

Noise Impact Assessment for Planning Purposes

Job No: 2411073

Dated: 04 March 2025

Report Status: Final

Prepared for: FCHA
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Document Management					
Issue/Revision	First issue	Revision 1	Revision 2	Revision 3	Final
Job Number	2411073	2411073			2411073
Report Number	R01	R01			R01
Remarks	Draft	Revised Layout following feedback from LPA			Final
Issue Date	31 st January 2025	28 th February 2025			04 March 2025
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ANL File Reference	\\ACNOISED1\Shared Folders\Job Files\F - J\FCHA\Cadoxton\report\2411073R01.docx				

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BRIEF FOR CONSULTANCY:

This report has been prepared by Acoustics & Noise Limited, Newport, South Wales, for FCHA, 10 Village Way, Greenmeadow Springs, Cardiff, CF15 7NE under the instruction of Sian Bradley.

Purchase Order No:

OBJECTIVES:

To investigate the noise impact on a proposed residential development at Crown and Sceptre Car Park, Main Road, Cadoxton, SA10 8AP.

Where applicable recommend mitigation to meet the impact criteria.

NON-TECHNICAL SUMMARY:

It is proposed to develop the Crown and Sceptre Car Park, Main Road, Cadoxton, SA10 8AP for residential use comprising four flats. The site is in a semi-urban location, surrounded by residential properties with the acoustic climate characterised by road traffic noise.

Following constructive feedback from the local planning authority based on the results of a preliminary noise impact assessment, the initial development design was modified. First floor bedrooms were relocated to the rear of the building and four proposed heat pumps were removed from the scheme.

This report has assessed the potential noise impact on the proposed development site using 3D acoustic modelling and good acoustic design principles. Recommendations for noise mitigation are provided to ensure that desirable internal and external ambient noise conditions are attainable at all proposed residential units in accordance with local and national planning requirements.

The recommended mitigation requires that several of the glazing units are required to be in the closed position to effectively control noise ingress. These glazing units are identified in this report and are generally located to the front of the development overlooking the road traffic. Habitable rooms to the rear of the development can be effectively ventilated using openable windows whilst still achieving desirable internal sound levels within those rooms. No additional mitigation is recommended for these rooms.

The decision on whether the windows should be permanently closed is outside the scope of this assessment and our technical expertise. This decision should be taken by appropriate authorities.

For those habitable rooms identified as requiring mitigation, manufacturer's data should be used to confirm the recommended minimum sound reduction performance are achievable from any specified glazing units to these rooms, including any provision for background ventilation where applicable.

All habitable rooms subject to sound mitigation measures should be provided with an alternative, effective means of ventilation. Any ventilation scheme should satisfy the requirements of Approved Document F and provide the required ventilation rates. Specialist advice should be obtained to ensure that any ventilation scheme is suitable for purpose. It is important that any scheme is approved by Building Control and does not compromise the internal noise levels. Recommendations for suitable ventilation are outside the scope of this assessment and technical expertise.

1.0 DESCRIPTION OF SITE

- 1.1 The site is located at Crown and Sceptre Car Park, Main Road, Cadoxton, SA10 8AP and is currently used as a carpark associated with a nearby Public House.
- 1.2 The site is in a semi-urban location, surrounded by residential properties. The acoustic climate is characterised by road traffic noise.
- 1.3 A satellite view of the site is presented in Appendix 2.

2.0 DISCUSSION

- 2.1 In response to a planning application for the proposed development, Neath Port Talbot County Borough Council provided the following comments:

“There are a number of potential sources of noise, namely the existing pub across the road, the busy main road and the proposed air source heat pumps. We need to understand what the impact of the combined noise sources will be on the proposed development and in the case of the heat pumps on neighbouring residents. It is possible that mitigation will need to be designed into the development, and therefore we recommend that planning request a noise impact assessment prior to determination of this application”.

- 2.2 Acoustics and Noise Ltd were engaged by FCHA to undertake a noise impact assessment for the above proposal to satisfy the requirements of the Local Authority, as detailed above.

