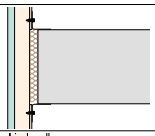
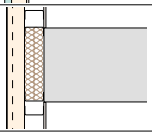
Office Buildings

Guidance on acceptable acoustic standards for office Buildings can be found in BS8233:1999 Sound insulation and noise reduction for buildings - Code of Practice. British Council of Offices also provide guidelines, which do not differ greatly from BS8233. The external noise break-in criteria* contribute to BREEAM assessments, and therefore can be crucial in gaining points. Issues to consider are:

- Privacy between offices, where a minimum of D_w 38dB is suggested going up to a D_w of 48dB where privacy is important.
- * Noise break-in from external sources where L_{Aeq} levels of between 35 and 45dB are considered to be appropriate, depending on the use.
- Control of reverberation will also help to control noise transfer and improve speech intelligibility. This is especially so in open plan offices, where ceilings with high absorption can be used.

In order to maintain the acoustic performance of internal partitions between offices, suitable flanking control has to be introduced. This is particularly so where the partition meets the external building envelope. In practice this means achieving the following typical flanking R_w's.

Typical Flanking Constructions

D_w 38 Offices - Rw 48		5F
D_w 48 Offices - Rw 58		9F

The D_w 38dB office partition standard may be achieve using any panel with plasterboard lining with no air gap (see construction 5F in Appendix C). Normal installation usually has an air gap so in reality this is a minimum requirement to achieve the above.

The D_w 48dB partition standard can be achieved with any panel that is lined with plasterboard as per the details (shown in the figures in Appendix F).

To control noise break-in, no lining is required for Kingspan insulated roof, wall and facade systems if external noise levels are L_{Aeq} 55dB or less. Where external noise levels exceed L_{Aeq} 55dB, an internal profiled steel liner or plasterboard lining is required. The exact specification depends on the external noise level.

In certain circumstances where external noise levels are less than 65dB L_{Aeq} it will be possible to use a panel with internal profiled perforated steel liner with 50mm insulation (60kg/m^3) in the cavity to control noise break-in via the roof. This system provides high levels of sound absorption which will help control noise transfer across open plan offices.

Commercial, Retail and Leisure Buildings

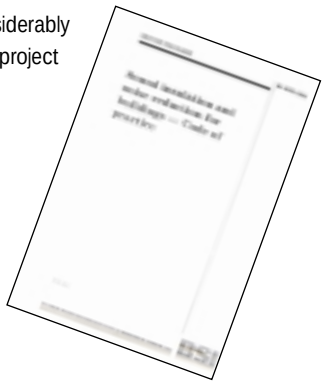
Some guidance on acoustic standards for commercial and retail developments can be found in BS8233:1999. 'Sound insulation and noise reduction for buildings' -Code of Practice. This gives suitable indoor ambient noise levels which range from 50 to 55dB L_{Aeq} for department stores.

This means that any Kingspan insulated roof, wall and facade systems can be used to control noise break-in to commercial or retail developments when the noise level outside is less than about 65dB L_{Aeq}. For higher external noise levels plasterboard or profiled steel liners may be required. Plasterboard linings will also control noise flanking around internal partitions through the external envelope.

The standard does not give advice on sound insulation between adjacent units in a retail development, although 40 to 45dB sound reduction is normally considered acceptable for normal retail uses. The performances of internal partitions can be achieved by limiting the flanking using any Kingspan insulated roof, wall and facade systems that is lined with plasterboard, as per the details shown shown in the figures in Appendix F.

Where higher levels of sound insulation are required between units, enhanced the flanking performance may be needed to sustain the performance of higher specification internal partitions and specialist advice should be sought.

Kingspan insulated roof, wall and facade systems can also be used for leisure schemes with the exact specifications depending on the activity and the tenant's requirements. These vary considerably and should be assessed on a project specific basis.






Virgin
ACTIVE

Industrial Buildings

Most industrial buildings would not require any particular acoustic performance, unless there are significant sources of internal noise generated by the process. It is these specific examples of noisy internal working environments (e.g. bottling plants) that are discussed below.

1- External Noise break-in

Some guidance on acoustic standards for industrial units can be found in *BS8233:1999 'Sound Insulation and noise reduction for buildings' - Code of Practice*. This gives suitable indoor ambient noise levels of 65dB L_{Aeq} being a good standard.

This means that any Kingspan insulated roof, wall and facade systems would be suitable for the building envelope except for exceptionally noisy sites with external noise levels above 75 to 80dB L_{Aeq}. However this would be an unusual situation and noise break-out to the environment is normally of greater concern.

Lining the Kingspan insulated roof, wall and facade systems with plasterboard may be appropriate in offices associated with the industrial units to control noise flanking and maintain privacy. The same principles apply here as these given in the Section of the guide on offices.

2- Internal Noise and Break-out

The main guidance is in *BS 4142:1997 'Method for rating industrial noise affecting mixed residential and industrial areas'*. This standard provides an assessment method for the industrial noise. It takes into account the character of the noise, the relative background noise and the duration of the noise. It determines whether complaints about a noise are likely. BS 4142 is the standard widely accepted in the UK to determine the acceptability, or otherwise, of industrial noise.

The noise levels inside industrial units depend upon the power of the noise sources and the way in which the noise builds up by multiple reflections inside the building. (See 'Reverberation and Absorption' section). The higher the noise levels inside the building, the higher will be the break-out to outside. In addition, the noise break-out depends on the sound insulation of the surrounding facade and other weaknesses such as open doors, windows and ventilation routes.

To reduce the level of noise breaking out from an industrial unit, the noise should be reduced to as low a level as practicable at the source. This is achieved by buying quiet plant or machinery, by the application of noise control techniques to the plant or machinery and by control of reverberation.

The reverberation of industrial buildings can be controlled by making sure that the internal building surfaces have a high absorption coefficient. A Kingspan KS1000 RW panel with 50mm thick insulation inside a profiled perforated steel liner of 30% open area (See result 2A, Appendix D) is a Class A absorber. It has very high absorption coefficients across the frequency spectrum. Using this system will improve the internal noise climate for employees (see section on Noise at Work) . This relates to reverberant noise only and not to direct noise which is experienced close to a source. However, due to their size, industrial buildings usually suffer a high proportion of reverberant noise.

In terms of noise break-out, any Kingspan panel will give about 25dB(A) sound reduction for typical industrial process noise (e.g. bottling plant). This can increase to typically 50dB(A) if the panels are lined with plasterboard. These are useful reductions which can be used to control noise break-out.

Most environmental industrial noise problems are caused by externally located plant, or break-out through open doors. However, tonal and impulsive internal noise can be problematic and each situation must be considered on a case by case basis (especially where the noise source contains high levels of low frequency noise). It is at low frequency where the sound insulation performance of Kingspan panels is relatively low.

3- Internal Noise Levels - Noise at Work

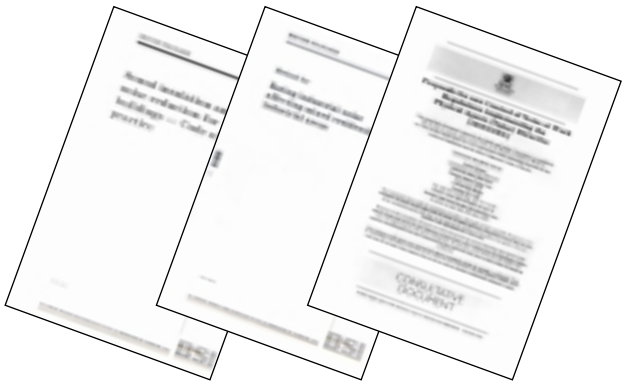
The ratified *Noise Control at Work Regulations 2006* stipulate that noise exposure levels for employees should be:

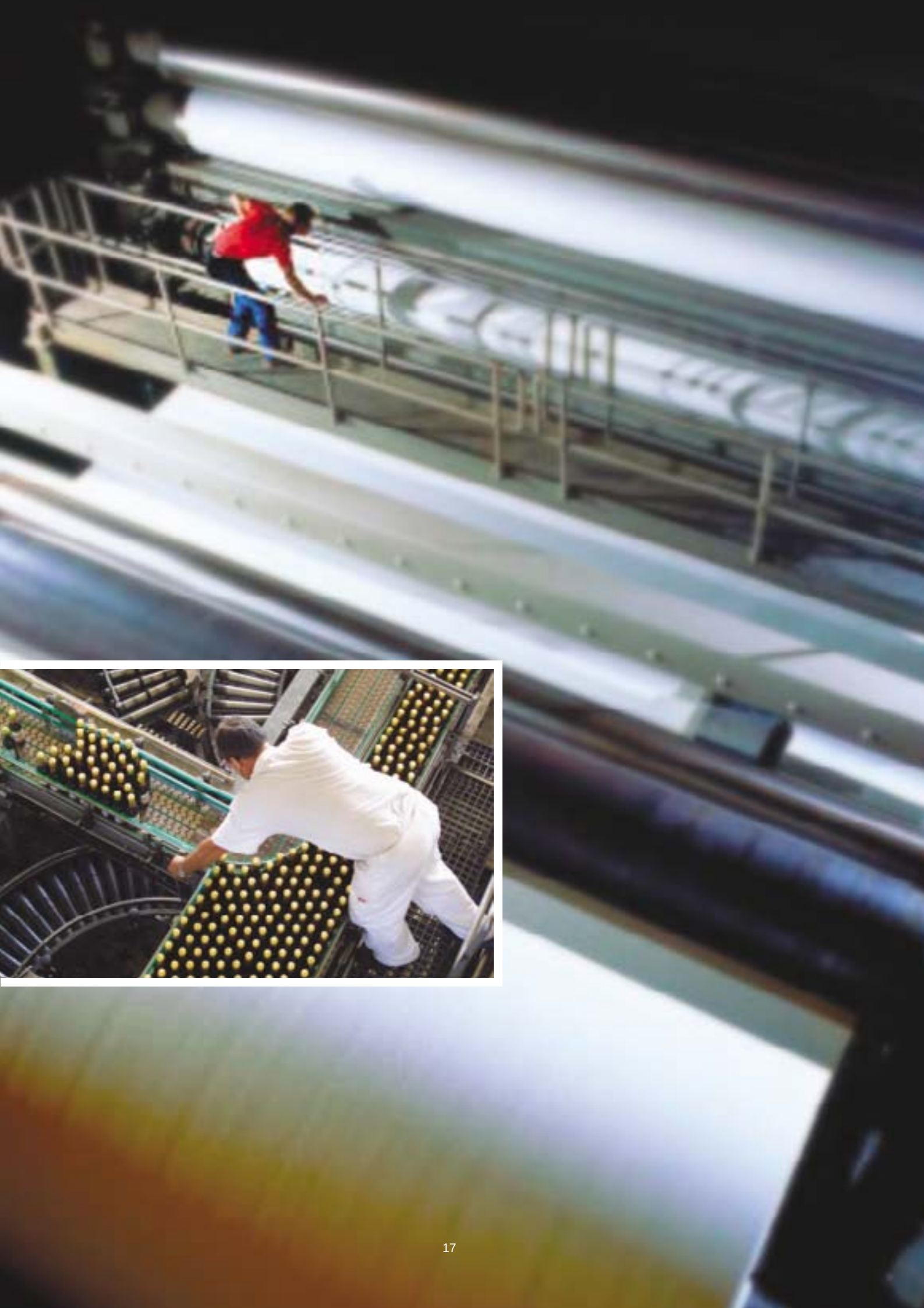
- Less than 80dB(A) for an 8 hour working day.
- If exposure is above this level, hearing protection should be worn.
- If the exposure per 8 hour working day is above 85dB(A), hearing protection must be worn.

There is also an obligation for employers to reduce noise levels generally in the workplace. The addition of the 50mm thick absorptive lining to Kingspan panels can reduce reverberant noise levels by 5 to 10dB(A). Thus it is possible to move a factory that is in the 'Compulsory Ear Protection' category where reverberant noise levels are above 85dB(A) (called the Upper Action value when exposure is for an 8 hour working day) to below the lower noise limit of 80dB(A) for an 8 hour working day (called the Lower Action Value) by using Kingspan panels, with an absorptive liner tray.

Correct treatment of an industrial building results in a building which is quieter to work in and is altogether more pleasant. Some particular benefits are:

- The PA system is more easily understood because of the elimination of echoes.
- Safety alarms are heard more easily.
- Conversation becomes easier.
- Noise caused by a faulty plant can be more readily identified; in a reverberant building it is difficult to detect the source of a particular noise.
- Free standing screens can be used to greater effect to control noise.






((80dB(A)))
An intercity train from a station platform

Residential and Hotels

Residential buildings, Apartments, and Room for Residential Purposes (i.e. Hotels, Student Accommodation, Single Living Accommodation, but excluding Nursing Homes at present) must satisfy Approved Document E (2003 Edition) of the Building Regulations 2000.

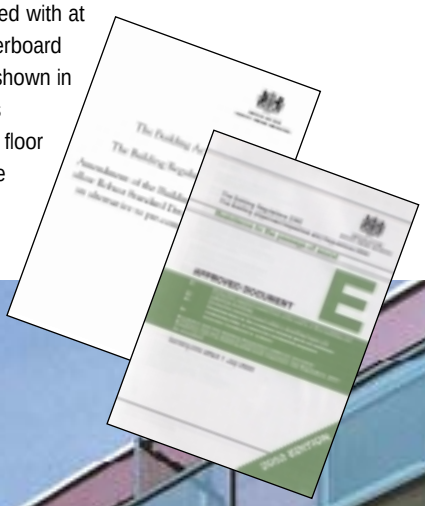
The Building Regulations require certain standards of sound insulation between residential units. This can be demonstrated in two ways. The first is to build the construction using Robust Details. This is a set of approved details issued by Robust Details Ltd which have been tested and shown to be reliable in providing the required sound insulation. This approach means that the builder does not have to have constructions tested for sound insulation.

The second approach is to build the residential property using appropriate designs normally approved by an acoustic consultant and do Pre-Completion Tests (PCT) on about 10% of the party walls and floors between residential units.

