

Noise Impact Assessment for Planning Purposes as per BS 4142:2014

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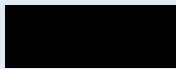
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BRIEF FOR CONSULTANCY:

This report has been prepared by Acoustics & Noise Limited, Newport, South Wales, for iPlan Architecture Ltd, 11 Ffordd Y Meillion, Machynys, Llanelli, SA15 2EX under the instruction of Carl Quick.

Purchase Order No:

OBJECTIVES:

To investigate the sound levels being experienced at a proposed residential development at Nant y Cafn, Seven Sisters, Neath, SA10 9ES and to carry out an assessment of the potential for an adverse noise impact from summer operations at an existing factory as per BS 4142:2014 + A1:2019 [11].

To investigate and report on potential solutions to mitigating the noise, if required.

NON-TECHNICAL SUMMARY:

It is proposed to develop a small parcel of land at the junction of Dulais Road and Nant y Cafn Business Park, Seven Sisters for residential purposes comprising five single-storey bungalows. The primary sound sources at the site are identified as road traffic plus occasional activities associated with the factory unit located 22m east of the site boundary.

A comprehensive noise impact assessment, ref: '2301002R01' [1] was carried out and submitted with planning application P2022/0902. The conclusions of the initial assessment indicate that, when assessed following the procedures detailed in TAN 11, the majority of the site is categorised as NEC 'A' and that '*noise need not be considered as a determining factor in granting planning permission*'.

At the time of the original noise survey, the factory was operating normally with all activities located within the factory building with the roller shutter doors closed. Observations at the time of the survey indicated that the irregular and intermittent sound emissions from the factory were barely perceptible at the survey location (centre of the development site) in comparison to the dominant road traffic sound emissions at that location. However, the local authority noted that during the warmer summer months, it is possible that doors and windows would remain open for cooling and ventilation purposes. This could potentially result in

increased operational factory sound levels which could adversely impact on the amenity of the proposed development.

This report details the results of a comprehensive assessment of the potential impact on the proposed residential development in cooperation with the Local Authority who liaised with the factory management to arrange a suitable operational activity schedule that is representative of typical summer conditions.

The results of this assessment indicate that during the '*summer months*', activities associated with the factory will have a low impact at the proposed residential development and an adverse impact does not occur when assessed following the procedures of BS 4142:2014. Desirable internal ambient noise levels are attainable within the most exposed dwelling and no specific mitigation is recommended.

The conclusions of both the original TAN 11 assessment and the additional assessment presented in this report indicate that noise need not be considered as a determining factor in granting planning permission and that the site is assessed as being suitable for residential development from a noise perspective.

1.0 DESCRIPTION OF SITE

- 1.1 The site is located at Nant y Cafn, Seven Sisters, Neath, SA10 9ES and is currently a vacant plot of unused land.
- 1.2 The site is located in a mixed commercial/residential area and is bounded by the A4109 at the western boundary. A uPVC glazing manufacturer operates from a small factory unit to the east of the site.
- 1.3 The acoustic climate at the site is characterised by road traffic with intermittent activity from the factory.
- 1.4 A satellite view of the site is presented in Appendix 2.

2.0 DISCUSSION

- 2.1 It is proposed to develop a small parcel of land at the junction of Dulais Road and Nant y Cafn Business Park, Seven Sisters for residential purposes comprising five single-storey bungalows. The primary sound sources at the site are identified as road traffic plus occasional activities associated with the factory unit located 22m east of the site boundary.
- 2.2 A comprehensive noise impact assessment, ref: '2301002R01' [2] was carried out and submitted with planning application P2022/0902. At the time of the noise survey, the factory was operating normally with all activities located within the factory building with the roller shutter doors closed. Observations at the time of the survey indicated that the irregular and intermittent sound emissions from the factory were barely perceptible at the survey location (centre of the development site) in comparison to the dominant road traffic sound emissions at that location.
- 2.3 The conclusions of the initial assessment indicate that, when assessed following the procedures detailed in TAN 11, the majority of the site is categorised as NEC 'A' with a small area along the western extent of the site encroaching into NEC 'B'.
- 2.4 Following a review of the noise impact assessment submitted with the application, Neath Port Talbot County Borough Council (NPTCBC) requested further information with regard to the summer operations at the factory. The original survey took place during the winter month of January when the factory was operating with all doors and windows closed to minimise heat loss from the building. However, NPTCBC noted that during the warmer summer months, it is possible that doors and windows would remain open for cooling and ventilation purposes.
- 2.5 To assess the likelihood of an adverse impact under the above 'summer' conditions, NPTCBC have requested a follow-up noise survey and assessment to be carried out during the warmer summer months.
- 2.6 Acoustics and Noise Ltd were engaged by iPlan Architecture Ltd to undertake the follow-up noise impact assessment in cooperation with the Local Authority who will be liaising with the factory management to arrange a suitable operational activity

schedule that is representative of typical summer conditions to the satisfaction of NPTCBC.

3.0 DETERMINATION OF SOUND LEVELS

- 3.1 The proposed residential development is located 30m west of an existing and long-established uPVC glazing manufacturing facility.
- 3.2 Activities at the factory have the potential to cause an adverse noise impact at the proposed development, particularly when the roller shutter doors remain open for cooling purposes.
- 3.3 The primary sound sources associated with the factory operations are presented in Table 1 below.

Table 1 – Primary Sound Sources

Sound Source	Distance to Receptor (m)	Comment
Factory workshop emissions	55	Sound emissions through the open roller shutter door on the north elevation of the factory building.
Forklift reversing alarm	55	Operates on the external factory yard to the north of the building. Only operates at the time of a delivery which occur once a week. Forklift movements last for 30 minutes during each delivery. Reversing alarm occurs at the start of a reversing movement and does not continue throughout the movement.
Wall terminated air extraction vent	45	Intermittent operations on demand. Vent is located at a height of 2m.

- 3.4 For the purposes of this assessment, the specific sound level to be assessed is the cumulative sound level from all operations calculated at the assessment location. To enable a robust assessment, it is assumed that the extract fan is operating continuously throughout the reference time period.
- 3.5 The acoustic climate at the assessment location is dominated by road traffic noise and it was not possible to determine the specific sound level as a discrete entity, distinct and free of other influences. Where it is impossible to carry out measurements because of high residual sound levels, BS 4142 [2] recommends that

measurements should be taken closer to the source and then use a calculation method to estimate the specific sound level at the assessment location.

- 3.6 In this case, measurements were carried out close to the individual sound sources and a 3D sound propagation model was utilised to calculate the cumulative specific sound level at the assessment location. The propagation calculations follow the procedures and methods detailed in ISO 9613 [10].
- 3.7 Full details of the relevant surveys are presented in Appendix 1 with the results detailed in Appendix 3. Full details of the 3D modelling are presented in Appendix 6 with the relevant results presented in Appendix 7.
- 3.8 A summary of the calculated specific sound level is presented in Table 2 below.

Table 2 – Summary of Calculated Specific Sound Levels

Sound Source	Calculated Specific Sound Level $L_{Aeq,1hr}$ (dB)
Factory workshop emissions	11
Forklift reversing alarm	23
Wall terminated air extraction vent	18
Cumulative Specific Sound	25

3.9 REPRESENTATIVE BASELINE NOISE LEVELS

- 3.9.1 The results of the original TAN11 24-hour survey [2] were used to describe the acoustic environment at the proposed development site. The relevant data are presented in Appendix 3.
- 3.9.2 The baseline noise levels summarised in Table 3 below are to be used to inform this assessment.

Table 3 – Representative Baseline Noise Levels

Receptor	Daytime Ambient Sound Level $L_{Aeq,1hr}$ (dB)	Daytime Background Sound Level $L_{A90,1hr}$ (dB)
Plot 1	49	38

4.0 IMPACT ASSESSMENT

4.1 RELEVANT GUIDANCE

4.1.1 As a matter of best practice, this assessment has been undertaken with reference to relevant guidance on noise. Summary descriptions of the guidance is presented in Appendix 8.

4.2 IMPACT ASSESSMENT OF FACTORY OPERATIONS AS PER BS 4142 [11]

4.2.1 An assessment of the potential impact on the proposed residential development was carried out following the methods and procedures detailed in BS 4142 [11].

4.2.2 The British Standard outlines the methods and procedures for assessing the significance of sound of an industrial nature by considering the margin by which the rating level of the specific sound exceeds the background sound and the context in which the sound occurs.

4.2.3 Details of the method and the calculation of the rating level is presented in Appendix 5 with the result summarised in Table 4 below.

Table 4 – Summary of Calculated Rating Level

Receptor	Calculated Rating Level $L_{Ar,Tr}$ (dB)
Plot 1 External Amenity Area	34

4.2.4 An initial estimate of the impact of the specific sound is obtained by subtracting the representative background sound level from the rating level. Typically, the greater this difference, the greater the magnitude of the impact.

Table 5 – Summary of BS 4142 Impact Assessment

Source	Rating Level (dB)	Background Sound Level (dB)	Excess over Background (dB)	BS 4142 Assessment of Impact
Factory	34	38	-4	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.

- 4.2.5 An initial estimate of the impact of the specific sound indicates that the factory sound emissions have a low impact at the assessment location depending on the context.
- 4.2.6 When considering the specific sound in context, the dominant sound at the site is road traffic noise. With reference to the initial TAN11 assessment [2], the ambient sound level at the assessment position was 49 dB $L_{Aeq,1hr}$. The cumulative specific sound level from all factory sound sources is 25 dB $L_{Aeq,1hr}$.
- 4.2.7 This is considered to be very low and given that the ambient sound level is 24 dB in excess of the specific sound level, it is reasonable to conclude that the initial estimate of a low impact is robust.
- 4.3 **ASSESSMENT OF INTERNAL NOISE LEVELS AT PLOT 1**
- 4.3.1 The factory building provides partial acoustic screening from the sound sources when considering Plot 1. However, bedroom 2 is located at the northern extent of the dwelling with a window facing the factory. The screening from the factory is less effective at this location. The external sound levels at the bedroom window could potentially impact on the occupants of the dwelling.
- 4.3.2 The 3D model was updated with a receiver located at the bedroom window and set to calculate the external free-field sound levels at this location. Details of the modelling are presented in Appendix 6 with the results presented in Appendix 7.
- 4.4 A summary of the calculated external free-field sound level at the bedroom window is presented in Table 6 below.