2.3 DESCRIPTION OF PROPOSED DEVELOPMENT

- 2.3.1 The development proposal seeks planning permission for the redevelopment of part of the Crown and Sceptre Car Park, Main Road, Cadoxton, SA10 8AP for residential purposes comprising four flats.
- 2.3.2 Following constructive feedback from the local planning authority based on the results of a preliminary noise impact assessment, the initial development design was modified. First floor bedrooms were relocated to the rear of the building and the proposed heat pumps were removed from the scheme.
- 2.3.3 The proposed air source heat pumps are to be replaced with Domestic Hot Water Heat Pumps (DHWHP) located within each property.
- 2.3.4 The revised development layout is presented in Appendix 4.

3.0 DETERMINATION OF NOISE LEVELS

3.1 ROAD TRAFFIC NOISE

3.1.1 To determine the acoustic conditions across the proposed development site a 24-hour road traffic noise survey was conducted at the position of the most exposed façade of the proposed scheme. This location enjoyed an uninterrupted view of the road traffic travelling along the A4230. Details of the survey are presented in Appendix 1 with the results provided in Appendix 3.

3.1.2 The results of this survey were used to inform a 3D acoustic model to calculate the road traffic noise propagation across the development site. Details of the modelling are presented in Appendix 5.

3.1.3 The results of the model are presented as easily understood, colour coded noise contour maps with each colour representing each NEC band as defined in TAN 11 [1]. Contour maps are produced for both daytime and night time periods.

3.1.4 The contour maps are presented in Appendix 6 and demonstrate that free field road traffic noise levels place the majority of the site within NEC 'B'. During the night time period, there were no instances of $L_{A_{Smax}}$ (free-field) exceeding 82 dB and therefore, there is no requirement to further amend the NEC.

3.1.5 For sites categorised as NEC 'B', TAN11 [1] states:

"Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise".

3.1.6 It is anticipated that an 'adequate level of protection against noise' will be attainable through the consideration of good acoustic design principles.

3.2 DHWHP NOISE

3.2.1 The revised scheme layout replaces the proposed external Air Source Heat Pumps (ASHP) with Domestic Hot Water Heat Pumps (DHWHP) which are to be located within each property. Each unit will exhaust to the outside via small vents installed to the external wall.

- 3.2.2 The manufacturer of the DHWHP units (Daikin) state that *'the indoor units of Daikin heat pumps generally produce a sound pressure level of about 30dBA, which is comparable to the sound of a person whispering'*.
- 3.2.3 These low levels will be further reduced by distance to the nearest sensitive receptor plus additional attenuation from the building façade. When partially open windows are relied upon for background ventilation, the sound reduction of the façade is reduced to 15 dB [8]. Therefore, the DHWHP noise level within the nearest habitable room will be no more than $30 - 15 = 15$ dB $L_{Aeq,t}$.
- 3.2.4 The noise emissions from the DHWHP will be effectively masked by the internal ambient noise levels within the habitable room and no adverse impact would be expected.
- 3.3 **COMMERCIAL NOISE**
- 3.3.1 The Crown and Sceptre public house is located 50m north east of the development site along the A4230.
- 3.3.2 Following a review of their website, it is our understanding that there is no regulated entertainment provided by the establishment with the pub primarily focussed on food and drink provision for the local community.
- 3.3.3 Given the close proximity to the pub of existing residential properties, and in the absence of no known noise issues, it is unlikely that activities at the public house will adversely impact on the proposed development. No formal assessment has been carried out at this time.

4.0 ROAD TRAFFIC NOISE IMPACT ASSESSMENT

4.1 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 7.

4.2 An assessment of the road traffic noise levels places the site into NEC 'B' and as per TAN 11 [1], *"Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise"*.

4.3 Assessment Criteria

4.3.1 It is anticipated that any planning conditions issued by the local authority will refer to the desirable internal and external ambient noise levels detailed in BS 8233 [5] and WHO guidelines [8]. These are interpreted in Table 1 below.

Table 1 – Anticipated Assessment Criteria

Location	07:00 – 23:00 hrs	23:00 – 07:00 hrs
Within Habitable Rooms	35 dB $L_{Aeq,16hrs}$	30 dB $L_{Aeq,8hrs}$ 45 dB L_{AFmax}
External Amenity Space	55 dB $L_{Aeq,16hrs}$	--

4.3.2 The night time L_{AFmax} criteria detailed in Table 1 refer to single noise events which could cause sleep disturbance to the future occupants of the proposed residential units.

4.4 Good Acoustic Design

4.4.1 Planning Policy Wales [2] recommends that the good acoustic design principles put forward in ProPG, Supplementary Document 2 [4] may also be adopted in Wales.