The standards which have to be met to achieve Approved Document E, using PCT are as follows:

		$D_{nT,w} + C_{tr}$ dB
Purpose built dwelling - houses and flats	- walls	45
	- floors	45
Dwelling - houses and flats formed by material change of use	- walls	43
Purpose built rooms for residential purposes	- walls	43
	- floors	45
Rooms for residential purposes formed by material change of use	- walls	43
	- floors	43

These standards can be achieved with Kingspan insulated roof, wall and facade systems as the external building envelope, provided they are internally lined with at least 1 layer of 12.5mm plasterboard using details similar to those shown in the figures in Appendix F. This assumes that suitable internal floor and partition constructions are used.







Rain Noise

When should Rain Noise be taken into account?

Rain noise should be taken into account at design stage where quiet conditions are essential, or where interference with speech communication is undesirable even for a short time (e.g. schools, call centres, some offices, cinemas etc). An acoustic consultant will be able to help determine whether careful attention to the control of rain noise is necessary or not.

The impact of rain on roof materials (particularly metal roofs) and the resulting internal noise created rain noise has been acknowledged as a potential problem in schools (in BB93). It should also be considered for other buildings such as hospital, residential, offices and leisure complexes.

Generally rain noise has been excluded from the standard classifications of environmental noise and the fact that it is transitory has led to little consideration over the years. However, BB93 requires that due consideration is given to the control of rain noise, either by external damping treatment or by enhancing the mass of the metal panels. The latter requires either internal mass layers or underscoring the roof panels with plasterboard or other material. BB93 suggests that either predicted results, but preferably laboratory measured results are needed, and reference is made to a draft measurement standard for impact sound from rain on the roof (ISO 140-18).

There is no actual limit that has to be achieved for rain noise, but levels as high as 70 to 80 dB L_{Aeq} can be caused inside spaces. This can have a dramatic effect on speech intelligibility. Kingspan insulated roof, wall and facade systems have tested in Sound Research Laboratories rain rig, to provide helpful information not previously available. The tests were done to ISO/CD 140-18, which is a working draft International Standard "Laboratory measurement of sound generated by rainfall on building elements", under "heavy" rainfall conditions. This is the standard referred to in BB93, but realistically these conditions are only likely to occur a few times a year in the UK.

The data is set out in Appendix E. The data enables rain noise levels to be predicted in any space where the room volume, reverberation time and roof area is known.

Appendix E also contains a worked example that demonstrates how this calculation can be done for a typical room. It provides a valuable tool to assess the impact of rain noise on the intended activities in a space. A judgement needs to be made on a case by case basis as to the acceptability of the noise.



Figure 4 : Sound Research Laboratories ISO 140-18 Rain Rig

((65dB(A)))

Typical rain on metal roof systems with ceiling tiles



Rain Noise Solutions

Please refer to Appendix E for data and construction details.

Slates and KS1000 TS Roof System

- The KS1000 TS system is a based on an insulated roof panel which acts as a carrier for tiles fixed onto timber battens. The configuration tested comprised of an 80mm panel with roof tiles of 17kg/m^2.

KS1000 RW roof systems with mineral fibre ceiling tiles

- Use existing text but remove last sentence. Text in first sentence in brackets should read (19mm and 24mm tiles).

KS1000 RW roof system with perforated liner & 50mm mineral fibre

- The base roof of a KS1000 RW 80mm was underdrawn with a profiled perforated steel liner (30% free area) containing 50mm thick mineral fibre (40-60 kg/m^2).

These acoustic roof systems provide appropriate solutions for situations where rain noise is an issue.



Acoustic Test Results Appendix A - Wall/Facade Panel Construction

Octave Band Sound Reduction Index (R) and Weighted Sound Reduction Index (R_w)

Wall	Panel and Lining	Octave Band Sound Reduction Index R								R_w	C_{tr}	Surface Weight Kg/m²
		63	125	250	500	1k	2k	4k	8k			
1W	AWP/60 + no lining	15	16	19	23	26	22	39	–	25	-3	18
2W	AWP/60 + F	12	19	32	42	50	52	60	–	43	-10	30
3W	AWP/60 + W15	14	17	31	40	48	46	56	–	41	-10	28
4W	AWP/60 + W15 + F	17	24	37	45	52	54	64	–	47	-9	40
5W	AWP/60 + P + W12	16	22	37	45	51	50	63	–	46	-10	41
6W	AWP/60 + P + W12	18	23	35	44	49	50	61	–	45	-8	41
7W	AWP/60 + I + P + W	18	24	37	48	53	55	63	–	48	-10	4
8W	KS1000 RW/40 + I + L	13	14	29	38	40	45	55	–	38	-9	20
9W	KS1000 RW/40 + I + L	12	16	30	40	44	51	64	–	40	-9	20
10W	AWP/70 + no lining	20	15	17	23	18	25	40	46	24	-4	12.5

Key

AWP = Architectural Wall Panel with various profiles (Optimo, MR, EB, FL, MM, CX, WV, Longspan)
F = 10mm dense particle board (11.7kg/m²)
W15 = 15mm plasterboard (10kg/m²)
W12 = 12.5mm wallboard (7.9kg/m²)
P = 19mm dense plasterboard plank (15.2kg/m²)
I = Insulation (see construction description for details)
L = 0.7mm profiled steel liner sheet
The figures after the forward slash refers to the panel thickness in mm (ie AWP/60 = panel thickness of 60mm)

Acoustic Test Results Appendix B - Roof Panel Construction

Octave Band Sound Reduction Index (R) and Weighted Sound Reduction Index (R_w)

Roof	Panel and Lining	Octave Band Sound Reduction Index R								R_w	C_{tr}	Surface Weight Kg/m²
		63	125	250	500	1k	2k	4k	8k			
1R	KS1000 LP/45 + I + 2 x SB	27	32	47	61	69	69	75	–	58	-11	–
2R	KS1000 RW/40 + I + L	8	17	32	43	48	54	60	–	43	–	2
3R	KS1000 RW/40 + I + L	11	19	36	48	54	61	73	–	46	–	19
4R	KS1000 RW/40 + I + Py	17	27	39	44	49	57	67	–	48	–	31
5R	KS1000 RW/30 + no lining	–	17	20	23	23	23	41	–	25	-3	–
6R	KS1000 RW/30 + I + L	–	18	35	50	55	59	60	–	44	-11	–
7R	KS1000 RW/50 + I + L	–	19	34	48	52	56	63	–	44	-10	–
8R	KS1000 RW/80 + I + L	–	20	36	48	50	66	70	–	46	-11	–
9R	KS1000 RW/80 + no lining	–	18	21	23	20	38	42	–	26	-4	–
10R	KS1000 RW/80 + no lining	20	18	20	24	20	29	39	47	25	-3	–
11R	KS1000 RW/80 + I + PL	18	19	22	29	31	40	58	49	32	-4	–
12R	KS1000 ZIP/90 + no lining	19	18	19	20	17	35	38	44	23	-4	–
13R	KS1000 LP/80 + no lining	19	19	19	22	19	35	39	46	24	-4	–
14R	KS1000 RT + no lining	20	19	21	22	22	32	38	44	25	-2	–
15R	KS1000 TS + no lining	20	16	15	23	29	39	45	53	27	-4	27

Key

I = Insulation (see construction description for details)

2 x SB = 2 x 12.5mm dense plasterboard (15.2kg/m²)

L = Profiled Steel Liner Sheet

Py = 10mm thick dense particle board (11.7kg/m²)

PL = Profiled Perforated Steel Liner Sheet

The figures after the forward slash refers to the panel thickness in mm (ie LP/45 = panel thickness of 45mm)

Acoustic Test Results Appendix C - Flanking Tests

Octave Band Sound Reduction Index (R) and Weighted Sound Reduction Index (R_w)

Wall	Panel and Lining	Octave Band Sound Reduction Index R								R_w	C_{tr}
		63	125	250	500	1k	2k	4k	8k		
1F	KS1000 RW/80 + no lining	14	30	35	40	35	45	54	57	40	-3
2F	KS1000 RW/80 + FSC	16	28	34	41	35	45	54	58	40	-4
3F	KS1000 RW/80 + FSC	17	29	37	44	36	46	55	62	42	-5
4F	KS1000 RW/80 + FSC	16	30	37	43	36	46	55	62	42	-5
5F	KS1000 RW/80 + FSC + Pb	28	34	41	46	52	62	62	68	51	-5
6F	KS1000 RW/80 + FSC + I + Pb1	29	39	50	58	64	66	63	68	60**(67)	-7
7F	AWP/70 + I	17	33	41	44	40	50	56	63	45	-4
8F	AWP/70 + I +PbM	19	34	43	46	41	50	57	64	47	-5
9F	AWP/70 + I + Pbz	32	36	49	57	63	66	63	69	59**(63)	-9
10F	KS1000 RW/80 + I + PL	21	21	24	34	52	58	57	56	37	-5

Key

+ See construction description for details

** Limited by performance of partition wall - Figures in brackets are calculated performances without the influence of partition wall.

FSC Fire Stop and Covers - Mineral fibre packing (60kg/m^3) and 90 degree coverflashings with mastic beads at edges.,

AWP Architectural Wall Panel with various profiles (Optimo, MR, EB, FL, MM, CX, WV, Longspan)

The figures after the forward slash refers to the panel thickness in mm (ie RW/80 = panel thickness of 80mm)

Test walls were flanking a partition wall comprising 8 x 12.5mm standard wallboard each side of 50mm isolated timber studs with a 150mm cavity between inner layers of plasterboard containing 100mm of 45kg/m^3 mineral fibre insulation - estimated R_w 61 dB.

Acoustic Test Results Appendix D - Constructions for Absorption Test

Octave Band Sound Reduction Index (R) and Weighted Sound Reduction Index (R_w)

Flanking Construction	Panel and Lining	Octave Band Sound Reduction Index R								NRC	α_w	Class*
		63	125	250	500	1k	2k	4k	8k			
1A	KS1000 RW + no lining	0.07	0.25	0.20	0.10	0.15	0.10	0.08	0.15	0.10	0.15	E
2A	KS1000 RW panel + perf metal lining 30% free area + 50mm insulation 40/60 kg/m^3	0.15	0.45	0.70	0.85	0.90	0.90	0.75	0.60	0.85	0.90	A

Key

* = Classification according to EN ISO 11654 (See Figure 3 for detail).

Acoustic Test Results Appendix E - Rain Noise Tests

Octave Band Impact Sound Power Levels L_w and A- Weighted Sound Power Levels L_{WA}

Ref No.	Panel and Lining	Octave Band Sound Reduction Index R								L_{WA}
		63	125	250	500	1k	2k	4k	8k	
*1RR	KS1000 RW/80 + T24	50	49	52	53	53	45	38	30	56
*2RR	KS1000 RW/80 + T19	50	49	52	54	54	47	37	29	57
*3RR	KS1000 RW/ 80 + I + PL	48	52	54	53	54	39	35	29	56
*4RR	KS1000 TS + 17kg/m² tiles	48	52	58	54	54	43	37	25	57

Key

* Rain flow rate 663ml/ minute with 3.5m drop height (heavy rain)

** Rain flow rate 450 to 465 ml/ minute with 1m drop height

T24 = 24mm Mineral Fibre Tiles of 8.23kg/m² and Dncw 41dB

T19 = 19mm Mineral Fibre Tiles of 4.46kg/m² and Dncw 38dB

I = Mineral Fibre Insulation (60kg/m³),

PL = Profiled Perforated steel liner

The figures after the forward slash refers to the panel thickness in mm (ie RW/80 = panel thickness of 80mm)

Worked Example of rain noise levels predicted inside a room, based on the above data

e.g. an office 5m long by 4m wide by 2.3m high has a KS1000 RW Kingspan roof with 24mm thick absorbent ceiling tiles hung beneath. (See construction 1RR in Appendix E). The reverberation time is 0.7 sec at all frequencies. Calculate the octave band sound pressure levels over the frequency range 63Hz to 8kHz and the A-weighted sound level.

The sound pressure level is calculated using the following equation:

$L_{pr} = L_{Wref} + 10 \log T - 10 \log V + 14 + 10 \log S$

Where L_{pr} is the rain noise sound pressure level in the room - dB

T is the reverberation time in the room - seconds

V is the volume of the room in m³

S is the room area m²

L_{Wref} sound power level - (when 1m² of roof is excited) dB

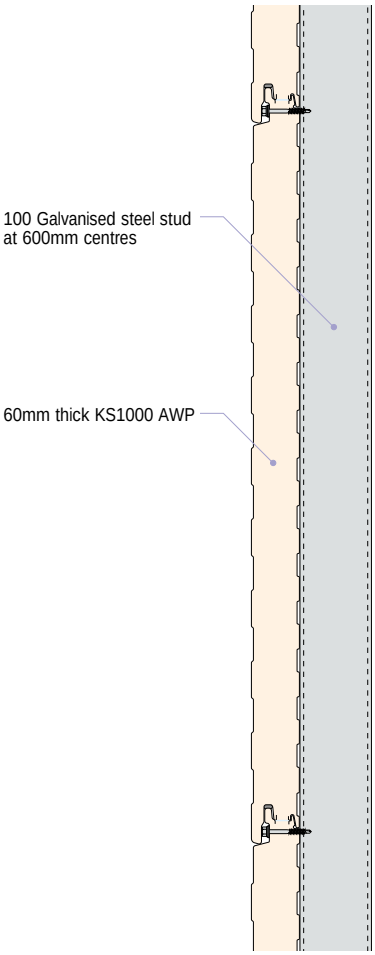
$L_{pr} = L_{Wref} + 10 \log (0.7) - 10 \log (46) + 14 + 10 \log (20)$