Table 6 – Summary of Calculated External Free-field Sound Levels at Bedroom 2, Plot 1

Sound Source	Calculated Specific Sound Level $L_{Aeq,1hr}$ (dB)
Factory workshop emissions	35
Forklift reversing alarm	25
Wall terminated air extraction vent	18
Cumulative Free-Field Sound Level	36

- 4.4.1 Whenever possible, it is desirable to open the windows to provide background ventilation and when partially open windows are relied upon for background ventilation, the sound reduction of the façade is reduced to 15 dB [7].
- 4.4.2 The internal noise level in a room is calculated by subtracting the sound reduction performance of the external façade from the noise level outside the room.
- 4.4.3 If we assume that during the summer months, the window will be partially open to provide background ventilation, then the external sound level will be reduced by 15 dB.
- 4.4.4 The internal sound level attributed to the factory operations will therefore be $36 - 15 = 21 \text{ dB } L_{Aeq,1\text{hour}}$.
- 4.4.5 This is 14 dB below the guideline criteria for desirable internal daytime ambient sound levels within dwellings, as described in BS 8233 [6] and the WHO guidelines [7].
- 4.4.6 An adverse impact does not occur, and the site is considered suitable for residential development in accordance with national and local planning guidance.

5.0 CONCLUSIONS

- 5.1 It is proposed to develop a small parcel of land at the junction of Dulais Road and Nant y Cafn Business Park, Seven Sisters for residential purposes comprising five single-storey bungalows. The primary sound sources at the site are identified as road traffic plus occasional activities associated with the factory unit located 22m east of the site boundary.
- 5.2 A comprehensive noise impact assessment, ref: '2301002R01' [2] was carried out and submitted with planning application P2022/0902. The conclusions of the initial assessment indicate that, when assessed following the procedures detailed in TAN 11, the majority of the site is categorised as NEC 'A'. Observations at the time of the survey indicated that the irregular and intermittent sound emissions from the factory were barely perceptible at the survey location (centre of the development site) in comparison to the dominant road traffic sound emissions at that location.
- 5.3 Following a review of the noise impact assessment submitted with the application, Neath Port Talbot County Borough Council (NPTCBC) requested further information with regard to the summer operations at the factory. NPTCBC noted that during the warmer summer months, it is possible that factory doors and windows would remain open for cooling and ventilation purposes. This could potentially result in increased operational factory sound levels which could adversely impact on the amenity of the proposed development.
- 5.4 This report details the results of an assessment of the potential impact on the proposed residential development under the above 'summer' conditions, in cooperation with the Local Authority who liaised with the factory management to arrange a suitable operational activity schedule that is representative of typical summer conditions to the satisfaction of NPTCBC.
- 5.5 The results of this assessment indicate that during the 'summer months', activities associated with the factory will have a low impact at the proposed residential development and an adverse impact does not occur when assessed following the procedures of BS 4142 [11].

- 5.6 Desirable internal ambient noise levels are attainable within the most exposed dwelling and no specific mitigation is recommended.
- 5.7 The conclusions of both the original TAN 11 assessment and the additional assessment presented in this report indicate that noise need not be considered as a determining factor in granting planning permission and that the site is considered suitable for residential development.

P.A.T. 31/08/23
M.Sc., I.Eng., M.I.O.A.,
M.Inst.SCE., M.A.E.S.

Appendix 1 Survey Details

A1.0 SURVEY DETAILS

Factory Specific Sound Survey

- A1.1.1 The meter was calibrated at the start of the measurement procedure and checked after each set of measurements. No significant deviation i.e. > 0.5 dB was recorded.
- A1.1.2 The survey commenced at 11:30 hours on 16th August 2023.
- A1.1.3 Weather conditions: 40% cloud cover, 18°C, dry, occasional slight intermittent breezes $< 2.5 \text{ ms}^{-1}$.

Measurement Procedure:

- A1.2.1 The meter was located on a tripod at a height of 1.5m. The equipment was located 2m in front of the open factory roller shutter door.
- A1.2.2 The meter was adjusted to log and store $L_{Aeq,t}$ and third-octave frequency band $L_{Zeq,t}$ for the duration of the specific sound survey (see Table 8).
- A1.2.3 The acoustic environment during the survey was characterised by factory activities and intermittent operation of extract fan which terminated at the factory façade, 10m from the measurement position.

Extract Fan Specific Sound Survey

- A1.2.4 The meter was located on a tripod at a height of 1.5m. The equipment was located 1m in front of the extract vent at a 45° angle.
- A1.2.5 The meter was adjusted to log and store $L_{Aeq,t}$ and third-octave frequency band $L_{Zeq,t}$ for the duration of the survey.
- A1.2.6 The acoustic environment during the survey was characterised by the continuous operation of extract fan which terminated at the factory façade.

Background Sound Validation Survey

- A1.2.7 The meter was located on a tripod at a height of 1.5m. The equipment was located on the development site at the location of the most exposed dwelling (Plot 1).
- A1.2.8 The meter was adjusted to log and store $L_{Aeq,t}$ and $L_{A90,t}$ for the duration of the survey.

- A1.2.9 The acoustic environment during the survey was characterised by road traffic noise from regular vehicle movements along the A4109. Noise emissions from the factory were irregular and infrequent during the survey and were only readily identifiable during lulls in the road traffic noise. In our opinion, the factory noise emissions did not materially affect the measurement of the background sound levels at the site.

Forklift Truck Reversing Survey

- A1.2.10 The meter was handheld at a distance of 1m from the rear of the forklift truck.
- A1.2.11 Measurements were collected during controlled manoeuvres of the vehicle on the delivery yard. The meter was held at a constant distance from the rear of the vehicle whilst following the vehicle.
- A1.2.12 During the survey, the acoustic climate was dominated by the gas-powered engine. The reversing alarms were only operational to announce the commencement of the reversing manoeuvre and not operating for the whole of the reversing movement.

A1.3 Equipment Used:

Table 7 – Equipment Used

ITEM	Serial No	UKAS Calibration Certificate Date (if applicable)
(ANL-M4) B&K 2250 Handheld Analyser	2567736	Certificate: 16159 Date: 09/03/23
(ANL-C4) B&K 4231 Calibrator	2567363	Certificate: 16157 Date: 07/03/23

Table 8 – Meter Details

Instrument:		2250
Application:		BZ7224 Version 4.7.6
Start Time:		08/16/2023 11:00:39
End Time:		08/16/2023 11:16:04
Elapsed Time:		00:15:25
Bandwidth:		1/3-octave
Max Input Level:		142.56
	Time	Frequency
Broadband (excl. Peak):	FSI	AZ
Broadband Peak:		A
Spectrum:	FS	Z
Instrument Serial Number:		2567736
Microphone Serial Number:		2560565
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field
Calibration Time:		08/16/2023 10:44:21
Calibration Type:		External reference
Sensitivity:		41.53 mV/Pa

Appendix 2 View of Measurement Position

A2.0 VIEW OF MEASUREMENT POSITION

Figure 1 – Measurement Position



Figure 2 – View of Equipment Location, Factory Noise Emissions



Appendix 3 Survey Results

A3.0 SURVEY RESULTS

Table 9 – Summary of Survey Results

	Start Time	Duration, t (hh:mm)	L _{Aeq,t} (dB)	L _{AF90,t} (dB)
Factory Emissions	11:30	00:30	71.5	60.2
Extraction Vent Emissions	12:03	00:33	74.9	74.3
Forklift Reversing	12:29	00:07	70.0	69.5
Background Sound Verification	11:00	00:15	46.0	39.5

Table 10 – Summary of Third-Octave-Band Sound Spectrum, L_{Zeq,t} (dB)

	63	125	250	500	1000	2000	4000	8000	Total
Factory Emissions	58.3	57.7	60.0	62.5	61.6	66.1	63.9	65.8	72.0
Extraction Vent Emissions	68.3	74.2	68.1	72.9	71.1	65.7	64.7	57.7	79.0
Forklift Reversing	89.3	74.0	69.4	68.3	62.1	58.1	57.0	53.5	89.5

Table 11 – Summary of Baseline Sound Levels, Daytime (07:00 – 23:00)

Period	Minimum L _{A90,15 mins} (dB)	Maximum L _{A90,15 mins} (dB)	Median Value L _{A90,15 mins} (dB)	Minimum L _{Aeq,15 mins} (dB)	Maximum L _{Aeq,15 mins} (dB)	Median Value L _{Aeq,15 mins} (dB)
Daytime Time (07:00 – 23:00)	33.4	42.5	38.1	37.9	54.3	49.4

* Extracted from initial assessment detailed in report '2301002R01' [2]