4.4.2 The principles of good acoustic design follow a hierarchy of noise management measures that Local Planning Authorities 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.*

4.4.3 The above measures are considered in the following sections.

4.4.4 **Maximising the spatial separation of noise source(s) and receptor(s).**

4.4.4.1 Due to the relatively small scale of the development site, there is limited scope to increase the source/receptor distance.

4.4.4.2 The proposed layout indicates that the development building is located towards the front of the site with associated car parking/amenity located at the rear.

4.4.4.3 There is potential for the site layout to be rearranged by relocating the building to the rear of the site with the car parking/amenity moved to the front.

4.4.4.4 However, this is unlikely to be acceptable from a visual aspect as it would not be in keeping with the surrounding street scene.

4.4.5 **Investigating the necessity and feasibility of reducing existing noise levels and relocating existing noise sources.**

4.4.5.1 As the road noise source is out of the control of the developer, reducing existing noise levels or relocating existing noise sources is not applicable.

4.4.6 **Using existing topography and existing structures to screen the proposed development site from significant sources of noise.**

- 4.4.6.1 There are no existing structures or topographical features between the noise source and the development site that could provide beneficial acoustic screening.
- 4.4.7 **Incorporating noise barriers as part of the scheme to screen the proposed development site from significant sources of noise.**
- 4.4.7.1 For any noise barrier to be effective it will need to interrupt the source to receptor propagation path (line of site). As the proposed residential development is for two storeys, a barrier would be of limited benefit to the majority of habitable rooms at or above the first storey.
- 4.4.7.2 A barrier at the front of the development would also be impractical as it would severely compromise the street scene.
- 4.4.8 **Using the layout of the scheme to reduce noise propagation across the site.**
- 4.4.8.1 Due to the relatively compact extent of the site, there is limited scope for alternative layout options that would materially affect the noise propagation to the habitable rooms.
- 4.4.8.2 Following consideration of good acoustic design, the revised design relocates the first floor bedrooms from the front of the building to the rear. The bedrooms will now benefit from being exposed to lower levels of road traffic noise.
- 4.4.9 **Using the orientation of buildings to reduce the noise exposure of noise-sensitive rooms.**
- 4.4.9.1 Due to the relatively compact extent of the site, there is limited scope for alternative orientation options that would materially affect the noise propagation to the habitable rooms.
- 4.4.10 **Using the building envelope to mitigate noise to acceptable levels.**
- 4.4.10.1 Consideration is given to the sound reduction performance of the proposed building envelope. The overall sound insulation of the building envelope is typically determined by the weakest acoustic element which would normally be the windows.

4.5 Assessment of Development Layout (Road Traffic Noise)

- 4.5.1 The only practicable road noise management measure suitable for this development is the consideration of the sound reduction performance of the proposed building envelope. As stated earlier, the overall sound insulation of the building envelope is typically determined by the weakest acoustic element which would normally be the glazing units.
- 4.5.2 With reference to the proposed development layout presented in Appendix 4, this report considers the minimum sound reduction performance for glazing units to all habitable rooms so that the desirable internal ambient noise levels detailed in Table 1 will be achievable.
- 4.5.3 Planning Policy Wales [2] states *"The planning system should maximise its contribution to achieving the well-being goals, and in particular a healthier Wales, by aiming to reduce average population exposure to air and noise pollution"*.
- 4.5.4 Proposed development should be designed, wherever possible, to prevent adverse effects to amenity, health and the environment. As a minimum, measures should be implemented to limit or constrain any effects that may occur.
- 4.5.5 As the proposed development site is categorised as being in NEC 'B' as per TAN 11 [1], appropriate mitigation will be required to ensure an *'adequate level of protection against noise'*.

4.6 Internal Ambient Noise Levels

- 4.6.1 The internal noise level in a room is calculated by subtracting the sound reduction performance of the external façade from the calculated noise level outside the room. This is described as the outdoor to indoor noise level difference. In this case, to represent worst-case, the sound reduction performance of the external façade is assumed to be equivalent to the weakest acoustic element which will be the glazing.
- 4.6.1.1 For housing design purposes, this outdoor to indoor noise level difference can be described in terms of the sound reduction index of appropriate parts of the building envelope calculated from values of R_w .