$L_{pr} = L_{Wref} - 1.5 - 16.5 + 14 + 13 = L_w + 9$

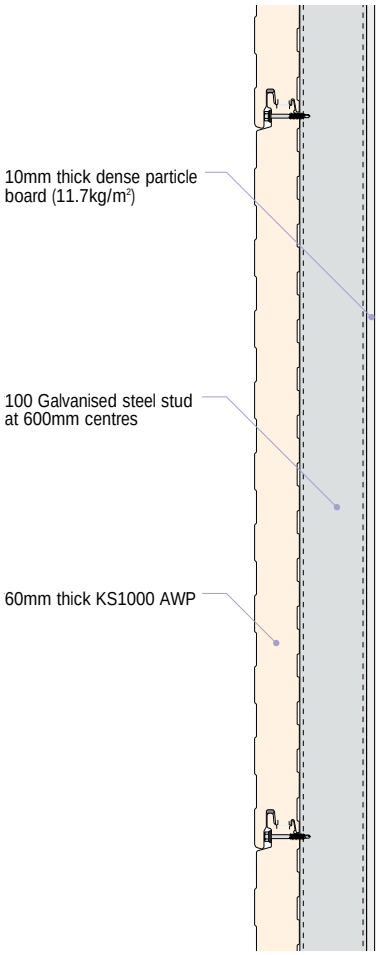
	Octave Band Centre Frequency								
	63	125	250	200	1k	2k	4k	8k	Hz
L_{Wref}	50	49	52	53	53	45	38	30	dB
L_{pr}	59	58	61	62	62	54	47	39	dB
A- weighting	-25	-16	-9	-3	0	+1	+1	0	
Octave Band A- weighted Level	34	42	52	59	62	55	48	39	dB
Overall A- weighted level = 65dB(A)									

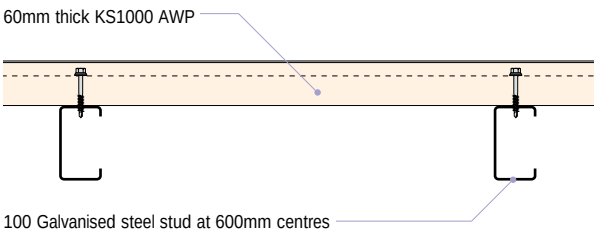
Appendix A - Wall/Facade Panel Construction Details

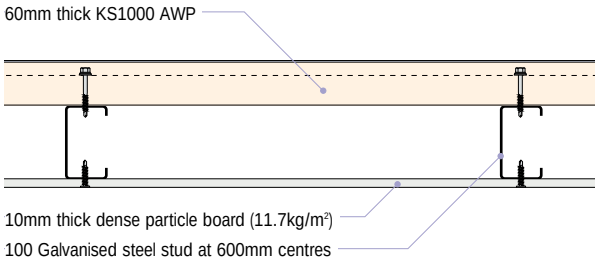
1W - KS1000 AWP(60) - Insulated Wall Panel



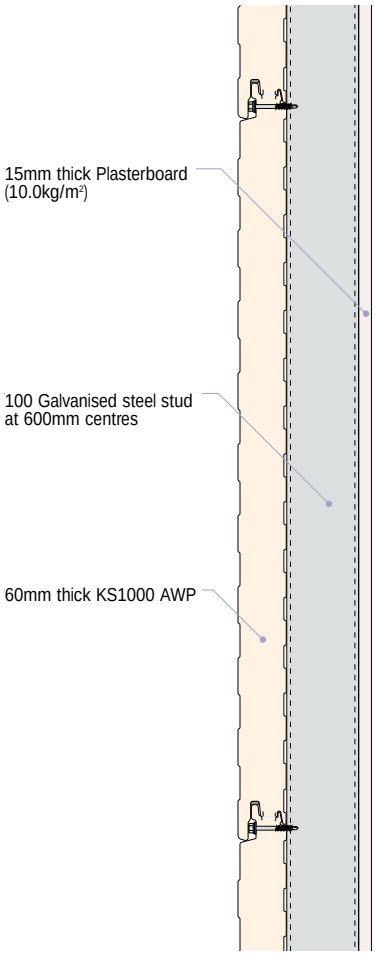
2W - KS1000 AWP(60) - Insulated Wall Panel



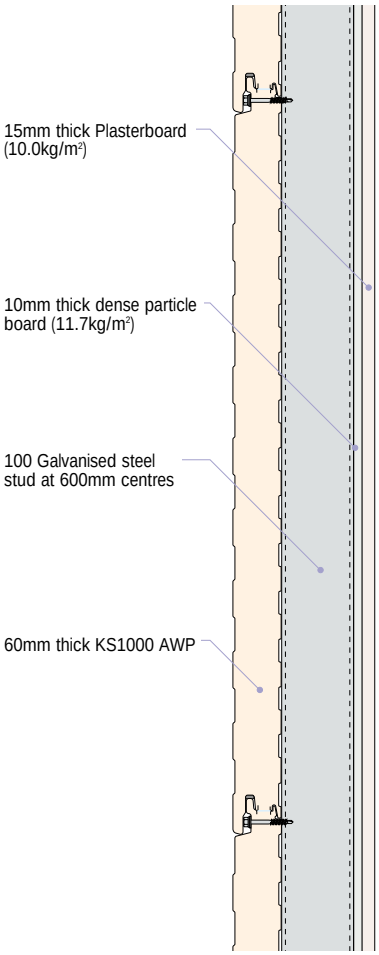


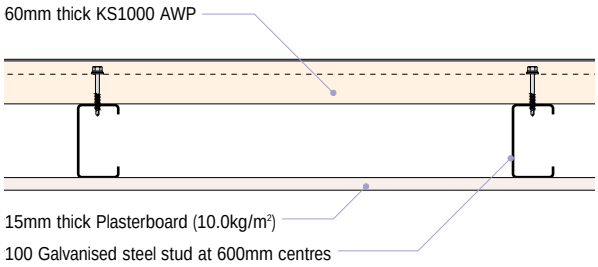


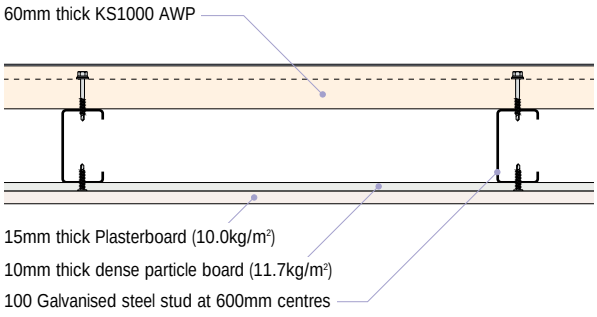
3W - KS1000 AWP(60) - Insulated Wall Panel



4W - KS1000 AWP(60) - Insulated Wall Panel

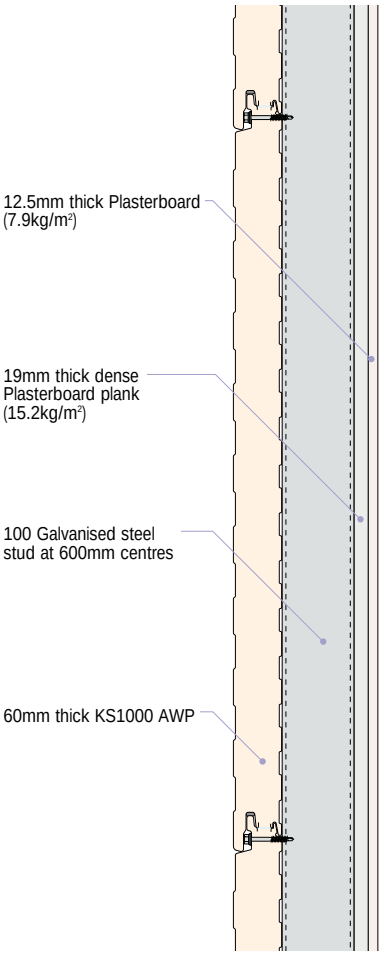




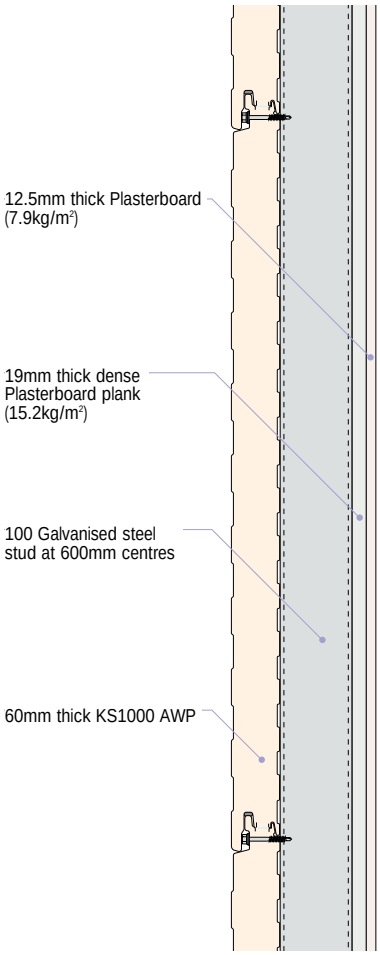


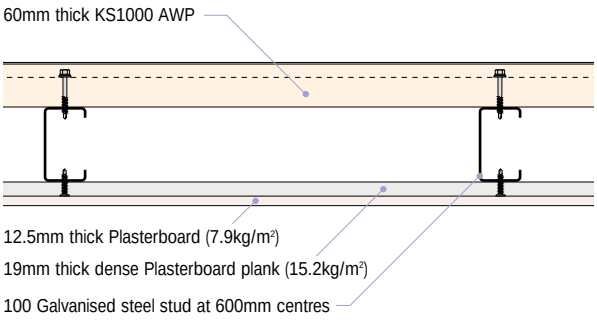
Appendix A - Wall/Facade Panel Construction Details

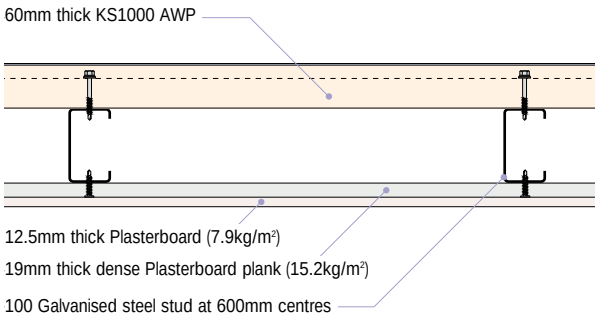
5W - KS1000 AWP(60) - Insulated Wall Panel



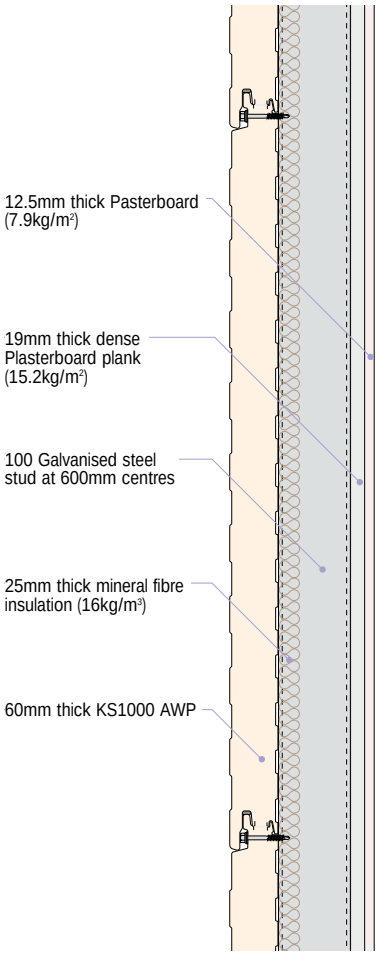
6W - KS1000 AWP(60) - Insulated Wall Panel

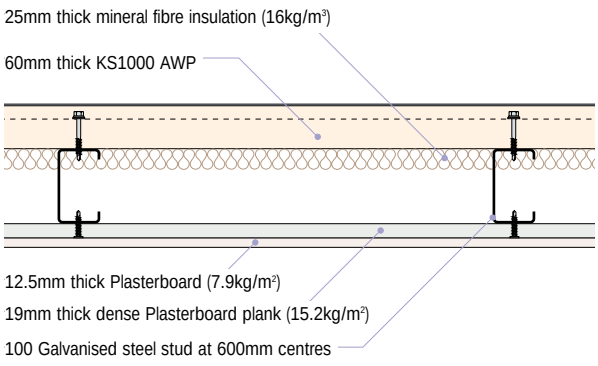




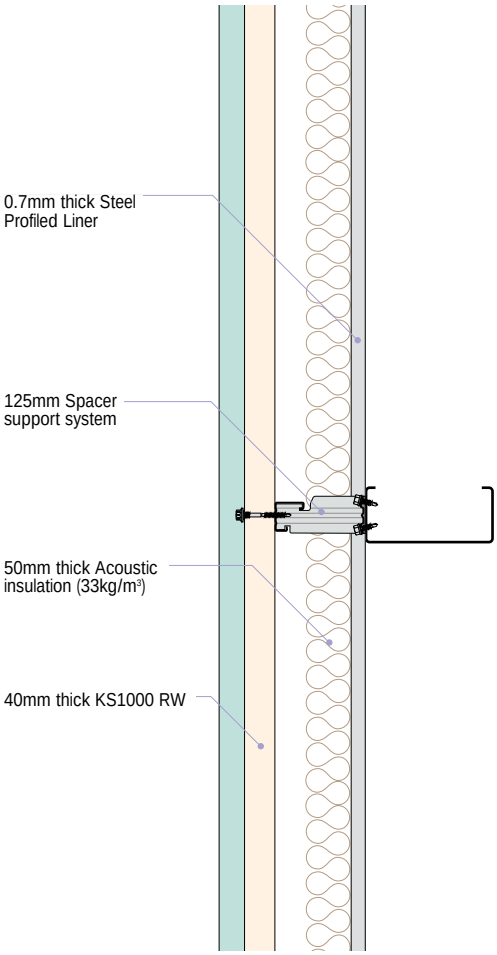


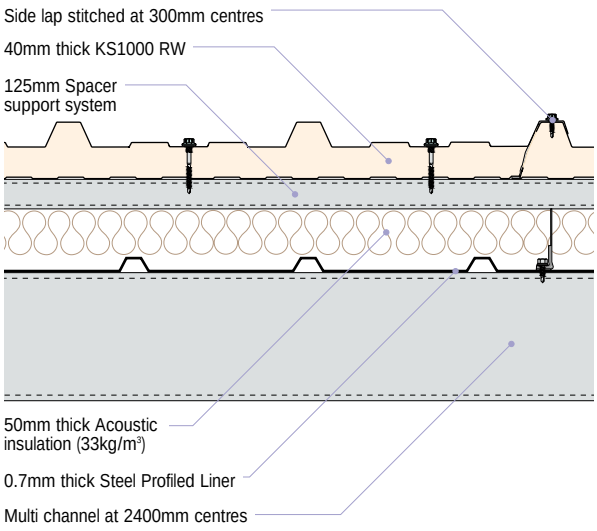
7W - KS1000 AWP(60) - Insulated Wall Panel