Appendix 4 Proposed Development Drawings

A4.0 PROPOSED DEVELOPMENT DRAWINGS

Figure 3 – Proposed Development Layout



Figure 4 – Floor Plan, Plot 1

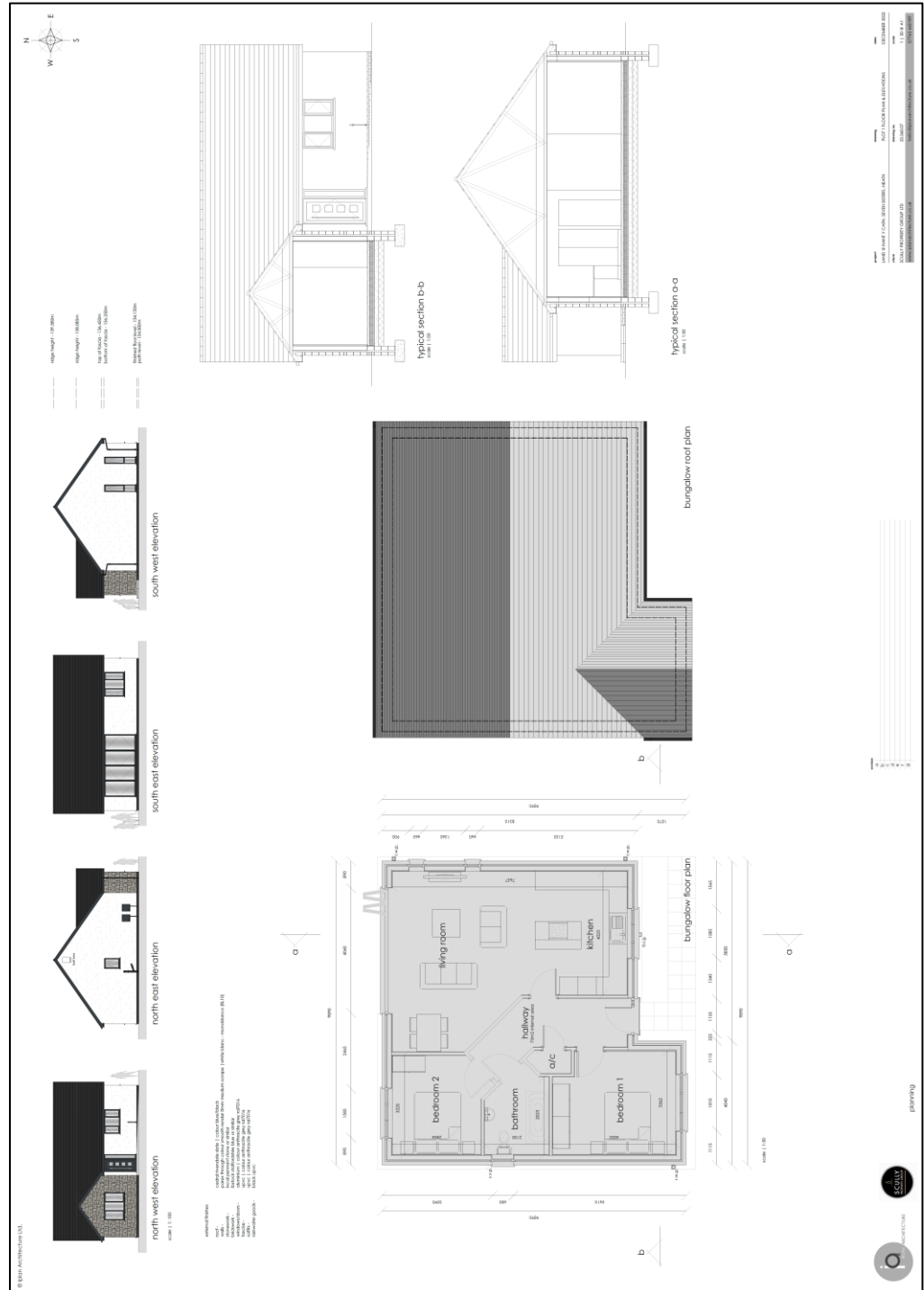


Figure 5 – Floor Plan, Plots 2 and 3

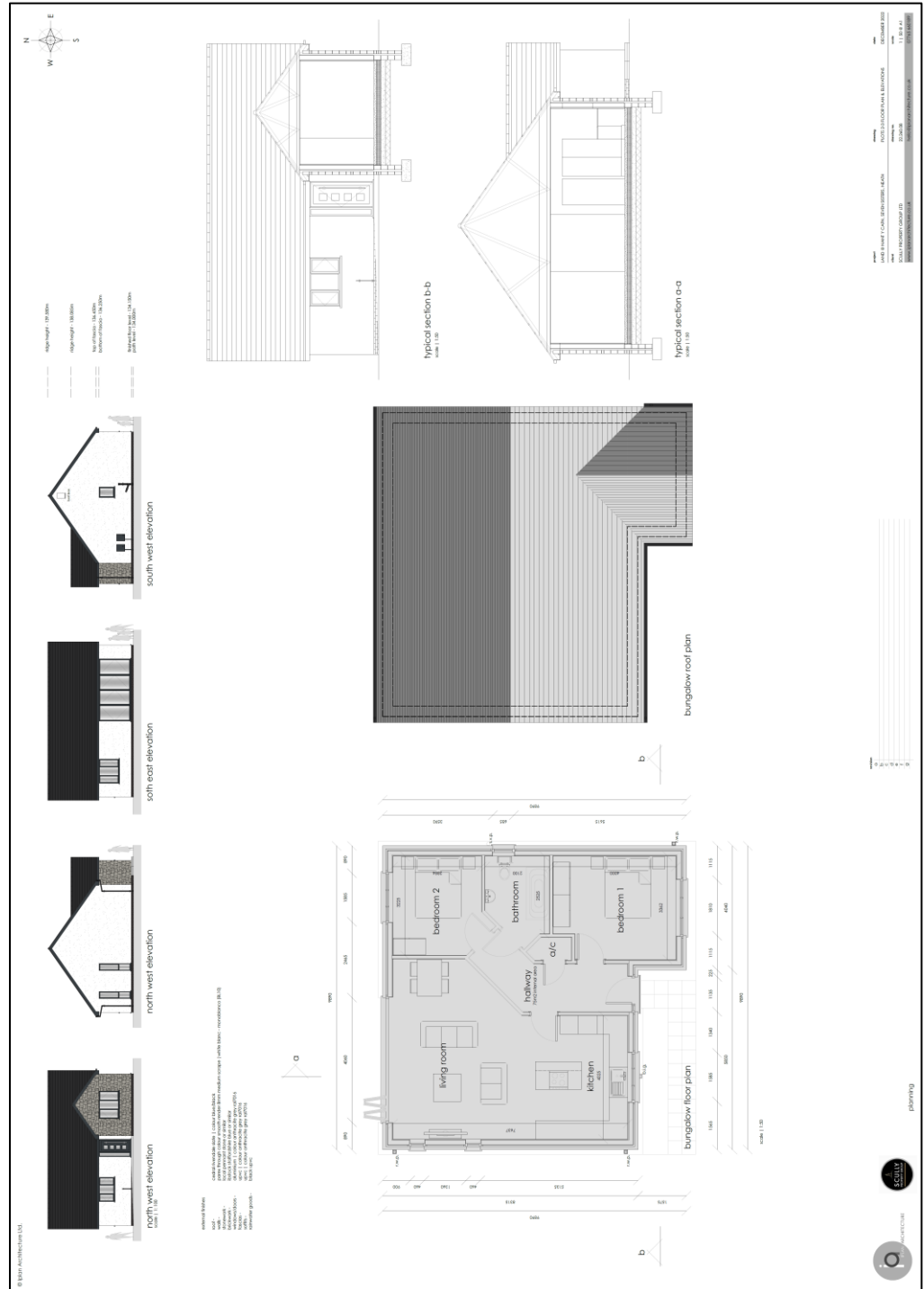


Figure 6 – Floor Plan, Plot 4

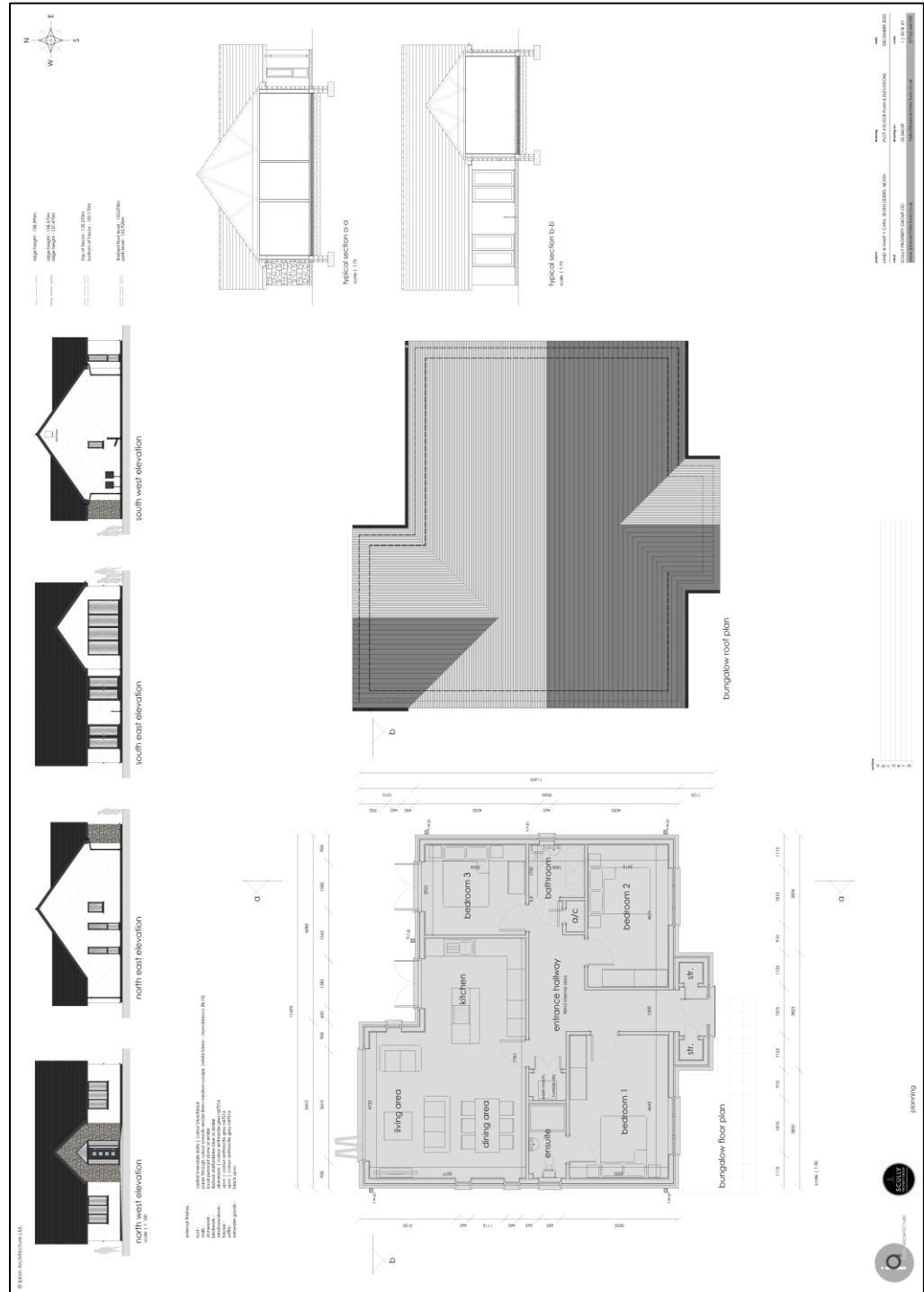
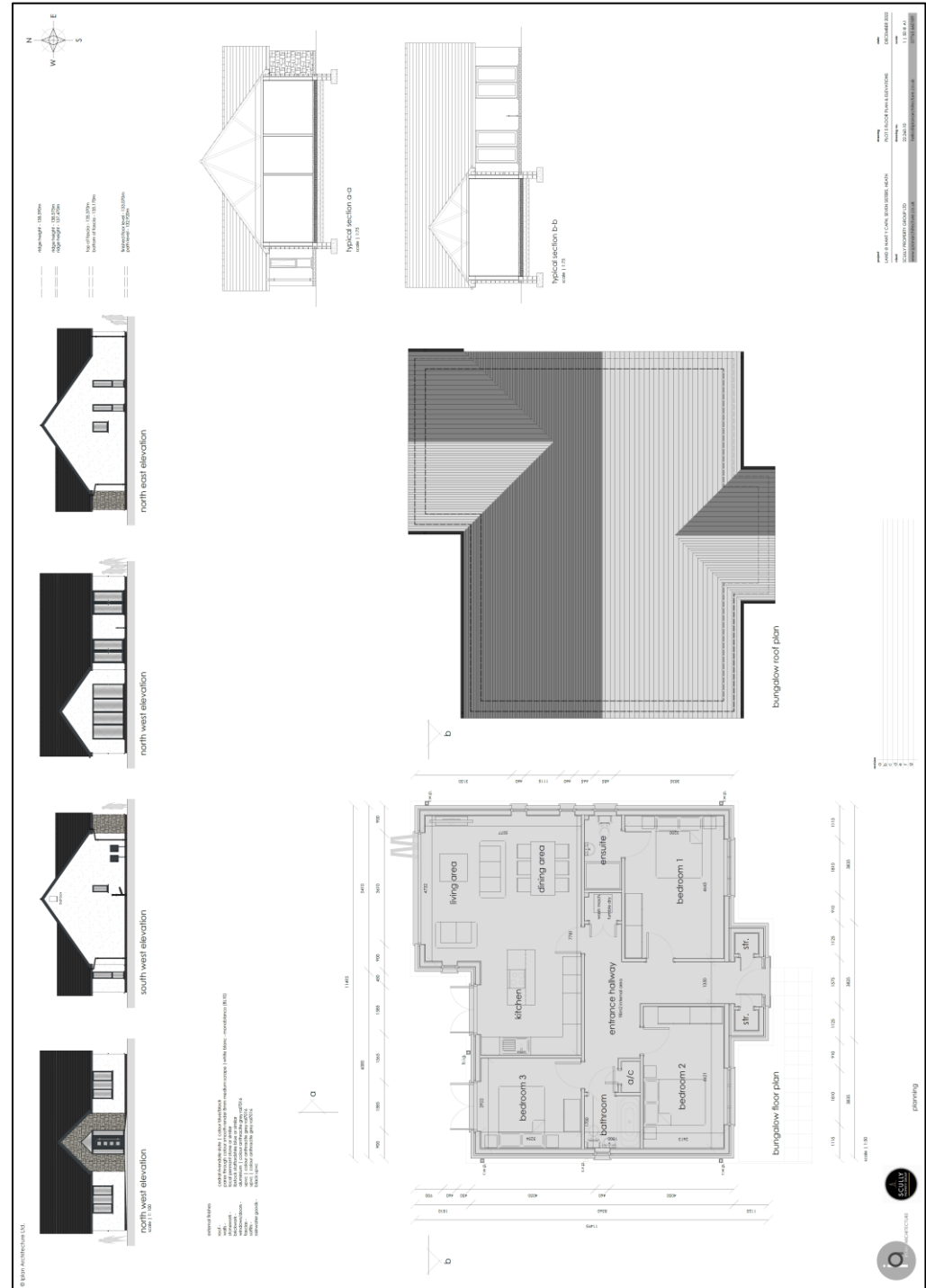