- 4.6.1.2 However, as stated in BS EN 12354-3, *"...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"*.
- 4.6.2 The relevant outdoor sound spectrum is defined in BS EN ISO 717-1 [10] as a correction term, C or C_{tr} , to be applied to the level difference.
- 4.6.3 When considering road traffic travelling at low speeds (<80 km/h), as is this case for traffic travelling along the A4230, the appropriate correction term is C_{tr} .
- 4.6.4 Therefore, in this case, the level difference of the elements for the building envelope can be described as the single number rating value, $R_w + C_{tr}$, where the element is exposed to road traffic travelling at low speed (<80km/h).
- 4.6.5 With reference to the layout drawings presented in Appendix 4, habitable rooms will be located on the ground floor and first floor. The height of the ground floor receptor is modelled at 1.5m and the first floor receptor modelled at a height of 4.5m.
- 4.6.6 The model is updated with individual receptors, placed 0.1m in front of each habitable room within the development to calculate the external free-field noise levels at each room. The results of the model are presented in Appendix 6.
- 4.6.7 **Open Window Ventilation Strategy**
- 4.6.7.1 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 [8].
- 4.6.7.2 To achieve the internal noise criteria of 35 dB $L_{Aeq,16hrs}$ with an open window during the daytime time period, the external noise level would be required to be below $35 + 15 = 50$ dB $L_{Aeq,16hrs}$. To achieve the internal noise criteria of 30 dB $L_{Aeq,8hrs}$ with an open window during the night time period, the external noise level would be required to be below $30 + 15 = 45$ dB $L_{Aeq,8hrs}$.

- 4.6.7.3 Following inspection of the modelling results, this assessment identified the following habitable rooms where the use of a partially open window for ventilation may be suitable during both the daytime and night time periods.

Table 2 – Habitable Rooms where an Open Window Ventilation Strategy may be Suitable

Habitable Room	Calculated External Road Traffic Noise Level Daytime (07:00 – 23:00 hrs) $L_{Aeq,16hrs}$ (dB)	Calculated External Road Traffic Noise Level Night Time (23:00 – 08:00 hrs) $L_{Aeq,8hrs}$ (dB)
Plot 3 Bed Rear	40	33
Plot 2 Bed Rear	40	33
Plot 4 Bed	39	32
Plot 1 Bed	39	32
Plot 1 Living Rear	39	32
Plot 4 Living Rear	39	32
Plot 2 Bed North East	37	30
Plot 3 Bed South West	37	30
Plot 3 Living Rear	36	29
Plot 2 Living Rear	36	29

- 4.6.7.4 The remaining habitable rooms are exposed to external road traffic noise levels that would result in the internal ambient noise level criteria being exceeded whilst using a partially open window to provide background ventilation.

4.6.8 Minimum Sound Reduction Specification, Glazing Units

- 4.6.8.1 It was demonstrated that an open window ventilation strategy would not be suitable for a number of habitable rooms within the proposed development. To achieve the required internal ambient noise levels within these habitable rooms, the windows will need to be in the closed position to control the noise ingress.

- 4.6.8.2 This report assesses the minimum sound reduction performance required from the glazing units for each of the habitable rooms exposed to unacceptable levels of external road traffic noise.
- 4.6.8.3 The results of the modelling exercise to determine the external road traffic noise levels at each habitable room are presented in Appendix 6.
- 4.6.8.4 There is also the potential for single noise events to cause sleep disturbance for the future occupants of the proposed residential units. For a restful sleep, the W.H.O. guidelines [8] recommend that the indoor sound pressure levels should not exceed approximately 45 dB L_{AFmax} more than 10 to 15 times per night.
- 4.6.8.5 To avoid over specifying the sound mitigation and to align with the 45 dB internal L_{AFmax} criteria of no more than 10 to 15 times a night [8], the L_{AFmax} data has been analysed and the outlying data has been excluded from the calculations.
- 4.6.8.6 In this case, we have assumed that the ten highest data points from the survey data represent ten noise events that could generate internal noise levels greater than 45 dB L_{AFmax} . The eleventh value is used to represent the external noise level for single noise events when determining suitable mitigation (see Appendix 3).
- 4.6.8.7 Table 3 below details the calculations for the minimum sound reduction for the glazing unit exposed to the highest level of road traffic noise in order to achieve the anticipated internal ambient noise criteria within all affected rooms.