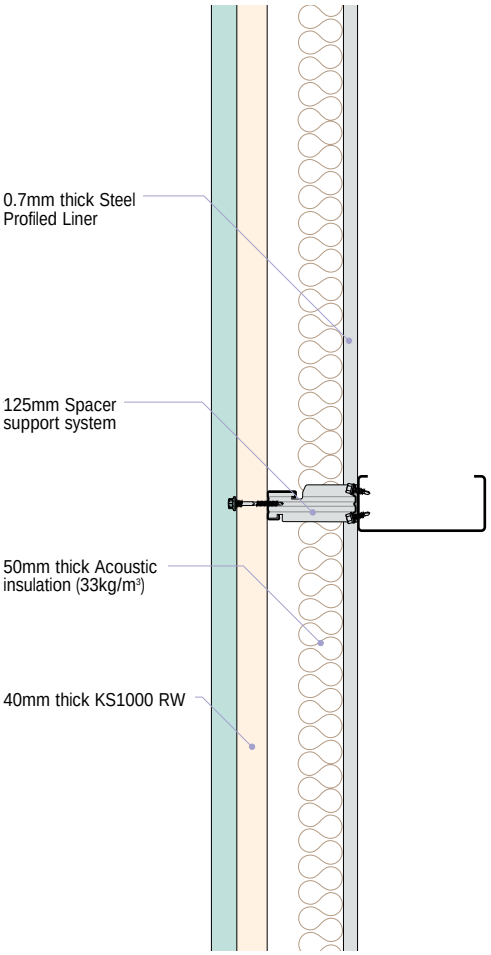
8W - KS1000 RW(40) - Insulated Trapezoidal Wall Panel



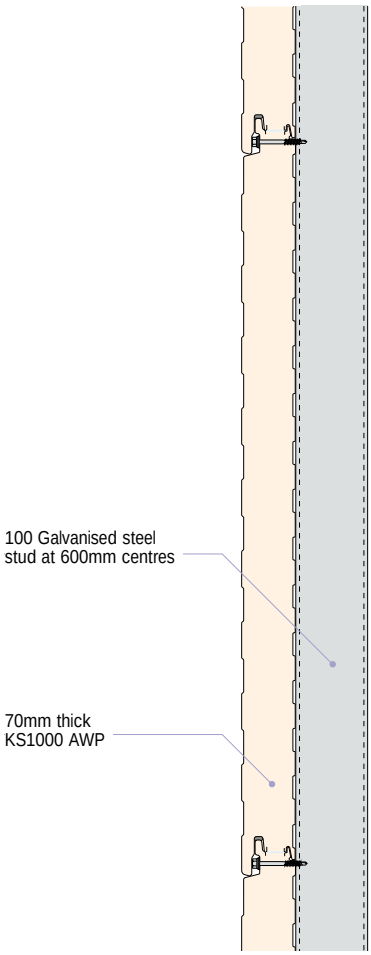


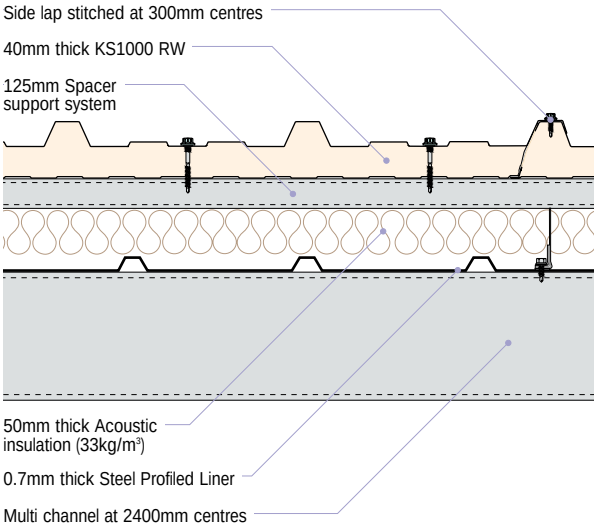
Appendix A - Wall/Facade Panel Construction Details

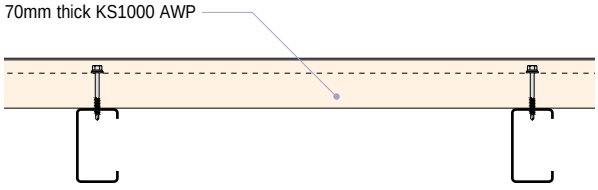
9W - KS1000 RW(40) - Insulated Trapezoidal Wall Panel



10W - KS1000 AWP(70) - Insulated Wall Panel

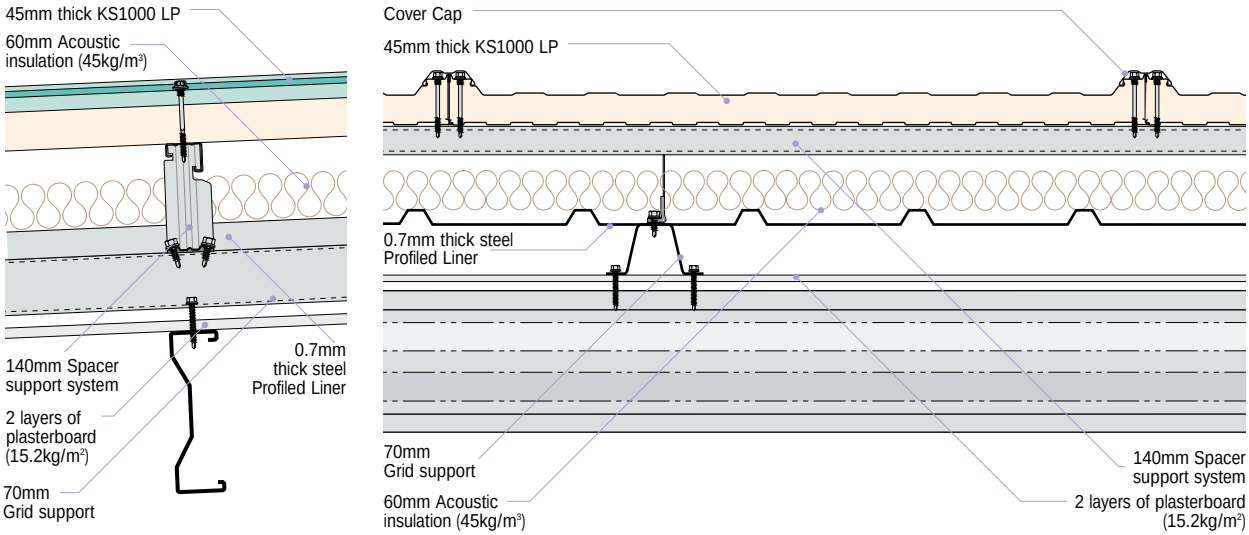




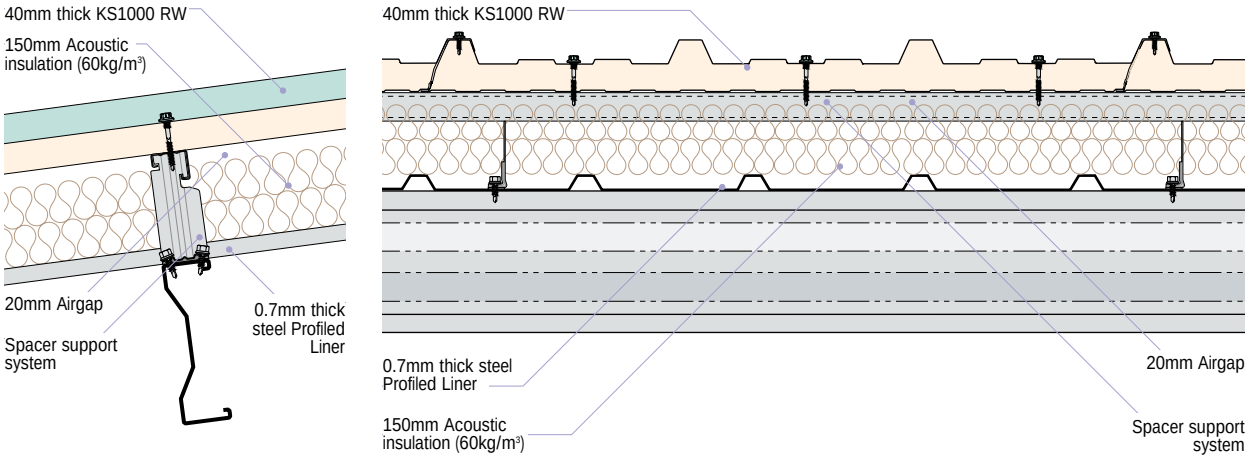


Appendix B - Roof Panel Construction Details

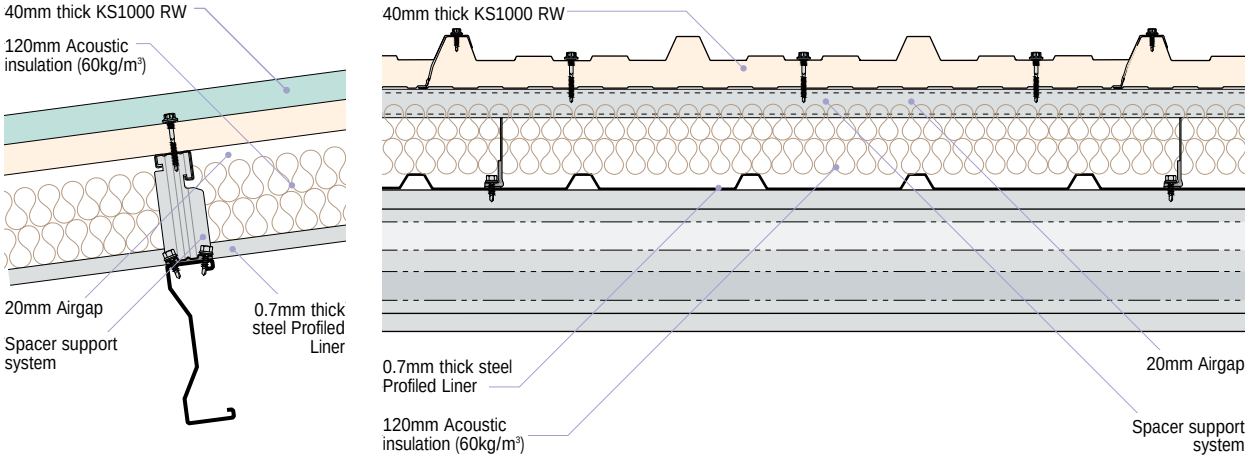
1R - KS1000 LP (45) - Insulated Roof Panel



2R - KS1000 RW (40) - Insulated Roof Panel

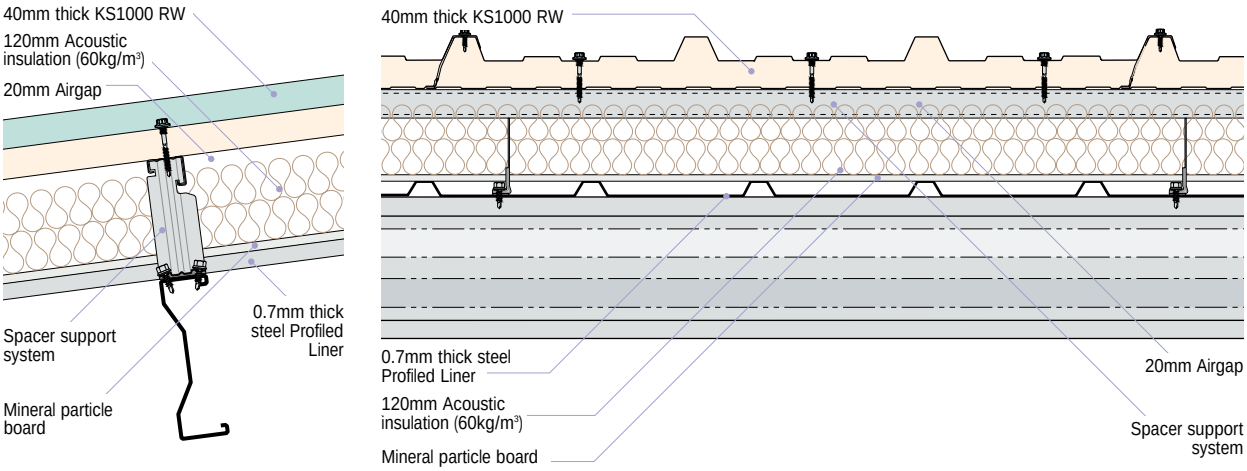


3R - KS1000 RW (40) - Insulated Roof Panel

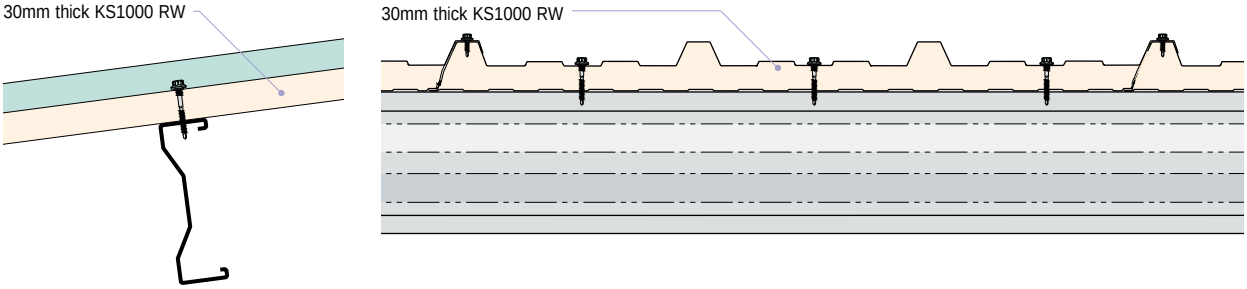


Appendix B - Roof Panel Construction Details Cont'd

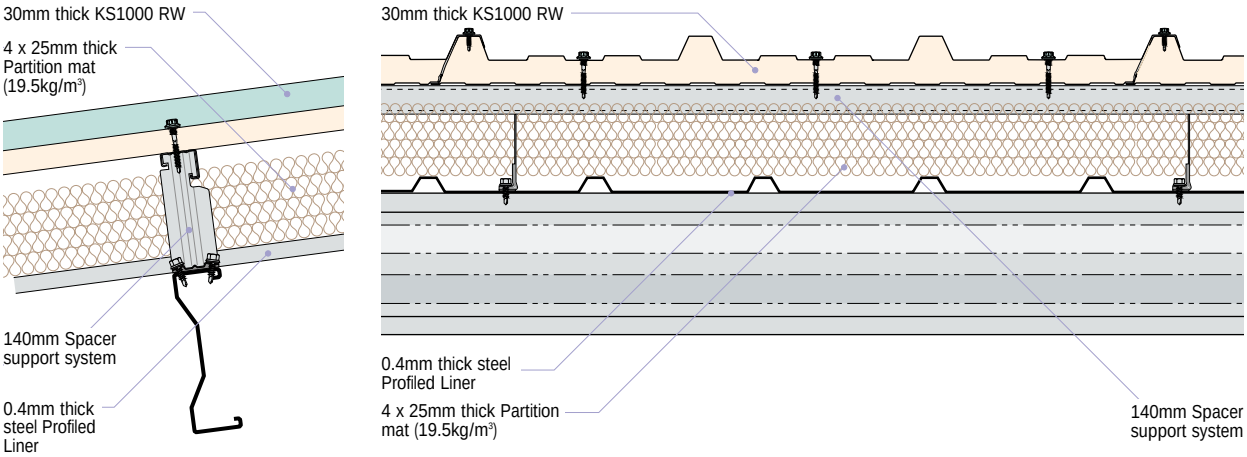
4R - KS1000 RW (40) - Insulated Roof Panel