Figure 7 – Floor Plan, Plot 5



Appendix 5 Noise Rating Level as per BS 4142:2014

A5.0 NOISE RATING LEVEL AS PER BS 4142:2014

- A5.1 It is proposed to develop a small parcel of land at the junction of Dulais Road and Nant y Cafn Business Park, Seven Sisters for residential purposes comprising five single-storey bungalows. The primary sound sources at the site are identified as road traffic plus occasional activities associated with the factory unit located 22m east of the site boundary.
- A5.2 A comprehensive noise impact assessment, ref: '2301002R01' [2] was carried out and submitted with planning application P2022/0902. At the time of the noise survey, the factory was operating normally with all activities located within the factory building with the roller shutter doors closed. Observations at the time of the survey indicated that the irregular and intermittent sound emissions from the factory were barely perceptible at the survey location (centre of the development site) in comparison to the dominant road traffic sound emissions at that location.
- A5.3 Following a review of the noise impact assessment submitted with the application, Neath Port Talbot County Borough Council (NPTCBC) requested further information with regard to the summer operations at the factory. The original survey took place during the winter month of January when it is likely that the factory would operate with all doors and windows closed to minimise heat loss from the building. However, NPTCBC noted that during the warmer summer months, it is possible that roller shutter doors and windows would remain open for cooling and ventilation purposes.
- A5.4 With fans running and doors and windows to the factory building open, there is the potential for increased factory noise emissions which may result in an adverse or significant adverse impact at some or all of the proposed dwellings.
- A5.5 To assess the likelihood of an adverse impact under the above conditions, NPTCBC have requested a follow-up noise survey and assessment to be carried out during the warmer summer months.
- A5.6 Following extensive discussions with the local authority, an assessment procedure and methodology was agreed to enable the authority to make an informed decision

on the suitability of the proposed development and allow the planning process to continue with confidence.

A5.7 DESCRIPTION OF SPECIFIC SOUND SOURCES

A5.7.1 The primary sound sources included in this assessment are the intermittent use of tools such as a chop saw within the factory unit, an air extract system terminating at the northern façade of the factory building and the reversing alarms during the external operation of the single gas-powered forklift truck within the external yard.

A5.7.2 For the purposes of this assessment, the roller shutter door remained open, and the factory activities were arranged by the local authority with full cooperation from the factory management and staff.

A5.7.3 The extract system is operational intermittently on demand.

A5.7.4 The forklift truck is only in use during the limited delivery schedule. Deliveries occur no more than once a week and forklift operations typically last no more than 30 minutes for each delivery.

A5.7.5 For the specific forklift in operation at the factory, the reversing alarm only occurs at the start of the reversing operation for a short period. The alarm does not operate continuously during a reversing movement.

A5.8 ASSESSMENT LOCATION

A5.8.1 The 'assessment location' will often be in an external residential amenity area such as a garden or balcony although it may, by necessity, be representative of an exposed residential façade where no such external amenity exists. Assessment locations should reflect the actual usage of the residence or associated amenity area. This may mean that assessment locations are within the main amenity area but not necessarily at the boundary.

A5.8.2 Where internal impacts are the prime concern, the height and orientation of windows should be considered when measuring or otherwise deriving sound levels externally. Free-field equivalent levels should normally be cited and used in the assessment unless circumstances dictate otherwise.

- A5.8.3 This assessment considers Plot 1 to be most exposed to operational sound emissions from the factory operation. Plot 1 is located 55m west of the open roller shutter factory door.
- A5.8.4 With reference to the layout drawing for Plot 1 presented in Appendix 4, a defined patio/external amenity area is provided at the rear of the dwelling. For the purposes of this assessment, the primary assessment location is at the northern extent of the patio area.
- A5.9 **REFERENCE TIME INTERVAL**
- A5.9.1 The factory only operates during the daytime period.
- A5.9.2 The appropriate reference time period is 1 hour as defined in BS 4142 [11] and reflects the potential impact during the daytime period.
- A5.10 **SUITABILITY OF MEASUREMENT EQUIPMENT**
- A5.10.1 BS 4142 [11] gives guidance on the lowest limit to which the sound level can be measured. The requirement for the measurement equipment is that the measured sound levels are greater than 10 dB above the inherent noise level of the measuring system.
- A5.10.2 The meter used for the surveys was a BK 2250 which has a specified inherent noise level of 16.6 dB(A) which means that sound levels of equal to or greater than $16.6 + 10 = 27$ dB(A) will meet the above criteria.
- A5.10.3 The lowest recorded sound level during the survey was 46 dB $L_{Aeq,15 \text{ mins}}$. This comfortably exceeds the internal noise floor of the measurement equipment as described above.
- A5.11 **SPECIFIC SOUND LEVEL**
- A5.11.1 The specific sound level is normally determined from the measured ambient sound level at the assessment location. However, in this case, it was not possible to determine the specific sound level at the assessment location due to the dominant road traffic noise.
- A5.11.2 BS 4142 [11] states in paragraph 7.3.5 '*Where it is not possible to determine the specific sound level by measurement of the ambient sound level and the residual*

sound level at the assessment location(s) ... determine the specific sound level by a combination of measurement and calculation'.

- A5.11.3 BS 4142 notes that '*In some cases, measurements can be supplemented by calculations. Calculations are often more reliable than a single short-term measurement when long-term averages are to be determined and in other cases where it is impossible to carry out measurements because of high residual sound levels. In case of the latter, it is sometimes convenient to carry out the measurements closer to the source and then use a calculation method to estimate the specific sound level at the assessment location(s)*'.
- A5.11.4 For the purposes of this assessment, the specific sound level at the assessment location is determined by a combination of measurement and calculation. Sound pressure level measurements were carried out close to each of the primary sound sources as detailed in Appendix 1. The specific sound level at the assessment location was calculated using 3D acoustic modelling techniques as detailed in Appendix 6.
- A5.11.5 The specific sound level at the assessment location was calculated as 25 dB L_{Aeq,1hr}. The assessed specific sound comprises the sound emissions from the factory door, the continuous operation of the extract system and the reversing movements of the forklift.
- A5.11.6 This represents worst case with all sound sources occurring during the reference time period of 1 hour.
- A5.12 **REPRESENTATIVE BACKGROUND SOUND LEVEL**
- A5.12.1 Following discussions with the local authority, it was agreed that the representative background sound should be determined from the 24-hour survey carried out for the initial assessment as detailed in our report '2301002R01' [2].
- A5.12.2 To ensure the robustness of the original data, a second short term measurement was requested by the local authority to be used to validate the original survey data. This short-term measurement was conducted prior to the specific sound survey, at the location of the proposed location of Plot 1.
- A5.12.3 A summary of the relevant daytime survey data is provided in Appendix 3.

- A5.12.4 To determine a representative value for the sound levels measured during the daytime we need to describe the survey data in terms of a typical value. This is often described as a measure of '*central tendency*'.
- A5.12.5 The term '*central tendency*' refers to the "*middle*" value or perhaps a typical value of the data and is measured using the mean, median or mode.
- A5.13 **PREFERRED MEASURE OF CENTRAL TENDENCY**
- A5.13.1 When you have a normally distributed set of data you can legitimately use either the mean or the median as your measure of central tendency. In any symmetrical distribution the mean, median and mode are equal.
- A5.13.2 However, when the data is skewed the median is generally considered to be the best representation of the central location or typical value of the data. The more skewed the distribution the greater the difference between the median and the mean and the greater emphasis should be placed on using the median as opposed to the mean.
- A5.13.3 In our analysis of the original daytime survey data, we have used the median to determine the central tendency of the data and describe the representative noise levels at the survey location.
- A5.13.4 In this case the background sound levels over the daytime period (07:00 – 23:00) were within the range of 33 – 43 dB $L_{A90,15mins}$. The representative, or median, value for the daytime background sound level was determined to be 38 dB $L_{A90,15mins}$.
- A5.13.5 The results of the short-term validation measurement indicate a background sound level of 40 dB $L_{A90,15mins}$. This is comfortably within the range of background sound levels measured during the original survey and thus validates the use of the original data to describe the background sound level for this assessment.
- A5.14 **RESIDUAL SOUND LEVEL**
- A5.14.1 The specific sound levels are calculated, so the measurement of the residual sound level was not necessary.
- A5.15 **ACOUSTIC FEATURE CORRECTION**

- A5.15.1 At the time of the survey, the sound characteristics of the factory operations, when observed at the proposed location of Plot 1, were subjectively described as broadband, intermittent and impulsive in nature.