Table 3 – Minimum Glazing Sound Reduction Calculations

	External Free-field Road Traffic Noise Level	Internal Ambient Noise Criteria	Minimum Glazing Sound reduction $R_w + C_{tr}$ (dB)
$L_{Aeq,16hr}$ (dB)	64	35	29
$L_{Aeq,8hr}$ (dB)	55	30	25
L_{AFmax} (dB)	70	45	25

- 4.6.8.8 To achieve desirable internal ambient noise levels for habitable rooms exposed to unacceptable road traffic noise, the glazing units for these rooms should have a minimum sound reduction performance of 29 dB $R_w + C_{tr}$.

- 4.6.8.9 Manufacturers' data should be used to confirm the above minimum sound reduction performance requirements are achievable from any specified glazing units, including any provision for background ventilation if applicable.
- 4.6.8.10 The windows are required to be in the closed position to effectively control noise ingress. The decision on whether the windows should be permanently closed is outside the scope of this assessment and our technical expertise. This decision should be taken by appropriate authorities.
- 4.6.8.11 All habitable rooms subject to sound mitigation measures should be provided with an alternative, effective means of ventilation. Any ventilation scheme should satisfy the requirements of Approved Document F and provide the required ventilation rates. Specialist advice should be obtained to ensure that any ventilation scheme is suitable for purpose. It is important that any scheme is approved by Building Control and does not compromise the internal noise levels.
- 4.6.8.12 Recommendations for suitable ventilation are outside the scope of this assessment and technical expertise.
- 4.6.8.13 The above minimum specification is determined from the highest specification required for either of the daytime or night time periods at each habitable room, to ensure good internal acoustic conditions at all times.
- 4.6.9 **External Amenity Areas**
- 4.6.9.1 A noise contour grid covering the whole site is constructed to display the external free field noise levels within amenity areas. Each grid represents the calculated free field noise levels throughout the site and is a collection of receivers set 1m apart at a height of 1.5m.
- 4.6.9.2 The anticipated criterion for the outdoor living areas, detailed in Table 1, require noise levels to be no greater than 55 dB $L_{Aeq,16hr}$.
- 4.6.9.3 The relevant noise contour maps are presented in Appendix 6.
- 4.6.9.4 Figure 8 presents the calculated noise levels at a height of 1.5m and indicates all areas of the development that satisfy this criterion in green. Areas that exceed this criterion are indicated in red.

- 4.6.9.5 The contour maps clearly identify that the external amenity areas associated with all plots are exposed to noise levels lower than 55 dB $L_{Aeq,16hr}$ and satisfies the anticipated criterion.

5.0 CONCLUSIONS

- 5.1 This report has assessed the development site and provided recommendations for necessary mitigation to ensure that desirable internal and external ambient noise conditions are attainable at all proposed residential units in accordance with local and national planning requirements.

6.0 RECOMMENDATIONS

6.1 Glazing

- 6.1.1 Glazing units should be specified with a minimum sound reduction performance of 29 dB $R_w + C_{tr}$.
- 6.1.2 Manufacturer's data should be used to confirm the above minimum sound reduction performance requirements are achievable from any specified glazing units, including any provision for background ventilation if applicable.
- 6.1.3 The windows are required to be in the closed position to effectively control noise ingress. The decision on whether the windows should be permanently closed is outside the scope of this assessment and our technical expertise. This decision should be taken by appropriate authorities.
- 6.1.4 All habitable rooms subject to sound mitigation measures should be provided with an alternative, effective means of ventilation. Any ventilation scheme should satisfy the requirements of Approved Document F and provide the required ventilation rates. Specialist advice should be obtained to ensure that any ventilation scheme is suitable for purpose. It is important that any scheme is approved by Building Control and does not compromise the internal noise levels.
- 6.1.5 Recommendations for suitable ventilation are outside the scope of this assessment and technical expertise.

P.A.T. 04/03/25
M.Sc., I.Eng., M.I.O.A.,
M.Inst.SCE., M.A.E.S.