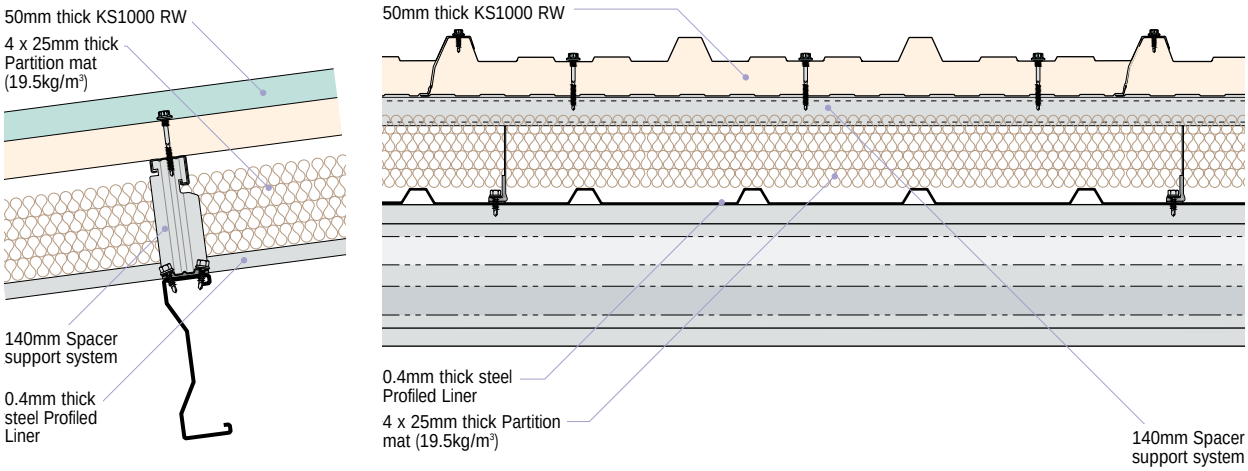
5R - KS1000 RW (30) - Insulated Roof Panel



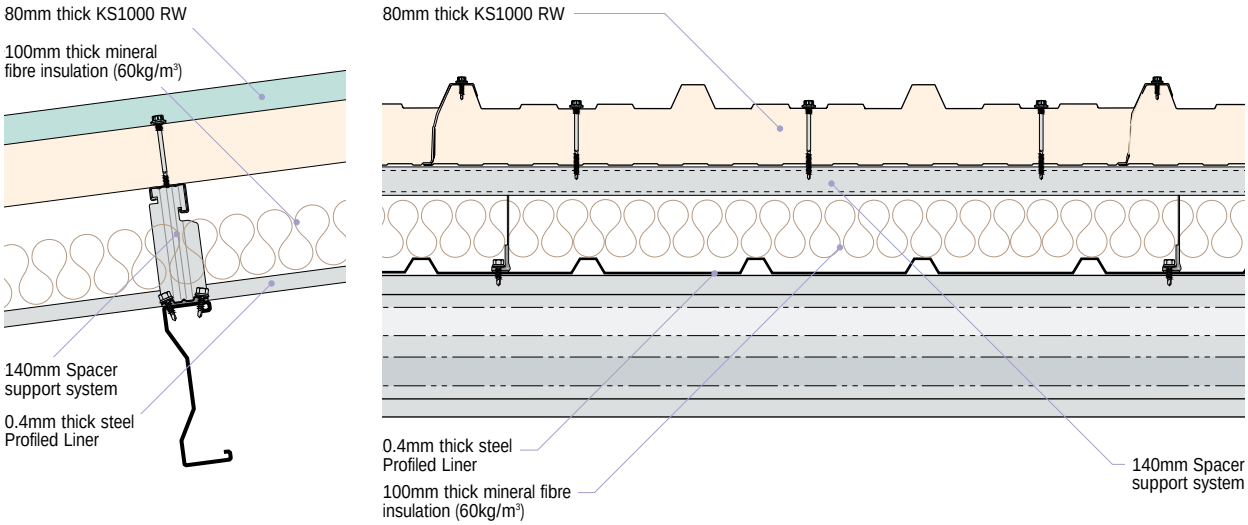
6R - KS1000 RW (30) - Insulated Roof Panel



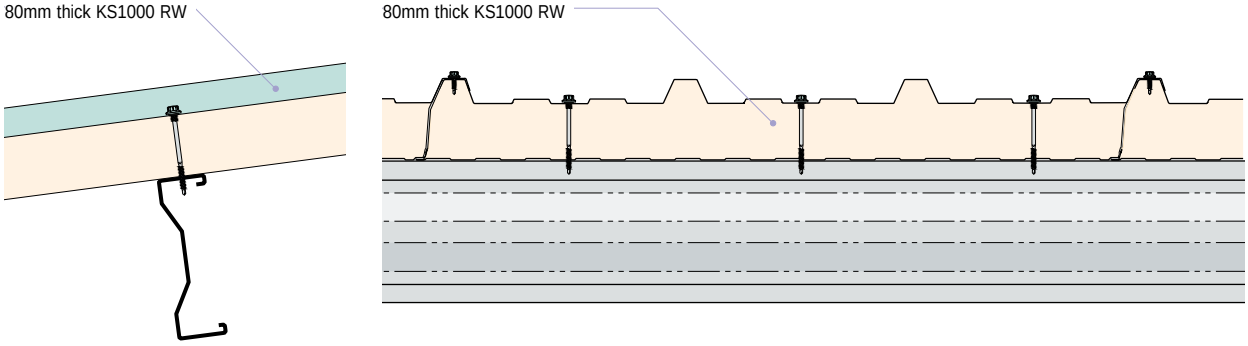
7R - KS1000 RW (50) - Insulated Roof Panel



8R - KS1000 RW (80) - Insulated Roof Panel

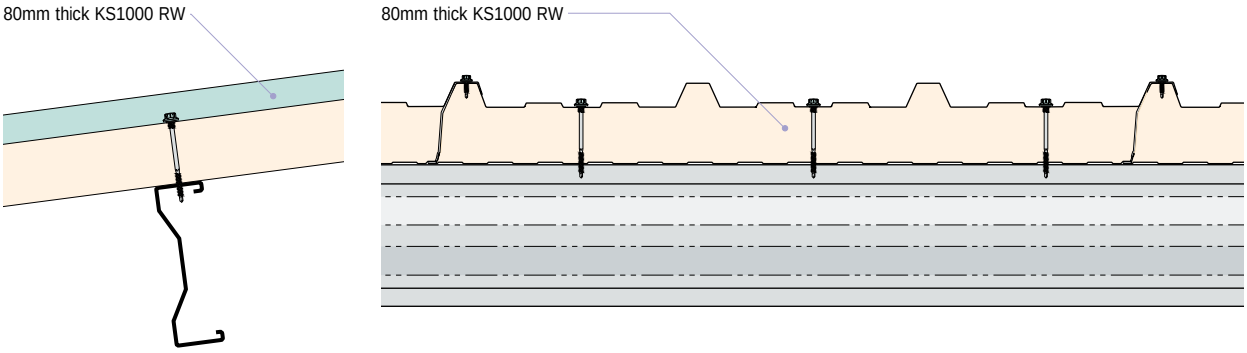


9R - KS1000 RW (80) - Insulated Roof Panel

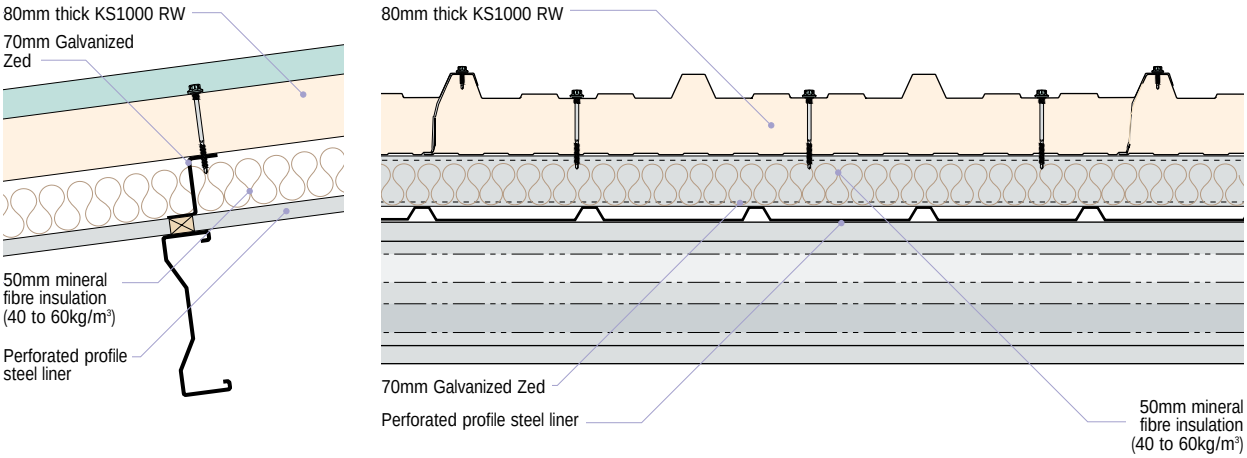


Appendix B - Roof Panel Construction Details Cont'd

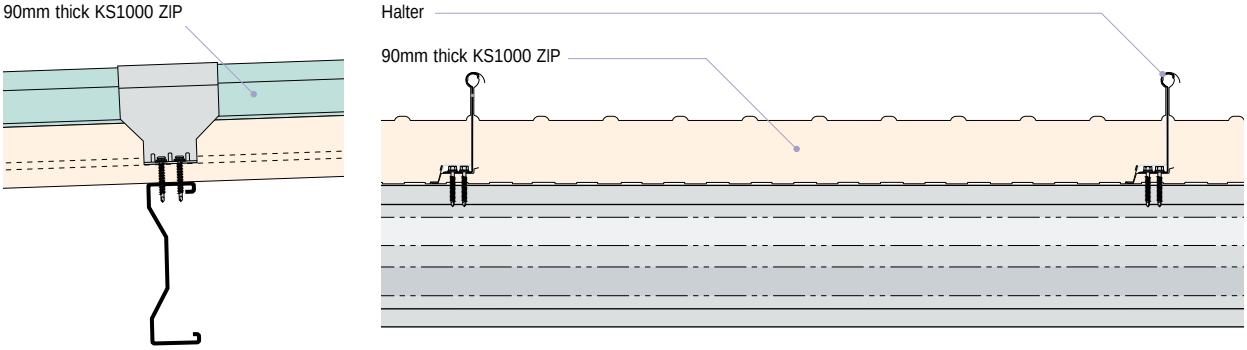
10R - KS1000 RW (80) - Insulated Roof Panel



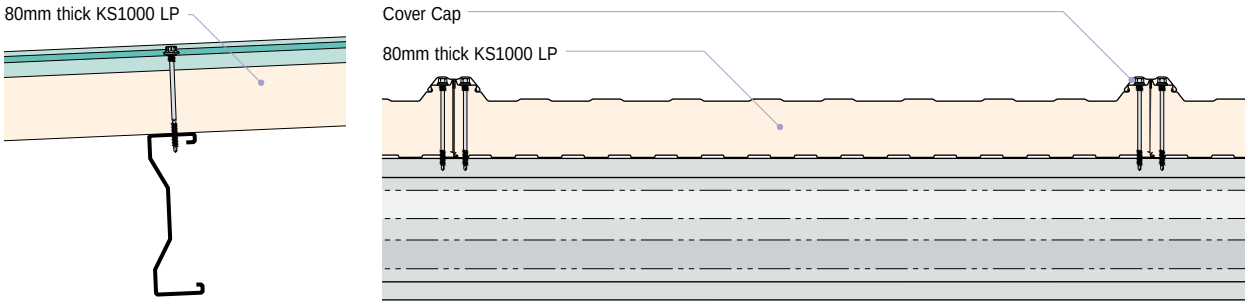
11R - KS1000 RW (80) - Insulated Rooftile Panel



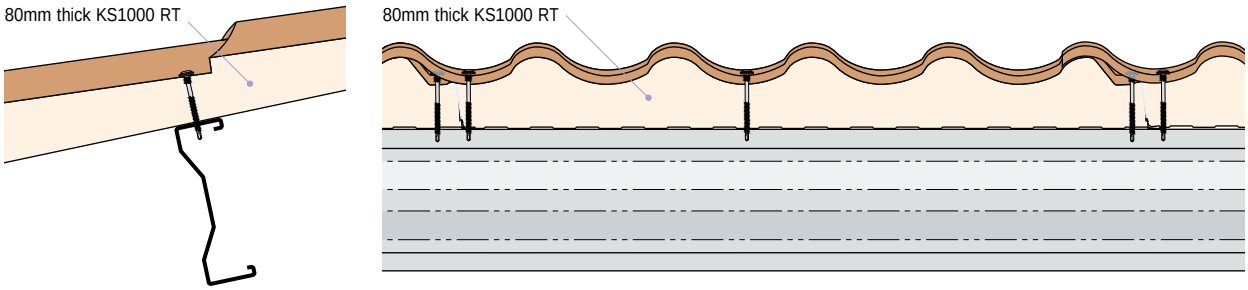
12R - KS1000 ZIP (90) - Insulated Standing Seam Roof Panel