Tonality

- A5.15.2 There were no discernible tonal components during the operation of the factory and no tonal feature correction was applied to the specific sound.

Impulsivity

- A5.15.3 At the time of the measurement, the survey engineer subjectively described a 'clearly perceptible' impulsive component during the operations at the factory. Therefore, a 6dB acoustic feature correction was applied to the specific sound level to account for the 'clearly perceptible' impulsivity.

Intermittency

- A5.15.4 At the time of the measurement, the survey engineer subjectively described the operations at the factory as intermittent throughout the 1 hour reference time period with clearly identifiable on/off conditions and therefore, a 3dB acoustic feature correction was applied to the specific sound level.

A5.16 TOTAL ACOUSTIC FEATURE CORRECTIONS

- A5.16.1 To account for the acoustic features described above, a total correction of + 9 dB is applied to the specific sound level to determine the rating level.

A5.17 RATING LEVEL

- A5.17.1 BS 4142 [11] requires the acoustic corrections are added to the specific sound level to give the rating level, $L_{Ar,Tr}$, as summarised in Table 12 below.

Table 12 – Summary of Calculated Rating Levels

Sound Source	Specific Sound Level $L_{Aeq,1hr}$ (dB)	Acoustic Feature Correction (dB)	Rating Level $L_{Ar,Tr}$ (dB)
Factory Operations	25	+9	34

- A5.17.2 The rating level is then compared with the background sound level, by subtracting the background sound level from the rating level. and the significance of any impact is assessed as per BS 4142 [11].

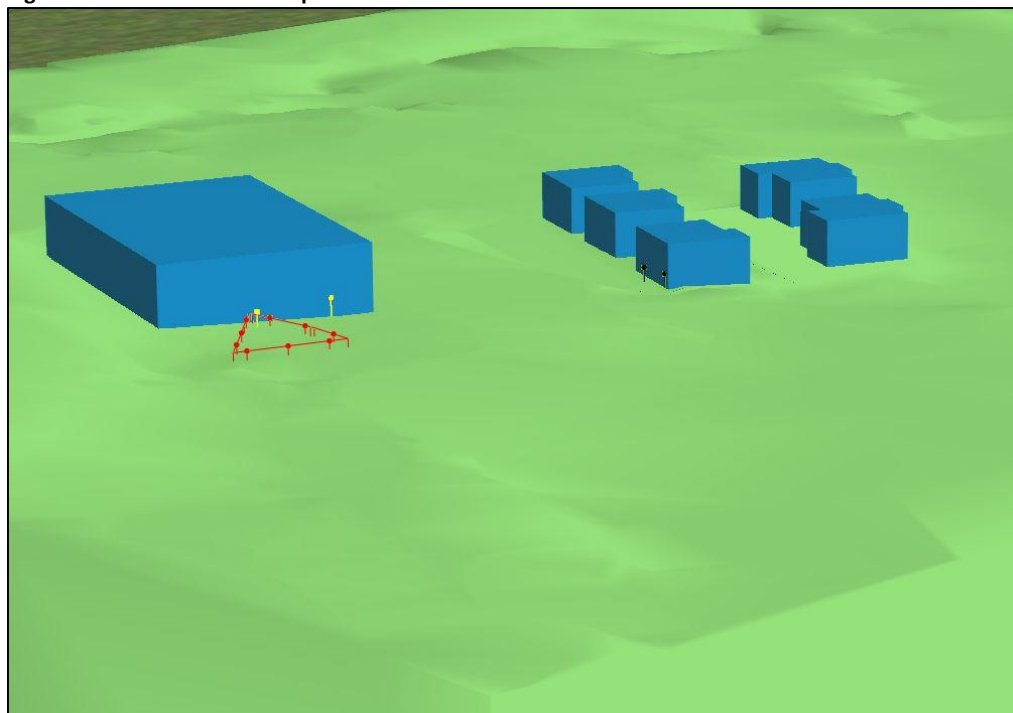
A5.18 UNCERTAINTY

- A5.18.1 There is a potential for uncertainty in how representative the measured background sound levels are due to the relatively short survey period. However, this uncertainty was minimised by undertaking the survey throughout a complete 16-hour daytime period and determining a representative value by statistical methods. The value was validated by undertaking a short term measurement on a different day.
- A5.18.2 The uncertainty due to atmospheric effects is minimal due to the short source receiver distance.
- A5.18.3 The measurement uncertainty was minimised by undertaking nearfield measurements of the sound sources and using 3D modelling to calculate the cumulative specific sound at the assessment location. All calculations adopt a worst-case approach.

Appendix 6 3D Acoustic Model Details

A6.0 3D ACOUSTIC MODEL DETAILS

Figure 8 - 3D View of Completed Acoustic Model



A6.1 ASSUMPTIONS MADE IN MODEL

A6.1.1 The noise emitting from a building is the sum of the internal noises all operating equally distributed between each face of the building. This will overestimate the noise emissions.

A6.1.2 The ground attenuation was modelled as hard with a ground factor value of 0.0.

A6.1.3 Atmospheric conditions were modelled as

- *Temperature: 283.15 K*
- *Pressure: 101.33*
- *Air Humidity: 70%*

A6.2 PREDICTION OF NOISE LEVELS ACROSS PROPOSED DEVELOPMENT SITE

A6.2.1 This assessment has utilised the 3D acoustic model constructed to inform the initial noise impact assessment. Full details of the modelling are presented in our report '2301002R01' [2] which was submitted with the planning application.

- A6.2.2 The model is updated with the results of the specific sound surveys detailed in Appendix 3.
- A6.3 **CAD MODEL PREDICTION**
- A6.3.1 This report assesses the sound emissions from the primary sound sources associated with the typical operations at the nearby factory. Nearfield measurements were taken to establish the factory sound emissions through the open roller shutter door, the emissions from a wall terminated extract vent and the emissions from the reversing alarms from the forklift truck.
- A6.3.2 The emissions through the factory roller shutter door are modelled by a substitute point source located at the measurement position. The emissions from the wall terminated vent are modelled as a point source located at a height of 2m, 0.1m from the façade of the building. The emissions from the forklift truck are modelled as a moving point source located within the delivery yard. Over the course of the reference time period of 1 hour, it is assumed that there are 20 reversing movements from the forklift truck.
- A6.3.3 Each of the proposed single storey residential properties will have habitable rooms located on the ground floor level only (see Appendix 4). The height of the ground floor receptor is modelled at 1.5m.
- A6.3.4 With reference to the proposed development layout, the most exposed dwelling is identified as Plot 1, at the north-east extent of the site.
- A6.3.5 An individual receptor is placed 0.1m in front of Plot 1, Bedroom 2 room and set to calculate the external free-field specific sound levels at each room. A second receiver is located at the northern extent of the proposed patio area for Plot 1 and set to calculate the external free-field specific noise levels.
- A6.3.6 A noise contour grid covering the whole site is also constructed to visually depict the external free field sound propagation across the whole development site. Each grid is a collection of receivers set 1m apart at a height of 1.5m.
- A6.3.7 Using EMS B&K Predictor V2019 software, calculations were made for each receiver using the defined sound source emissions as described above. Sound emission levels were calculated using the 1.5m high grid covering the proposed site.

A6.3.8 The results of the assessment are presented in the form of easily understood noise contour maps as shown in Appendix 7 with the receiver sound levels in tabulated form detailing the contribution from each of the sound sources.

A6.4 **NOISE CONTOUR MAPS**

A6.4.1 Colour coded noise contour maps are generated by the acoustic model to aid identification of the following:

- *External free-field noise levels across the proposed development (including buildings) at a height of 1.5m. Areas where the calculated rating level is at or below the representative background sound level are indicated in green for ease of identification. Note that where the calculated rating level is below the background sound level is a good indication of a low impact.*

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Appendix 7 Modelling Results