Appendix 1 Survey Details

A1.0 SURVEY DETAILS

- A1.1 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.
- A1.2 The survey commenced at 10:15 hours on 15th January 2025 for a continuous 24-hour period.
- A1.3 Weather conditions: 0% cloud cover, 4°C, dry, still.
- A1.4 **Measurement Procedure:**
- A1.4.1 The meter was located in a weather-proof container and powered with heavy duty rechargeable batteries. The microphone was located on a stand extended to a height of 4.1m to enable a clear line of site to the road traffic, avoiding any acoustic shielding from the temporary metal boundary fencing. The microphone was inside an approved weather-proof microphone housing.
- A1.4.2 The meter was adjusted to log and store L_{Aeq} , L_{A90} and L_{AFmax} in 15-minute periods for the duration of the survey (see Table 5).
- A1.4.3 On completion of the survey, the data was downloaded to a computer for further analysis.
- A1.4.4 The analysis consisted of using B&K 7820 Evaluator software to divide the results into the time periods 07:00-23:00 and 23:00-07:00.
- A1.4.5 **Subjective Impressions**
- A1.4.6 The acoustic environment during the survey was characterised by road traffic travelling along the adjacent A4230.

A1.5

Equipment Used:**Table 4 – Equipment Used, Front Elevation**

ITEM	Serial No	UKAS Calibration Certificate Date (if applicable)
(ANL-M3) B&K 2250 Handheld Analyser	2559188	Certificate: 16158 Date: 08/03/23
(ANPC3) B&K 4231 Calibrator	2162602	Certificate: 16156 Date: 07/03/23

Table 5 – Meter Details, Front Elevation

Instrument:		2250
Application:		BZ7224 Version 4.7.6
Start Time:		01/15/2025 10:13:22
End Time:		01/16/2025 10:15:03
Elapsed Time:		1.00:01:41
Bandwidth:		Broadband
Max Input Level:		141.39
	Time	Frequency
Broadband (excl. Peak):	FSI	AZ
Broadband Peak:		A
Instrument Serial Number:		2559188
Microphone Serial Number:		2556132
Input:		Top Socket
Windscreen Correction:		None
Sound Field Correction:		Free-field
Calibration Time:		01/15/2025 10:05:58
Calibration Type:		External reference
Sensitivity:		47.53 mV/Pa

Appendix 2 View of Measurement Position

A2.0 VIEW OF MEASUREMENT POSITION

Figure 1 – Measurement Position



Figure 2 – View of Survey Equipment



Appendix 3 Survey Results

A3.0 SURVEY RESULTS

Table 6 – Summary of Survey Results (Free-field Noise Levels)

Front Elevation	Period	Duration, t	L _{Aeq,t} (dB)	L _{AF90,t} (dB)	L _{AFmax} (dB)
Daytime	07:00 – 23:00	16:00	62.6	53.2	93.1
Night Time	23:00 – 07:00	08:00	54.1	38.7	76.1

Table 7 – Daytime Free-field Noise Levels (07:00 – 23:00)

Start date	Start time	L _{Aeq,15mins} (dB)	L _{AF90,15mins} (dB)	L _{AFmax} (dB)
16/01/2025	07:00:00	61.7	54.8	74.9
16/01/2025	07:15:00	61.3	56.1	73.7
16/01/2025	07:30:00	62.4	56.5	74.6
16/01/2025	07:45:00	62.5	55.0	71.4
16/01/2025	08:00:00	63.7	57.8	72.3
16/01/2025	08:15:00	64.2	58.7	74.5
16/01/2025	08:30:00	64.4	59.0	73.5
16/01/2025	08:45:00	64.6	58.8	80.1
16/01/2025	09:00:00	63.7	57.8	74.1
16/01/2025	09:15:00	62.7	56.2	75.2
16/01/2025	09:30:00	62.2	54.8	78.7
16/01/2025	09:45:00	62.9	54.0	76.3
16/01/2025	10:00:00	62.9	54.2	78.1
15/01/2025	10:15:00	62.7	55.9	73.7
15/01/2025	10:30:00	62.6	55.6	74.4
15/01/2025	10:45:00	62.2	55.4	70.5
15/01/2025	11:00:00	62.7	56.2	76.1
15/01/2025	11:15:00	62.3	55.0	73.0
15/01/2025	11:30:00	63.2	57.1	72.4
15/01/2025	11:45:00	62.4	55.6	77.8