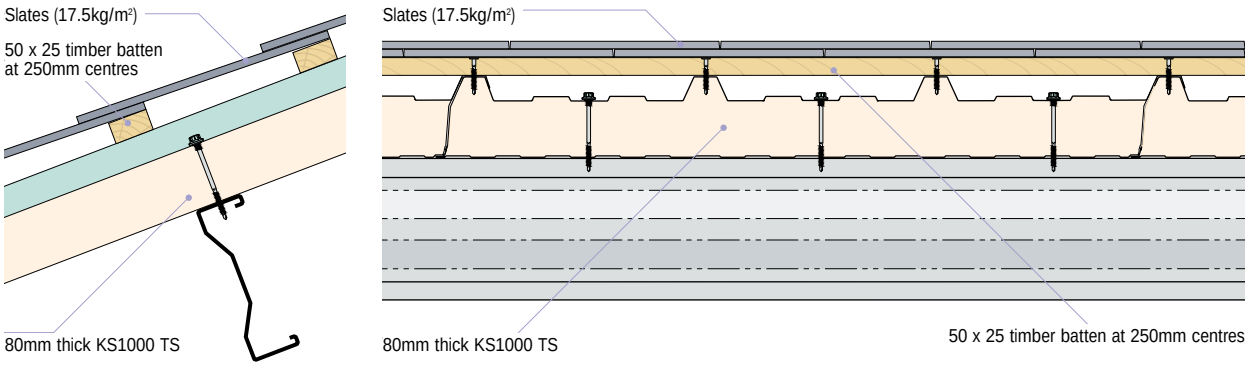
13R - KS1000 LP (80) - Insulated Roof Panel



14R - KS1000 RT (80) - Insulated Rooftile Panel

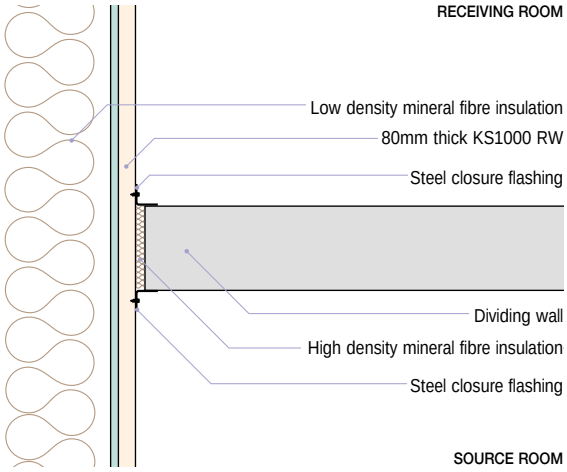


15R - KS1000 TS (80) - Insulated Tile Support Panel

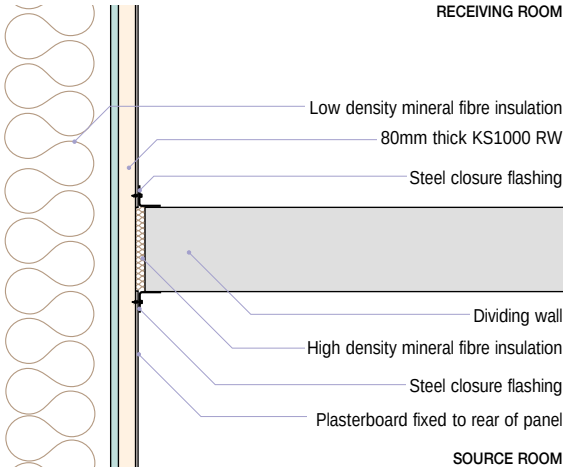


Appendix C - Flanking Test Construction Details

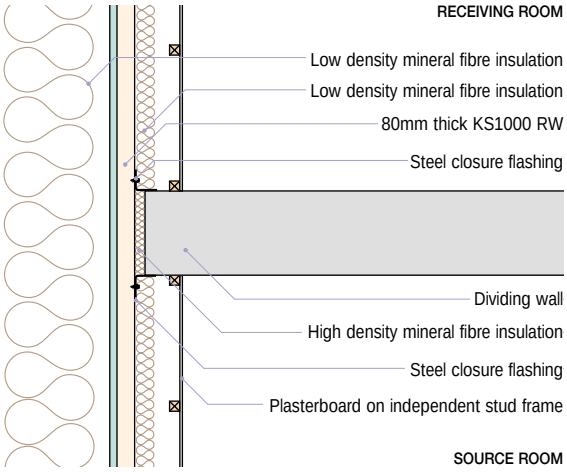
1F - KS1000 RW Insulated Roof & Wall Panel



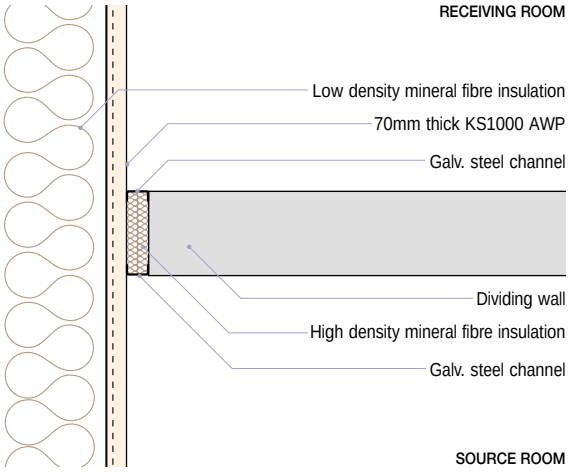
5F - KS1000 RW Insulated Roof & Wall Panel



6F - KS1000 RW Insulated Roof & Wall Panel

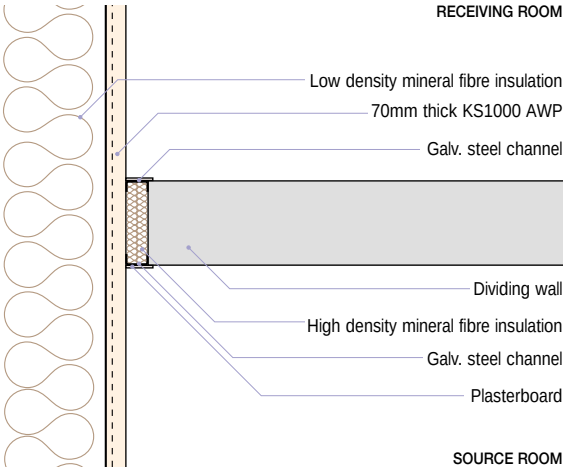


7F - KS1000 AWP Insulated Wall Panel

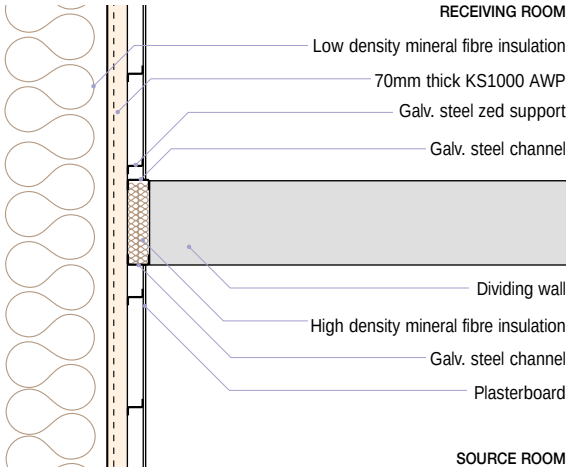


Appendix C - Flanking Test Construction Details

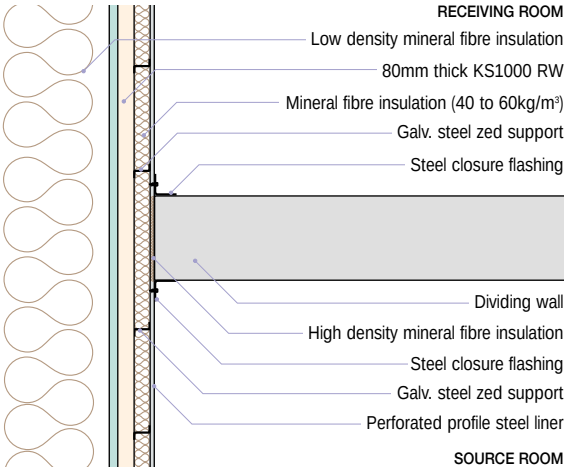
8F - KS1000 AWP Insulated Wall Panel



9F - KS1000 AWP Insulated Wall Panel

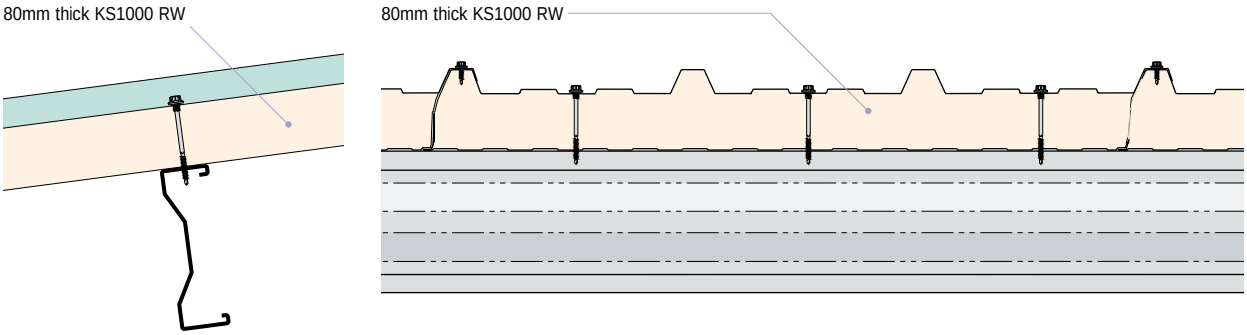


10F - KS1000 RW Insulated Roof & Wall Panel

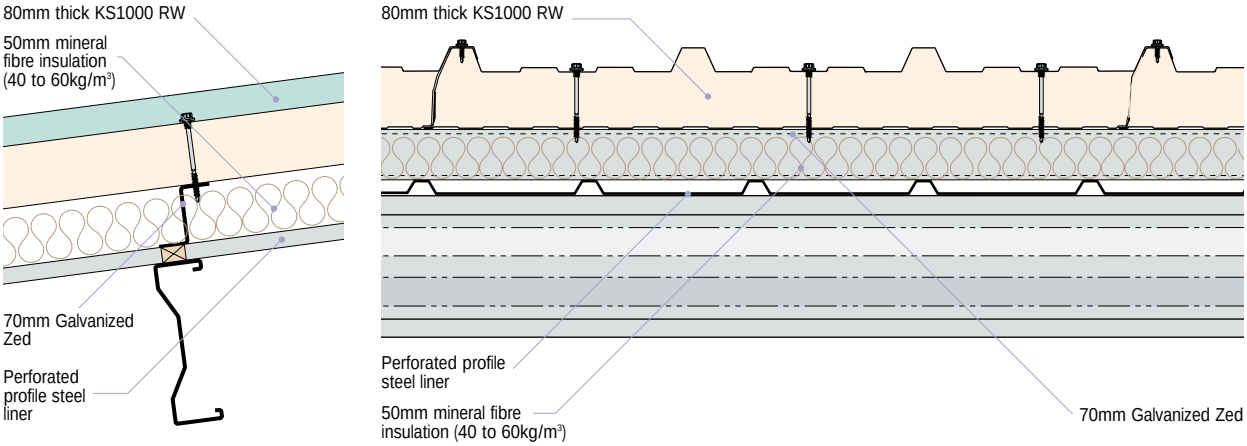


Appendix D - Absorption Test Construction Details

1A - KS1000 RW (80) - Insulated Roof Panel

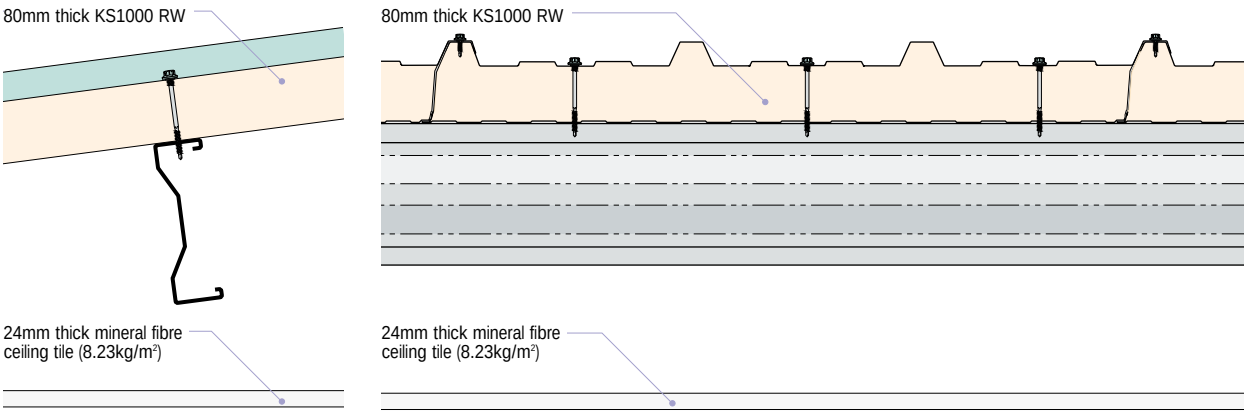


2A - KS1000 RW (80) - Insulated Roof Panel



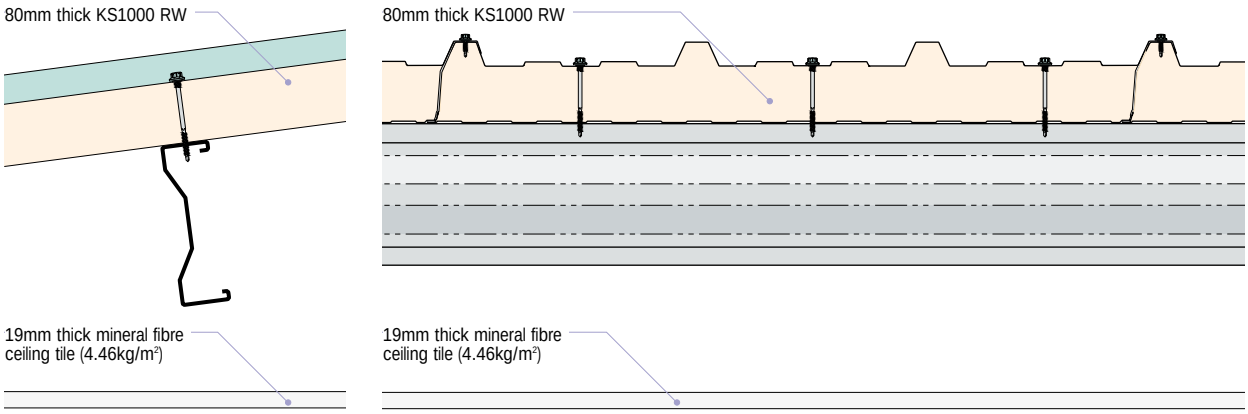
Appendix E - Rain Noise Tests Construction Details