A7.0 MODELLING RESULTS

Figure 9 – External Free Field Sound Propagation, 1 hour Reference Time Period

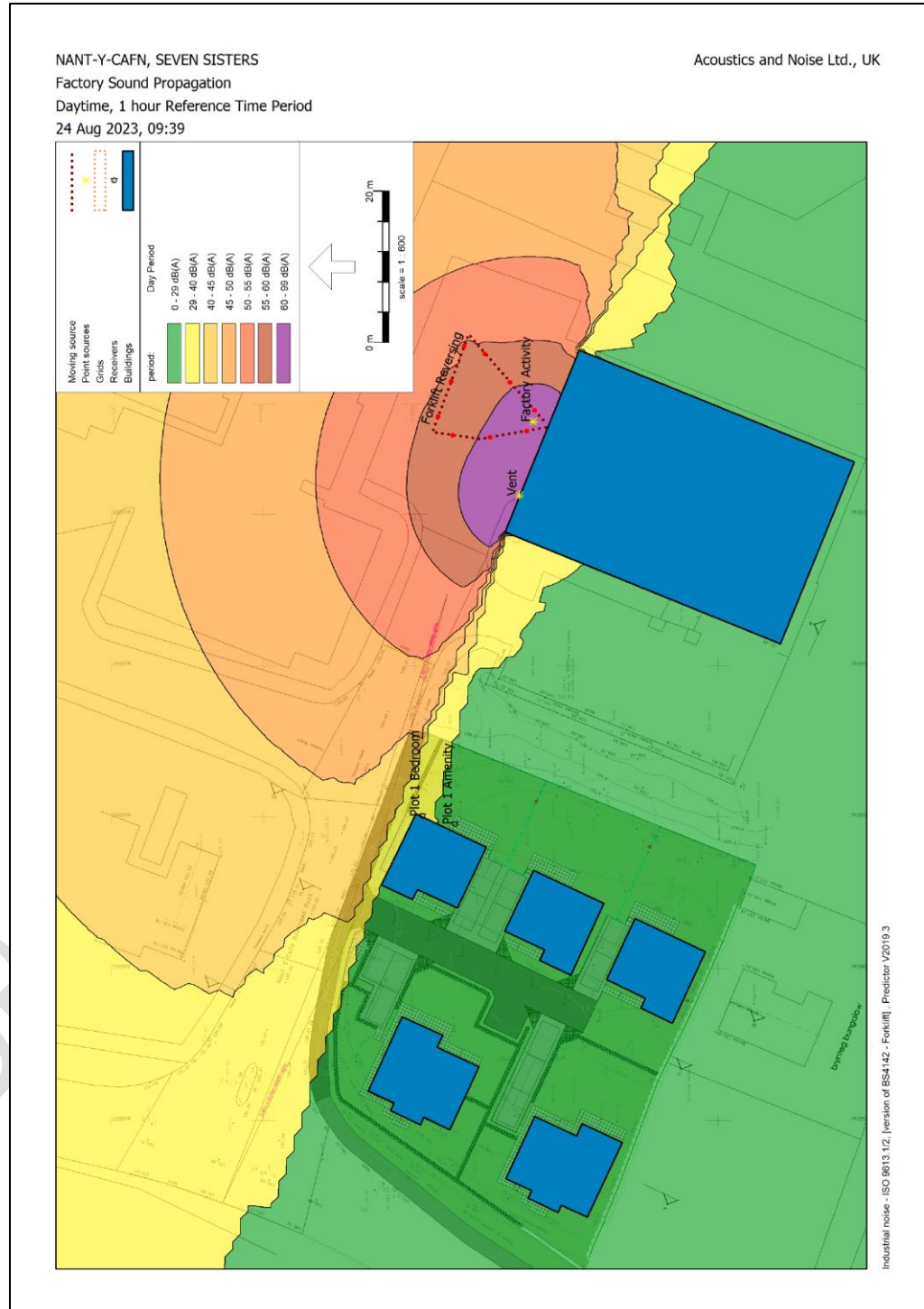


Table 13 – Calculated Specific Sound Levels at Receptors

Receptor	Factory Activity $L_{Aeq,1hr}$ (dB)	Forklift Reversing $L_{Aeq,1hr}$ (dB)	Vent $L_{Aeq,1hr}$ (dB)	Total $L_{Aeq,1hr}$ (dB)
Plot 1 Amenity	11.1	23.3	17.5	24.5
Plot 1 Bedroom	35.3	24.5	17.7	35.7

Appendix 8 Relevant Guidance

A8.0 RELEVANT GUIDANCE

A8.1 Planning Policy Wales [3]

- A8.1.1 The foreword to the Planning Policy Wales (PPW) document states that *'PPW will help to ensure that the planning decisions taken in Wales, no matter how big, or how small, are going to improve the lives of both our current and future generations. It will support changing the way we live and work, and the buildings and environment of Wales, today, building a better environment to accommodate current and future needs'*.
- A8.1.2 PPW sets out the land use planning policies of the Welsh Government. The primary objective is to ensure that the planning system contributes towards the delivery of sustainable development and improves the social, economic, environmental and cultural well-being of Wales. A well functioning planning system is fundamental for sustainable development and achieving sustainable places.
- A8.1.3 The planning system should create sustainable places (Placemaking) which are attractive, sociable, accessible, active, secure, welcoming, healthy and friendly. Development proposals should create the conditions to bring people together, making them want to live, work and play in areas with a sense of place and well-being, creating prosperity for all.
- A8.1.4 Placemaking in development decisions happens at all levels and involves considerations at a global scale, including climate change, down to the very local level, such as considering the amenity impact on neighbouring properties and people. Negative environmental impacts should be avoided in the wider public interest.
- A8.1.5 The environmental impact relevant to this assessment, will be from noise. PPW refers to the term *'soundscape'* which it describes as *'the acoustic environment as perceived or experienced and/or understood by a person or people, in context (ISO definition)'*.
- A8.1.6 An appropriate soundscape contributes to a positive experience of place as well as being necessary for public health, amenity and well-being. Conversely, noise pollution can have negative effects and should be reduced as far as possible.

- A8.1.7 Certain sounds, such as those created by trees, birds or water features, can contribute to a sense of tranquillity whilst others can be reassuring as a consequence of their association with the normality of everyday activities. Problematic forms of sound are generally experienced as noise pollution and can affect amenity and be prejudicial to health or a nuisance. Noise action plans drawn up by public bodies aim to prevent and reduce noise levels where necessary and preserve soundscape quality where it is good. Both high and low levels of noise, depending on context, can be annoying or disruptive and impact on amenity, health and well-being and as such should be protected through the planning process wherever necessary.
- A8.1.8 A key planning policy principle is to consider the effects which proposed developments may have on soundscape quality and the effects which existing soundscape quality may have on proposed developments. Soundscape influences the choice of location and distribution of development and it will be important to consider the relationship of proposed development to existing development and its surrounding area and its potential to exacerbate or create poor or inappropriate soundscapes.
- A8.1.9 The agent of change principle says that a business or person responsible for introducing a change is responsible for managing that change. In practice, for example, this means a developer would have to ensure that solutions to address noise from nearby pre-existing infrastructure, businesses or venues can be found and implemented as part of ensuring development is acceptable.
- A8.1.10 Proposed development should be designed wherever possible to prevent adverse effects to amenity, health and the environment but as a minimum to limit or constrain any effects that do occur.
- A8.2 **Noise and Soundscape Action Plan [4]**
- A8.2.1 This document sets out action plans for each of the three agglomerations in Wales. These are identified as the Cardiff and Penarth agglomeration, the Newport agglomeration and the Swansea and Neath agglomeration.
- A8.3 **ProPG: Planning & Noise [5]**

- A8.3.1 Even though ProPG has been written principally to assist with the planning process in England, PPW recommends that the good acoustic design principles put forward in Supplementary Document 2 may also be adopted in Wales.
- A8.3.2 A good acoustic design process takes a multi-faceted and integrated approach to achieve optimal acoustic conditions, both internally (inside noise-sensitive parts of the building(s)) and externally (in spaces to be used for amenity purposes).
- A8.3.3 Good acoustic design should provide the optimum acoustic outcome, without design compromises that will adversely affect living conditions and the quality of life of the inhabitants or other sustainable design objectives and requirements.
- A8.3.4 In requiring good acoustic design, there is a hierarchy of noise management measures that LPAs should encourage, including the following, in descending order of preference:
- *Maximising the spatial separation of noise source(s) and receptor(s).*
 - *Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.*
 - *Using existing topography and existing structures (that are likely to last the expected life of the noise-sensitive scheme) to screen the proposed development site from significant sources of noise.*
 - *Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.*
 - *Using the layout of the scheme to reduce noise propagation across the site.*
 - *Using the orientation of buildings to reduce the noise exposure of noise-sensitive rooms.*
 - *Using the building envelope to mitigate noise to acceptable levels.*
- A8.3.5 It is acknowledged that the inherent challenge of introducing noise-sensitive development in noisy locations can limit the extent to which good acoustic design can be achieved in harmony with the other factors that influence the overall quality of a scheme and that compromises may need to be made e.g. accepting that it may not always be possible to achieve acoustic standards with windows open or

accepting that noise levels in parts of the outdoor amenity areas may not be optimal.

- A8.3.6 Where the scheme relies on windows being closed to achieve good internal noise conditions, details should be provided why this approach has arisen and how the use of layout, orientation, spatial design and non-building envelope mitigation has been considered to minimise the need for reliance upon closed windows.
- A8.3.7 Where the LPA accepts that there is a justification that the internal target noise levels can only be practically achieved with windows closed, which may be the case in urban areas and at sites adjacent to transportation noise sources, special care must be taken to design the accommodation so that it provides good standards of acoustics, ventilation and thermal comfort without unduly compromising other aspects of the living environment. Furthermore, in this scenario the internal L_{Aeq} target noise levels should not generally be exceeded.
- A8.3.8 A good acoustic design will be one that continues to minimise noise impacts and to avoid significant noise effects for the lifetime of the development or as long as is practicable taking into account other economic, environmental and social impacts. Ideally new development should also help to mitigate any existing adverse impacts elsewhere, for example by acting as a barrier between noisy infrastructure and any existing noise-sensitive uses that do not benefit from incorporated mitigation.
- A8.4 **BS 8233 - Guidance on Sound Insulation and Noise Reduction for Buildings [6]**
- A8.4.1 For many common situations, BS 8233 suggests criteria, such as suitable sleeping/resting conditions, and proposes noise levels that normally satisfy these criteria for most people.
- A8.4.2 The foreword advises that the information detailed in BS 8233 “...takes the form of guidance and recommendations. It should not be quoted as it were a specification or a code of practice and claims of compliance cannot be made to it.”.
- A8.4.3 Section 7.7.2 details the guideline values for desirable internal ambient noise levels within dwelling houses, flats and rooms in residential use (when unoccupied) when such properties are exposed to steady external noise sources.

- A8.4.4 These guideline values range from 35 - 40 dB $L_{Aeq,16hrs}$ during the daytime period and 30 dB $L_{Aeq,8hrs}$ during the night time period as detailed in Table 14 below.

Table 14 – BS 8233 Internal Noise Level Guidelines

Activity	Location	07:00 – 23:00 hrs	23:00 – 07:00 hrs
Resting	Living Room	35 dB $L_{Aeq,16hrs}$	--
Dining	Dining room	40 dB $L_{Aeq,16hrs}$	--
Sleeping (Daytime Resting)	Bedroom	35 dB $L_{Aeq,16hrs}$	30 dB $L_{Aeq,8hrs}$

- A8.4.5 The guidelines also provide scope for relaxing these values by up to 5 dB and still achieve reasonable internal conditions.
- A8.4.6 The internal noise level in a room is calculated by subtracting the sound reduction performance of the external façade from the noise level outside the room.
- A8.4.7 It should be noted that the acoustic performance of the building envelope will be reduced, in the event windows are opened for ventilation or cooling purposes, to no more than 10 to 15 dB(A).
- A8.4.8 For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq,16hrs}$ with an upper guideline value of 55 dB $L_{Aeq,16hrs}$ which would be acceptable in noisier environments.
- A8.4.9 It is recognised that these guideline values may not be achievable in all circumstances where development might be desirable. In higher noise areas, a compromise between elevated noise levels and other factors such as the convenience of living in these locations or making efficient use of land resources to ensure development needs can be met, might be warranted. In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited.

- A8.4.10 The guideline values presented in BS8233, applies to external noise as it affects the internal acoustic environment from sources without a specific character such as road traffic noise.
- A8.4.11 BS 8233 provides both simple and detailed calculation methods for determining the internal ambient noise levels attributable to the external noise level. These methods are based on those given in BS EN 12354-3 [8].
- A8.4.12 The indoor sound pressure level is estimated from the measured or calculated outdoor sound pressure level by using the sound level difference of the façade.
- A8.4.13 The more rigorous calculation method described in BS 8233 uses octave band data to determine the internal noise level and is more appropriate where the external noise may exhibit specific characteristics.
- A8.5 **Guidelines for Community Noise, W.H.O. [7]**
- A8.5.1 Community noise (also called environmental noise, residential noise or domestic noise) is defined as noise emitted from all sources except noise at the industrial workplace. Main sources of community noise include road, rail and air traffic, industries, construction and public work, and the neighbourhood.
- A8.5.2 The objective of the World Health Organization (WHO) is '*the attainment by all peoples of the highest possible level of health*'.
- A8.5.3 WHO defines 'health' as '*A state of complete physical, mental and social well-being and not merely the absence of disease or infirmity*'. This broad definition of health makes reference to the concept of well-being and thereby includes noise impacts such as annoyance, speech interference, and impaired task performance as 'health' issues.
- A8.5.4 The WHO guidelines deal with all aspects of environmental noise impact and provide guideline values for community noise in specific environments. Most of the noise guidelines are given as period L_{Aeq} values. The relevant values for Dwellings are summarized in Table 15 below.

Table 15 – WHO Guideline Noise Levels for Dwellings

Residential Environment	Critical Health Effect(s)	$L_{Aeq,T}$ (dB)	Time Base, T
Outdoor Living Area	Serious Annoyance, daytime and evening	55	07:00 – 23:00 (16 hours)
	Moderate Annoyance, daytime and evening	50	07:00 – 23:00 (16 hours)
Dwelling, indoors	Speech intelligibility & moderate annoyance, daytime & evening	35	07:00 – 23:00 (16 hours)
Inside Bedrooms	Sleep disturbance, night-time	30	23:00 – 07:00 (8 hours)
Outside Bedrooms	Sleep disturbance, window open (outdoor values)	45	23:00 – 07:00 (8 hours)

- A8.5.5 These guideline values consider specific environments and identified health effects. Each value is set at the lowest levels that affect health such as annoyance and were derived from annoyance studies.
- A8.5.6 The guidelines, whilst not having any legal force in the UK, are commonly used by local authorities when setting environmental noise criteria for proposed developments.
- A8.5.7 In addition, the Guidelines also state that “...at night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB L_{Aeq} ... so that people may sleep with the windows open...the noise reduction from outside to inside with the windows partly open is 15dB”.
- A8.6 **BS EN 12354 Part 3, Airborne Sound Insulation against Outdoor Sound [8]**
- A8.6.1 This Standard specifies a calculation model to estimate the sound insulation or the sound pressure level difference of a façade or other external surface of a building. The calculation is based on the sound reduction index of the different elements from which the façade is constructed. Calculations can be carried out for frequency bands or single number ratings.

- A8.6.2 The results of the calculation can be used to determine the indoor sound pressure level due to external sound sources such as road traffic.
- A8.6.3 BS EN 12354 states that *'The sound level difference refers to a position 2m in front of the façade. If the calculated or measured outdoor sound pressure level refers to other positions or situations, the level at 2m in front of the façade should be deduced from it. It could, for instance, be deduced from the sound pressure level of the incident sound (without the building) by taking into account the façade reflection. For a plain façade this will result in a 3dB higher level, globally for all frequency bands'*.
- A8.6.4 The indoor A-weighted sound pressure level can be determined from calculation in frequency bands for the appropriate frequency range, applying the A-weighting.
- A8.6.5 Alternatively, the indoor A-weighted sound pressure level can be determined directly from the A-weighted outdoor sound pressure level, provided the level difference is expressed in a single number rating for the relevant outdoor sound spectrum in accordance with BS EN ISO 717-1 [9], i.e. applying the spectrum adaptation terms C_{tr} or C to describe the level difference as, for example, $R_w + C_{tr}$ when the outdoor sound is road traffic.
- A8.7 **ISO 9613 [10]**
- A8.7.1 Part 1 of this standard specifies an analytical method of calculating the attenuation of sound as a result of atmospheric absorption for a variety of meteorological conditions
- A8.7.2 Part 2 describes a 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 ISO 1996) under meteorological conditions.
- A8.8 **Objective Assessment using BS 4142 [11]**
- A8.9 **General guidance**
- A8.9.1 The Foreword to the standard states *"Response to sound can be subjective and is affected by many factors, both acoustic and non-acoustic. The significance of its*

impact, for example, can depend on such factors as the margin by which a sound exceeds the background sound level, its absolute level, time of day, and change in the acoustic environment, as well as local attitudes to the source of the sound and the character of the neighbourhood”.

A8.9.2 The scope of BS 4142 includes the following guidance “The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident”.

A8.9.3 It should be noted that exclusions to the use of the standard is carefully defined as follows

- *“The determination of noise amounting to a nuisance is beyond the scope of this British Standard “and that the*
- *“Sound of an industrial and/or commercial nature does not include sound from the passage of vehicles on public roads and railway systems” also*
- *“The standard is not intended to be applied to the derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels” and.*
- *“The standard is not applicable to the assessment of low frequency noise”*

Therefore, the consideration of any of the above is outside the scope of this report.

A8.9.4 The Scope of the standard goes on to state that:

“This standard is applicable to the determination of the following levels at outdoor locations:

- *Rating levels for sources of sound of an industrial and/or commercial nature; and*
- *Ambient, background, and residual levels*

For the purposes of:

- *Investigating complaints;*

- *Assessing sound from proposed, new, modified or additional sources(s) of sound of an industrial and/or commercial nature; and*
- *Assessing sound at a proposed new dwellings or premises used for residential purposes.”*

- A8.9.5 The unit of measurement usually used for measuring environmental sound is the A weighted decibel (dB). The “A weighting” is an internationally agreed frequency response, generally similar to that of the human ear, so that measured sound levels correspond reasonably well with what is heard.
- A8.9.6 In most situations, sound levels vary continuously, and it is customary to use a system of percentile values, which enable the noise climate to be described statistically. For example, the L_{A10} is the A-weighted noise level exceeded for 10% of a given time period and in the case of road traffic, for which it is widely used, it provides an indication of typical maximum levels. The L_{A90} , being the noise level exceeded for 90% of the time, represents the typical minimum noise level in an area and is often referred to as the background noise level.
- A8.9.7 Sometimes it is convenient to give a single figure summarising all the sound received by equating it to the equivalent continuous sound level L_{Aeq} in dB, which would contain the same sound energy as the actual fluctuating sound levels.
- A8.9.8 In general, sound is liable to provoke adverse comment whenever its level exceeds, by a certain margin, that of the pre-existing background sound level. Measurement locations are chosen that will give results that are representative of the ambient sound and residual sound at the assessment location(s).
- A8.9.9 Specific, ambient and background sound measurements are usually taken at a height of 1.2m to 1.5m above the ground and under similar conditions to the assessment location(s) and at least 3.5m from any other reflecting surface. Where this is not possible, calculated levels as per an accepted methodology e.g. BS 5288 or ISO 9613-2, can be used.
- A8.10 **Specific Sound Level**

- A8.10.1 The specific sound level in terms of L_{Aeq} , produced by the sound source under investigation, is determined at the assessment location(s) as a discrete entity, distinct and free of other influences contributing to the ambient sound.
- A8.11 **Reference Time Interval**
- A8.11.1 The specific sound level is evaluated over an appropriate reference time interval, T_r defined in the standard as:
- 1 hour during the daytime period (07:00 – 23:00 hours)
 - 15 minutes during the night time period (23:00 – 07:00 hours)
- A8.12 **Background Sound Level**
- A8.12.1 The background sound level is discussed in Clause 8.1 in BS 4142 as follows “*The background sound level is an underlying level of sound over a period, T, and might in part be an indication of relative quietness at a given location. It does not reflect the occurrence of transient and/or higher sound level events and is generally governed by continuous or semi-continuous sounds*”.
- A8.12.2 And “*...Since the intention is to determine a background sound level in the absence of the specific sound that is under consideration, it is necessary to understand that the background sound level can in some circumstances legitimately include industrial and/or commercial sounds that are present as separate to the specific sound*”.
- A8.12.3 BS 4142 gives guidance on the lowest limit to which the background sound level can be measured as follows “*Care is necessary in circumstances where background sound levels are low to ensure that self-generated and electrical noise within the measurement system does not unduly influence reported values, which might be the case if the measured background sound levels are less than 10 dB above the noise floor of the measuring system*”.
- A8.12.4 BS 4142 provides extensive guidance on assessing the representative background sound level advising that “*In practice, there is no “single” background sound level as this is a fluctuating parameter. However, the background sound level used for the assessment should be representative of the period being assessed*”.

- A8.12.5 When introducing a new noise-sensitive receptor to an area with extant industrial and/or commercial sound, BS 4142 notes that *'Where a new noise-sensitive receptor is introduced and there is extant industrial and/or commercial sound, it ought to be recognised that the industrial and/or commercial sound forms a component of the acoustic environment. In such circumstances other guidance and criteria in addition to or alternative to this standard can also inform the appropriateness of both introducing a new noise-sensitive receptor and the extent of required noise mitigation'*.
- A8.12.6 The scope of BS 4142 also states that *'The standard is not intended to be applied to derivation of indoor sound levels arising from sound levels outside, or the assessment of indoor sound levels'*.
- A8.12.7 In such circumstances it may be more appropriate to determine the indoor sound levels arising from sound levels outside by using the calculation methods detailed in BS 8233 [6].
- A8.12.8 The calculation methods used in BS 8233 [6] utilise octave-band spectrum data to calculate the internal sound levels by consideration of the sound insulation of the building envelope.
- A8.13 **Residual Sound Level**
- A8.13.1 The ambient sound level i.e., all sounds near and far measured without the specific sound level present is termed the residual level. If the residual level is close to the specific sound level, the specific sound level is corrected to account for the addition of the background sound to the specific sound level measured.
- A8.13.2 Where the ambient sound level and the measured specific sound level are within 10dB of each other, then the specific sound level is corrected as follows

$$L_S = 10 \lg \left(10^{\frac{L_A}{10}} - 10^{\frac{L_R}{10}} \right)$$

where:

L_S is the specific sound level;

L_A is the ambient sound level; and

L_R is the residual sound level.

A8.13.3 As per the guidance in BS 4142 “Where it is not possible to determine the specific sound level by measurement of the ambient sound level and the residual sound level at the assessment location(s), for example, because the difference between the ambient sound level and the residual sound level is >3 dB, determine the specific sound level by a combination of measurement and calculation. Report the method of calculation in detail and give the reason for using it”.

A8.14 Correction to Specific Sound for On-Time of Source

A8.14.1 If the specific sound is intermittent and either steady or cyclic and the on-time of the source is less than the reference time interval, then the specific sound level corrected for the effect of the residual level determined above is further corrected for the on-time using the correction term:

$$10 \lg \left(\frac{T_o}{T_r} \right)$$

where T_o is the on-time of the specific source
and T_r is the reference time period.

A8.15 Specific Sound Acoustic Features Corrections

A8.15.1 Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background level.

A8.15.2 If the source sound has a feature which makes it particularly noticeable, e.g., a tonal or impulsive characteristic, a character correction is added to the measured or calculated specific sound level to obtain the rating level in order to account for its more noticeable nature.