1RR - KS1000 RW (80) - Insulated Roof Panel

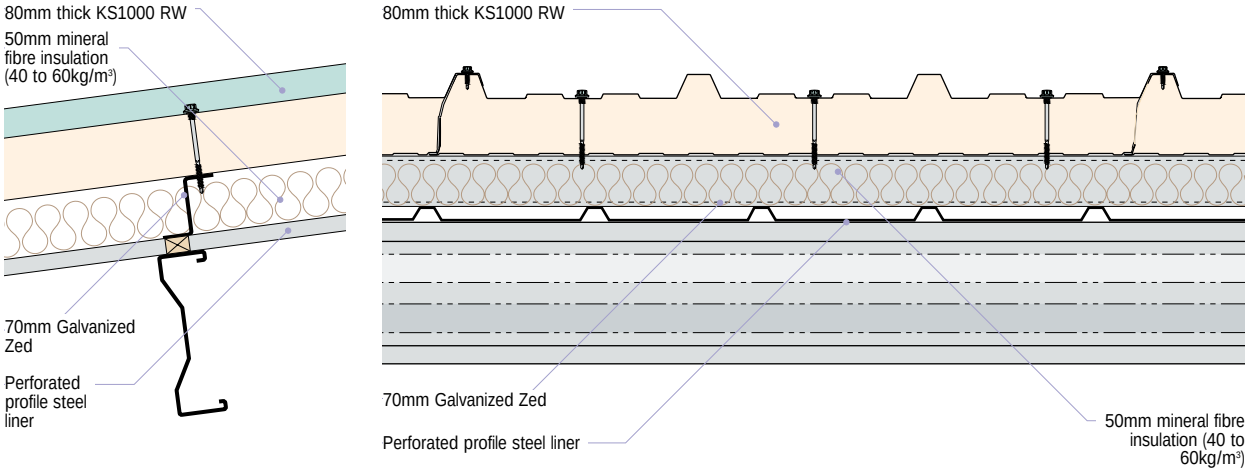


Appendix E - Rain Noise Tests Construction Details

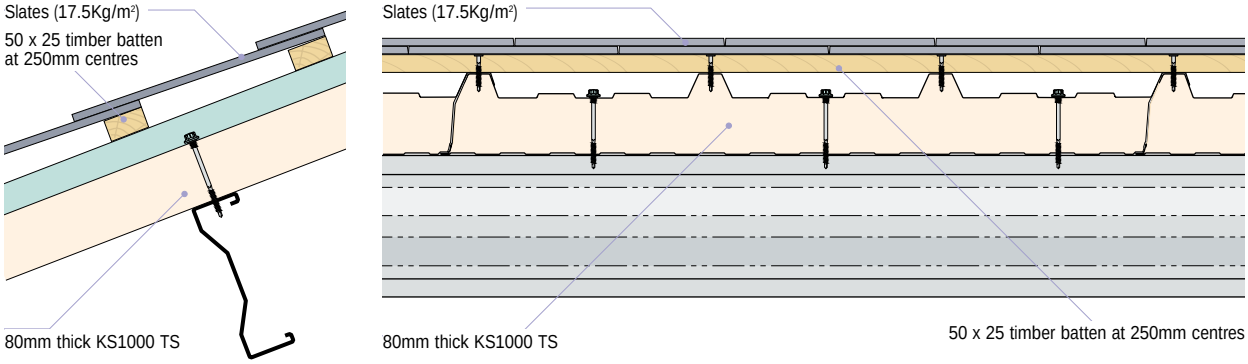
2RR - KS1000 RW (80) - Insulated Roof Panel



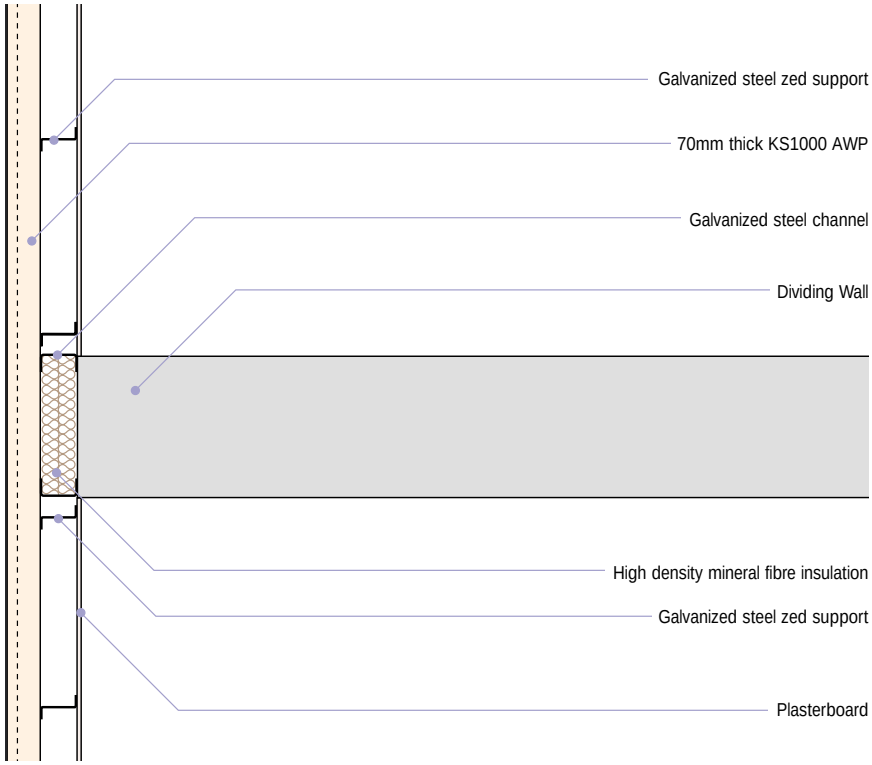
3RR - KS1000 RW (80) - Insulated Roof Panel



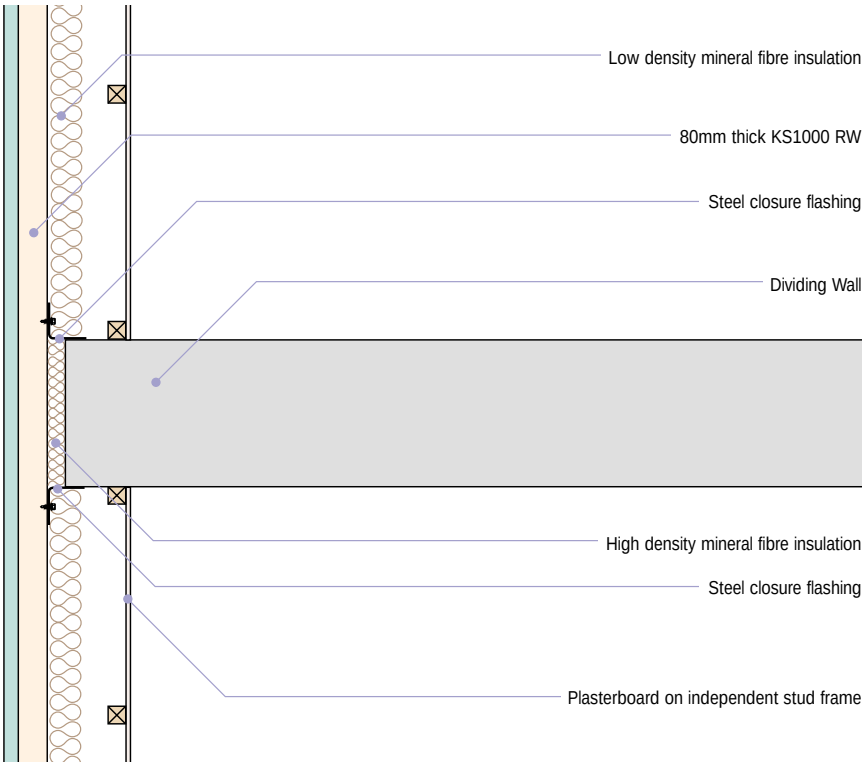
4RR - KS1000 TS (80) - Insulated Tile Support Panel



Appendix F - Standard Flanking Construction Detail



Enhanced Flanking Construction Detail



Appendix G - Terminology

Acoustic Measurement Parameter Definitions

dB

Decibel: a logarithmic scale applied to acoustic units such as sound pressure and sound power. Decibels are always the ratio between two numbers. Sound Pressure in Pascals becomes "Sound Pressure Level re $2x10^{-5}$ Pa" in decibels. Sound Power in watts becomes "Sound Power Level re 10^{-12} W" in decibels. It is also used for sound reduction or sound insulation and is the ratio of the amount of sound energy incident upon a partition and the proportion of that energy which passes through the partition. The result is stated as a "decibel reduction".

dB(A)

A- weighting: This is an electronic filter which attenuates sound levels at some frequencies relative to the sound levels at other frequencies. The weighting is designed to produce the relative response of a human ear to sound at different frequencies. The A-weighted sound level is therefore a measure of the subjective loudness of sound rather than physical amplitude. A- weighting is used extensively and is denoted by the subscript A as in L_{A10}, L_{Aeq} etc. (Levels given without the subscript A are linear sound levels without the A- weighting applied, e. g. L_{10}, L_{eq} etc.).

$L_{Aeq,T}$

The “A” weighted equivalent continuous sound pressure level. This may be thought of as the "average" sound level over a given time “T”. It is used for assessing noise from various sources: industrial and commercial premises, construction sites, railways and other intermittent noises.

$L_{A90,T}$

The “A” weighted sound pressure level that is exceeded for 90% of the time T. It reflects the quiet periods during that time and is often referred to as the "background noise level". It is used for setting noise emission limits for industrial and commercial premises.

L_{Amax}

The maximum "A" weighted sound pressure level during a given time on fast or slow response.

L_{pA}

The "A" weighted sound pressure Level. The sound pressure level is filtered through a standard frequency weighting known as A-weighting. This filter copies the frequency response of the human ear, so that the resulting sound level closely represents what people actually hear.

R

Is the sound reduction index of a construction element in octave or $^1/_3$ octaves and can only be measured in a laboratory. There must be no flanking transmission.

R'

Is the sound reduction index of a construction element in octave or $^1/_3$ octaves measured on site, and normally includes flanking transmission (ie where sound travels via paths other than straight through the element being tested, such as columns, ducts, along external walls, etc).

R_w

To get the weighted sound reduction index (R_w) of a construction, the R values are measured in octave or $^1/_3$ octave bands covering the range of 100Hz to 3150Hz. The curve is adjusted so that the unfavourable deviation (or shortfall of the actual measurements below this standard curve) averaged over all the octave or $^1/_3$ octave bands is not greater than 2dB. The value of the curve at 500Hz is the R_w.

R'_w

The apparent sound reduction index, which is determined in exactly the same way as the R_w but on site where there is likely to be some flanking transmission.

D

This is the "level difference". It is determined by placing a noise source in one room and measuring the noise levels in that room (the "source room") and an adjacent room (the "receiver room"). You calculate the level difference by simply deducting the "receiver " noise level (dB) from the "source" noise level (dB).

D_w

This is the weighted level difference. D is measured on site in octave or $^1/_3$ octave bands covering the range of 100Hz to 3150Hz. The D values are compared to a standard weighting curve. The curve is adjusted so that the "unfavourable deviation" (or shortfall of the actual measurements below this standard curve) averaged over all the octave or $^1/_3$ octave bands is not greater than 2dB. The D_w is then the value of the curve at 500Hz.

D_{nw}

This is the weighted normalised level difference. D is measured on site in octave or $^1/_3$ octave bands covering the range of 100Hz to 3150Hz. As the level difference is affected by the area of the common wall/ floor and the volume of the receiving room, as well as the amount of absorption in the receiving room, in the case of the $D_{nT,w}$, the results are "normalised" by a mathematical correction to $10m^2$ of absorption (D_n). The same weighting curve as for D_w is used to obtain the single figure: D_{nw}.

$D_{nT,w}$
This is the weighted standardised level difference. D is measured on site in octave or $^1/_3$ octave bands covering the range of 100Hz to 3150Hz. As the level difference is affected by the area of the common wall/ floor and the volume of the receiving room, as well as the amount of absorption in the receiving room, in the case of the $D_{nT,w,}$ the results are "standardised" by a mathematical correction a reverberation time, usually 0.5 seconds (D_{nT}). The same weighting curve as for D_w is used to obtain a single figure: $D_{nT,w}$.

$D_{nT(Tmf,\ max),w}$
This is the weighted BB93 standardised level difference corresponding to a Building Bulletin 93 reference value reverberation time in a receiving room. It is measured on site in accordance with BS EN ISO 140- 4: 1998.

$D_{n,c}$
Suspended ceiling normalised level difference. This is the sound level difference between two rooms, separated by a suspended ceiling, normalised to a reference value of absorption in the receiving room (10m² for the Laboratory as specified in ISO 140- 9 : 1985). It is measured in $^1/_3$ octave or octave frequency bands.