A8.15.3 BS 4142 specifies the following methods to assess this penalty

- *Subjective method;*
- *Objective method for tonality;*
- *Reference method.*

A8.16 Subjective method

- A8.16.1 Where appropriate, establish a rating penalty for sound based on a subjective assessment of its characteristics. This would also be appropriate where a new source cannot be measured because it is only proposed at that time, but the characteristics of similar sources can subjectively be assessed.
- A8.16.2 Guidance as to the application of the penalties is given as follows “*Where tonal and impulsive characteristics are present in the specific sound within the same reference period then these two corrections can both be taken into account. If one feature is dominant then it might be appropriate to apply a single correction. Where both features are likely to affect perception and response, the corrections ought normally to be added in a linear fashion*”.
- A8.16.3 BS 4142 specifies the following penalties for tones:
- 2 dB for a tone which is just perceptible at the noise receptor
 - 4 dB where it is clearly perceptible
 - 6 dB where it is highly perceptible
- A8.16.4 BS 4142 specifies the following penalties for impulsivity:
- 3 dB for impulsivity which is just perceptible at the noise receptor
 - 6 dB where it is clearly perceptible
 - 9 dB where it is highly perceptible
- A8.16.5 Where the specific sound features characteristics are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied.
- A8.16.6 Where the specific sound is intermittent and has identifiable on/off conditions that are “*readily distinctive against the residual acoustic environment*”, a penalty of 3 dB can be applied.
- A8.16.7 The maximum character corrections that could be applied to the specific sound level would be 18 dB for a specific sound that has both highly perceptible tonal and impulsive characteristics with identifiable on/off conditions.
- A8.17 **Rating Level**

A8.17.1 The correction for any acoustic features present in the sound source is added to the specific sound level to give the rating level $L_{Ar,Tr}$ which is then compared with the background sound level, $L_{A90,T}$, by subtracting the background sound level from the rating level and the significance of impact is assessed.

A8.18 **Uncertainty**

A8.18.1 Consideration should be given to the level of uncertainty in the data and associated calculations. Where the level of uncertainty could affect the conclusion, any assessment should take reasonably practicable steps to reduce the level of uncertainty.

A8.19 **Assessment of Impacts**

A8.19.1 The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs.

A8.19.2 An initial estimate of the impact of the specific sound is normally obtained by subtracting the measured background sound level from the rating level and using the magnitude of this difference to assess the magnitude of impact as summarised in Table 16 below. Typically, the greater this difference, the greater the magnitude of the impact.

Table 16 – BS 4142 Impact Significance Criteria

Rating Level minus Background Sound Level	BS 4142 Significance of Impact
+10 dB	<i>A difference of around +10 dB or more is likely to be an indication of a significant adverse impact, depending on the context</i>
+5 dB	<i>A difference of around +5 dB or more is likely to be an indication of an adverse impact, depending on the context</i>
≤ 0 dB	<i>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 context.</i>

A8.19.3 Adverse impacts include, but are not limited to, annoyance and sleep disturbance.

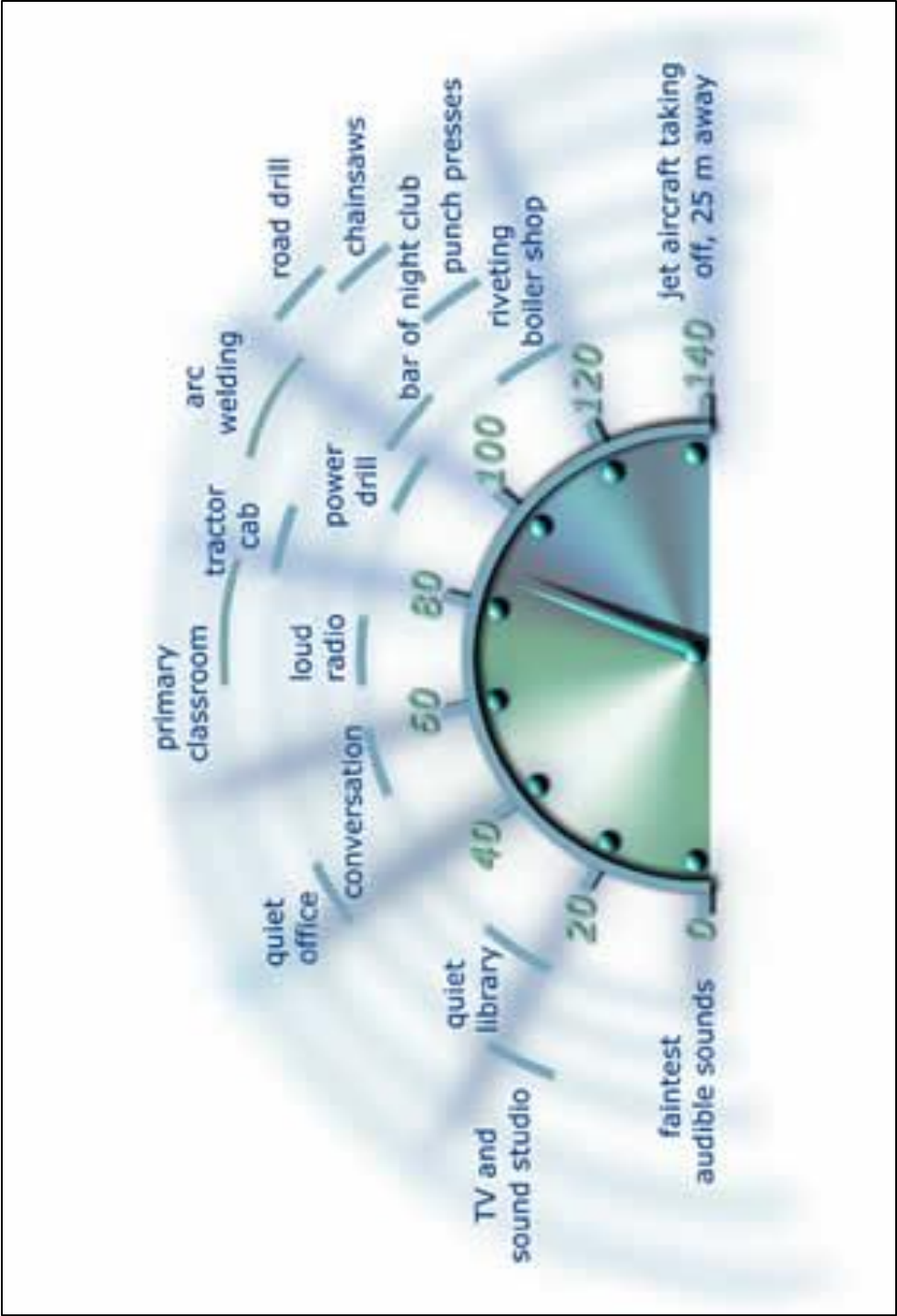
A8.19.4 It should be noted that not all adverse impacts will lead to complaints and not every complaint is proof of an adverse impact.

- A8.19.5 Following consideration of the context in which the specific sound occurs/will occur, it may be appropriate to modify the initial estimate of the impact.

Appendix 9 Range of Typical Sound Levels

A9.0 RANGE OF TYPICAL SOUND LEVELS

Figure 10 – Range of Typical Sound Levels



Appendix 10 Glossary of Acoustic Terms

A10.0 GLOSSARY OF ACOUSTIC TERMS

A10.1 Acoustic environment:

Sound from all sound sources as modified by the environment [BS ISO 12913-1:2013]

A10.2 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.

A10.3 Ambient sound level, $L_A = L_{Aeq,T}$:

The 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

NOTE the ambient sound level is a measure of the residual sound and the specific sound when present.

A10.4 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 time interval, T, measured using time weighting F and quoted to the nearest whole number of decibels

A10.5 Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$:

The value of the A-weighted sound pressure level in decibels of continuous steady sound that, within a specified time interval, $T = t_2 - t_1$, has the same mean-squared sound pressure as a sound that varies with time, and is given by the following equation:

$$L_{Aeq,T} = 10 \lg \left\{ \left(\frac{1}{T} \right) \int_{t_1}^{t_2} \left[\frac{p_A(t)^2}{p_0^2} \right] dt \right\}$$

where:

p_0 is the reference sound pressure (20 μ Pa); and

$p_A(t)$ is the instantaneous A-weighted sound pressure (P_A) at time t

NOTE The equivalent continuous A-weighted sound pressure level is quoted to the nearest whole number of decibels.

A10.6 Measurement time interval, T_m :

Total time over which measurements are taken

NOTE This may consist of the sum of a number of non-contiguous, short-term measurement time intervals.

A10.7 Rating level, L_{A,r,T_r} :

Specific sound level plus any adjustment for the characteristic features of the sound

A10.8 Reference time interval, T_r :

Specified interval over which the specific sound level is determined

NOTE this is 1 h during the day from 07:00 h to 23:00 h and a shorter period of 15 min at night from 23:00 h to 07:00 h.

A10.9 Residual sound:

Ambient sound remaining at the assessment location when the specific sound source is suppressed to such a degree that it does not contribute to the ambient sound

A10.10 Residual sound level, $L_r = L_{Aeq,T}$:

Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T

A10.11 Specific sound level, $L_s = L_{Aeq,T_r}$:

Equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, T_r

A10.12 Specific sound source:

Sound source being assessed

A10.13 A-weighting:

Normal hearing covers the frequency (pitch) range from about 20 Hz to 20,000 Hz but sensitivity is greatest between about 500 Hz and 5,000 Hz. The 'A-weighting' is an electrical circuit built into noise meters to approximate this characteristic of human hearing.

A10.14 Decibel (dB):

The logarithmic measure of sound level. 0dB (A) is the threshold of normal hearing. 140 dB (A) is the level at which instantaneous damage to hearing is caused. A change of 1 dB is detectable only under laboratory conditions.

A10.15 dB(A):

Decibels measured on a sound level meter incorporating a frequency weighting (A-weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB(A) broadly agree with an individual's assessment of loudness. A change of 3 dB (A) is the minimum perceptible under normal conditions and a change of 10 dB(A) corresponds roughly to doubling or halving the loudness of a sound.

A10.16 Free Field:

A sound field in which no significant sound reflections occur.

A10.17 L_{Amax}:

The maximum 'A-weighted' level of sound recorded during a sound event. The time weighting used (fast or Slow) should be stated.

A10.18 Tonality:

The degree to which a sound contains audible pure tones. Broadband sound (across a wider range of frequencies) is generally less annoying than sound with identifiable tones.

A10.19 Frequency:

The number of cycles per second of a vibration usually expressed in units of Hertz, Hz

A10.20

Hertz:

Unit of frequency, equal to one cycle per second. Frequency determines the pitch of a sound.

Appendix 11 References

A11.0 REFERENCES:

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