$D_{n,c,w}$
Weighted suspended ceiling normalised level difference. This is a single number quantity representing the sound reduction between two rooms separated a suspended ceiling. It is obtained by applying specified weightings to the $^1/_3$ octave band suspended ceiling normalised level differences in the frequency range 100Hz to 3150Hz.

C_{tr}
Spectrum adaptation term: Value, in decibels, to be added to a single- number rating (e. g. R_w) to take account of the characteristics of particular sound spectra. C_{tr} is calculated using an A- weighted urban traffic noise spectrum as defined in BS EN ISO 717- 1 : 1997.

NR
Stands for Noise Rating. (It is NOT noise reduction).
It is (e. g. NR30, NR35 etc.) a single number, which represents the sound level in a room and takes account of the frequency content of the noise. The lower the NR value, the quieter the room will be. It is mainly used for assessing noise from mechanical services systems. In leisure developments it is used as a standard for noise break- in to rooms from external noise sources such as traffic.

NC
stands for Noise Criteria. It is very similar to NR but (e.g. NC30, NC35 etc.) uses slightly different frequency weightings.

NRC
Stands for Noise Reduction Coefficient. The noise reduction coefficient of a material is the average, to the nearest multiple of 0.05, of the absorption coefficients at 250Hz, 500Hz, 1kHz and 2kHz.

α
Stands for Absorption Coefficient, which represents the proportion of incident sound energy arriving from all directions that is not reflected back into the room. It ranges between 0 and 1, where 0 is reflective and 1 is totally absorptive.

α_w
Stands for Weighted Absorption Coefficient. Single- number frequency dependent value which equals the value of the reference curve at 500Hz after shifting it as specified in EN ISO 11654 : 1997.

α_p
Stands for practical absorption factor. It is a frequency dependent value of sound absorption coefficient which is based on measurements in one- third- octave bands in accordance with ISO 354 and which is calculated in octave bands in accordance with EN ISO 11654 : 1997. It is the arithmetic mean of the three one-third- octave sound absorption coefficients within the octave being considered. The mean value is calculated to the second decimal place and rounded in steps of 0.05 up to a value of 1.0.

Class X
Stands for the Absorption Class between 250 and 4kHz, as defined by EN ISO 11654. Class A is the best classification representing the highest level of absorption, and Class E offers to lowest classification.

RT or T_{60}
Is Reverberation Time. It is a measure of the echoic nature of a room. It is normally measured in $^1/_3$ octave or $^1/_1$ octave bands by creating a loud noise and measuring the time it takes for that noise to decay by 60dB.

The longer the reverberation time, the more ‘echoey’ a room sounds. For dwellings, a reverberation time of 0.5 seconds or less is normal. Cinema auditoria will have reverberation times of 1.0 second or below when fitted out, but up to 9 seconds at shell completion. When designing acoustically sensitive areas such as concert halls or lecture theatres, it is necessary to design the room finishes to achieve optimum reverberation times. These will vary depending on the type of activity in the room and the room volume.

T_{mf}
Stands for the arithmetic average of the reverberation times in the 500Hz, 1kHz and 2kHz octave bands, for the type of receiving room, as defined in Building Bulletin 93.

$T_{mf,max}$
Stands for the maximum T_{mf} value in the range of reverberation time for the type of receiving room, as defined in Building Bulletin 93.

References

Building Bulletin 93 (BB93), Acoustic Design of Schools - A Design Guide, DfES

Health Technical Memorandum 2045 (HTM), Acoustics, NHS Estates, 1996

British Standard 8233, Sound Insulation and Noise Reduction for Buildings - Code of Practice, BSi, 1999

British Standard 4142, Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas, BSi, 1997

Noise Control at Work Regulations 2006 (Consultative Version), HSE, 2004

Approved Document E (2003 edition)

Building Regulations 2000

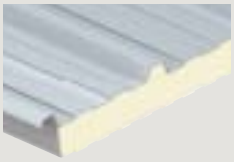
Further reading

Noise Control in Building Services, Sound Research Laboratories, 1998, ISBN 0- 08- 034067- 9

Kingspan Insulated Roof, Wall & Facade Systems

Roof Systems

KS1000 RW
Trapezoidal



KS1000 SF
Secret Fix



KS1000 TS
Tile Support



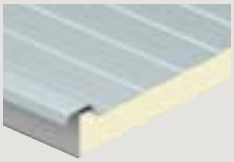
KS500/1000 ZIP
KingZIP®



KS1000 LP
Lo-pitch



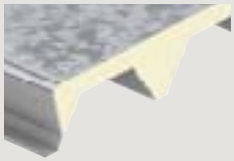
KS1000 CR
Curved



KS1000 RT
Roof Tile



KS1000 XD
X-dek®



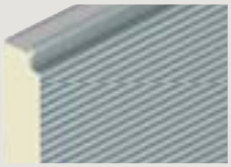
renders for LP and CR being amended at moment

Wall & Facade Systems

KS600, 900 & 1000
Optimo™



KS600, 900 & 1000 MR
Micro-Rib



KS600, 900 & 1000 EB
Euro-Box



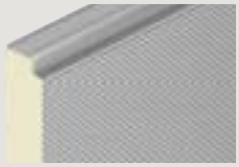
KS600, 900 & 1000 FL-S
Flat (Stucco)



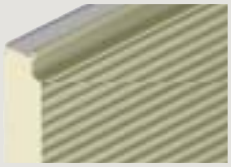
KS1000 MR
Facade System



KS600, 900 & 1000 MM
Mini-Micro



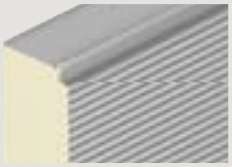
KS600, 900 & 1000 CX
Convex



KS600, 900 & 1000 WV
Wave



KS600, 900 & 1000 LS
LongSpan



KS1000 RW
Trapezoidal



Controlled Environment Systems

KS1100 CS-Rib



KS1100 CS-FL



KS1100 CS-MR



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Appendix D Primary Crusher Noise Survey

Noise Impact Assessment

Hemerdon Mine

Drakelands Restoration Ltd

SLR Project No.: 403.066596.00001

11 September 2026

Memorandum

To:	Alex Dawson	At:	Wolf Minerals (UK) Ltd.
From:	Trevor Olver	At:	SLR Consulting Ltd.
Date:	19th June 2018	Ref:	422.01939.00070.M01
Subject:	***CRUSHER***		

Due to operational issues, Wolf Minerals (UK) Ltd. (Wolf) are currently investigating a number of alternative crushers to replace the primary crusher at the Drakelands Mine. Surveys have been undertaken by Wolf employees at other sites of operational crushers to ascertain noise levels.

The data from the surveys has been analysed to determine sound power levels of the plant and the noise model previously produced for the site has been utilised to predict the resultant noise level at the nearest noise-sensitive receptor, namely Birchland Farm.

The results of the predictions have been compared to the noise limits detailed in the planning conditions for the site.

1.0 NOISE LIMITS

An updated planning permission for the mine was granted in February 2017 (ref: 9/42/49/0542/85/3). This planning permission has a number of conditions relating to noise. Condition 5 details noise limits that would be applicable to the proposed operation.

"5. Noise levels arising from the development shall not exceed the following limits at any noise sensitive property:

(i) Between the hours of 0700 and 1900 (daytime) Monday to Saturday 50 dBLAeq. 1 hour free field;

(ii) Between the hours of 1900 and 2200 (evening) Monday to Saturday 45dBLAeq. 1 hour free field;

(iii) Between the hours of 2200 and 0700 (night-time) 42 dBLAeq. 1 hour free field;

(iv) Between 0700 and 2200 on Sunday or on any Bank or Public Holiday (as defined by Condition 4) 45 dBLAeq. 1 hour free field.

The limits stated above, apply when measured on a Type 1 sound level meter sited at least 3.5 metres from any reflective surface (other than the ground) and 1.2 – 1.5m above the ground, in the garden amenity space of any lawfully existing residential premises.

Irrespective of the noise limits specified above the applicant should take all reasonable steps to minimise noise from the site especially noise containing significant tonal elements or peak and impulsive noise. Steps to reduce noise of this nature should be detailed in the noise management mitigation and monitoring scheme required by condition 6 below.

REASON: In the interests of controlling and limiting the effects on the local environment and community, and to comply with policies of the Development Plan: in particular policy MP41 of the Devon County Minerals Local Plan and Policy M23 of the adoption version of the Devon Minerals Plan."

2.0 NOISE SOURCE LEVELS

The results of the monitoring exercise undertaken by Wolf employees have been analysed to determine a worst-case sound power level for each of the crushers surveyed. The sound power levels used in the model are subsequently detailed in Table 1.

Table 1
Sound Power Levels

Plant	Noise Level, dB(A)
Finlay 1420	122
Metso LT305	119
Unkown Model at Goonvean	121

The octave band frequency data from the associated measurement has been obtained.

3.0 PREDICTED NOISE LEVELS

Predictions have been undertaken to determine the noise levels as a result of the operation of the crushers detailed in Table 1.

The octave band frequency data measured during the survey has been used in the model and adjusted to the overall sound power level.

Predictions have been undertaken for four proposed locations of the crusher as shown in Figure 1.

Figure 1
Proposed Crusher Locations



The results of the predictions are presented in Table 2.

Table 2
Predicted Results

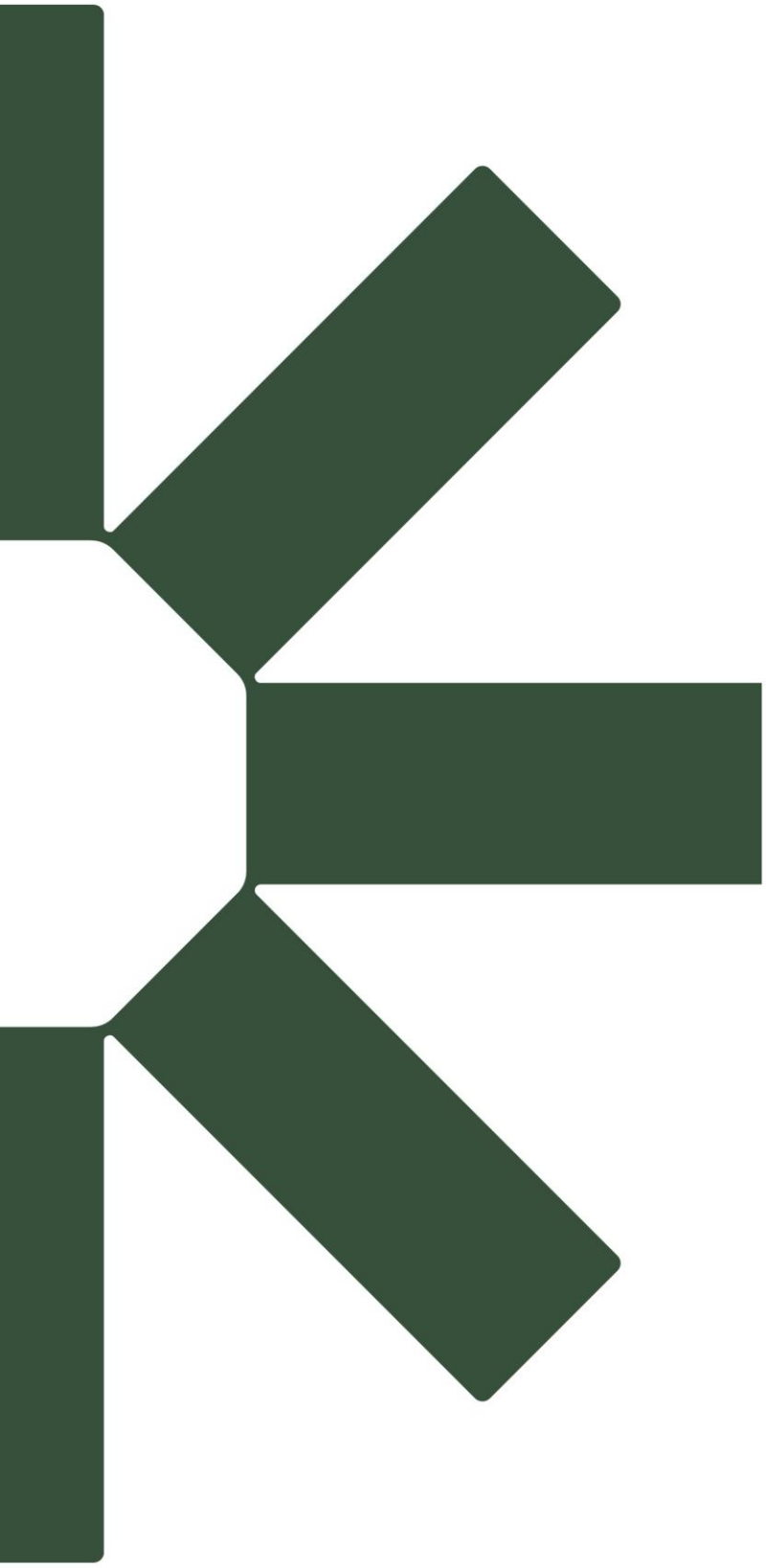
Plant	Location	Predicted Noise Level, dB $L_{Aeq,\,T}$ at Birchland Farm
Finlay 1420	1	33.3
	2	30.7
	3	31.2
	4	34.8
Metso LT305	1	30.9
	2	28.2
	3	28.8
	4	32.3
Goonvean	1	33.1
	2	30.5
	3	31.0
	4	34.5

As can be seen from the above table, noise levels during the operation of the crusher in isolation is significantly below the most restrictive noise limit, i.e. night-time, at the nearest noise-sensitive receptor; Birchland Farm

For the above predicted noise levels to elevate the noise from site operations above the night-time noise limit existing operations would need to result in a noise level of in excess of 41dB at Birchland Farm. On the basis of compliance monitoring undertaken at Birchland Farm it is considered that existing site operations are significantly below this level.

Notwithstanding the above, the acoustic character of the crushing activity should be taken in to consideration including tonal and impulsive noise. The available data does not indicate a tonal element but the perception of impulsive noise at the nearest noise-sensitive receptor is not known.

It is understood that a trial would be undertaken prior to permanent installation which provides an opportunity to investigate noise levels as well as audibility of the activity.



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