Start date	Start time	L _{Aeq,15mins} (dB)	L _{AF90,15mins} (dB)	L _{AFmax} (dB)
15/01/2025	12:00:00	62.5	55.5	73.5
15/01/2025	12:15:00	62.8	54.0	80.8
15/01/2025	12:30:00	62.0	51.8	71.5
15/01/2025	12:45:00	62.6	54.2	71.6
15/01/2025	13:00:00	62.6	54.4	74.6
15/01/2025	13:15:00	62.7	54.6	74.9
15/01/2025	13:30:00	61.6	53.3	70.4
15/01/2025	13:45:00	62.3	54.8	73.0
15/01/2025	14:00:00	63.0	56.4	73.1
15/01/2025	14:15:00	62.3	53.9	71.2
15/01/2025	14:30:00	62.1	54.7	71.5
15/01/2025	14:45:00	62.0	53.8	69.8
15/01/2025	15:00:00	63.4	56.4	76.7
15/01/2025	15:15:00	63.4	55.9	75.4
15/01/2025	15:30:00	63.5	56.7	78.0
15/01/2025	15:45:00	63.1	55.1	74.9
15/01/2025	16:00:00	65.7	56.4	86.5
15/01/2025	16:15:00	63.3	56.2	73.8
15/01/2025	16:30:00	63.4	56.1	72.4
15/01/2025	16:45:00	63.4	57.3	73.6
15/01/2025	17:00:00	63.7	57.7	72.4
15/01/2025	17:15:00	64.2	57.7	80.8
15/01/2025	17:30:00	64.0	58.4	79.4
15/01/2025	17:45:00	63.2	57.4	72.0
15/01/2025	18:00:00	63.4	57.5	71.3
15/01/2025	18:15:00	63.2	57.5	74.2
15/01/2025	18:30:00	63.3	57.6	72.7

Start date	Start time	L _{Aeq,15mins} (dB)	L _{AF90,15mins} (dB)	L _{AFmax} (dB)
15/01/2025	18:45:00	62.7	56.6	77.4
15/01/2025	19:00:00	62.6	55.3	74.1
15/01/2025	19:15:00	62.0	54.3	74.5
15/01/2025	19:30:00	61.1	53.2	70.8
15/01/2025	19:45:00	60.9	53.9	71.5
15/01/2025	20:00:00	60.2	50.4	71.1
15/01/2025	20:15:00	59.9	51.2	72.3
15/01/2025	20:30:00	59.9	50.7	68.9
15/01/2025	20:45:00	59.3	48.1	69.1
15/01/2025	21:00:00	59.8	50.9	70.9
15/01/2025	21:15:00	59.3	50.6	71.4
15/01/2025	21:30:00	60.0	50.2	70.1
15/01/2025	21:45:00	57.1	47.5	77.4
15/01/2025	22:00:00	58.9	49.0	72.8
15/01/2025	22:15:00	57.2	45.8	70.9
15/01/2025	22:30:00	65.9	46.6	93.1
15/01/2025	22:45:00	55.3	46.7	72.9

Table 8 – Night Time Free-field Noise Levels (23:00 – 07:00)

Start date	Start time	L _{Aeq,15mins} (dB)	L _{AF90,15mins} (dB)	L _{AFmax} (dB)
15/01/2025	23:00:00	54.3	42.0	69.6
15/01/2025	23:15:00	51.9	39.7	66.5
15/01/2025	23:30:00	49.6	38.3	69.1
15/01/2025	23:45:00	49.7	38.7	67.5
16/01/2025	00:00:00	50.3	37.4	67.5
16/01/2025	00:15:00	46.0	35.7	62.8
16/01/2025	00:30:00	49.6	37.1	71.7
16/01/2025	00:45:00	49.8	38.6	71.8
16/01/2025	01:00:00	49.8	42.0	67.9
16/01/2025	01:15:00	46.5	44.0	61.7
16/01/2025	01:30:00	45.8	44.0	60.1
16/01/2025	01:45:00	50.8	44.1	68.9
16/01/2025	02:00:00	50.9	44.2	73.2
16/01/2025	02:15:00	48.1	44.1	70.3
16/01/2025	02:30:00	45.1	36.2	61.9
16/01/2025	02:45:00	49.6	37.5	68.2
16/01/2025	03:00:00	48.2	37.4	70.1
16/01/2025	03:15:00	40.0	35.7	55.1
16/01/2025	03:30:00	43.7	36.8	59.9
16/01/2025	03:45:00	49.0	38.4	67.6
16/01/2025	04:00:00	49.6	37.3	69.1
16/01/2025	04:15:00	53.0	41.3	70.2
16/01/2025	04:30:00	50.9	45.9	66.9
16/01/2025	04:45:00	52.9	46.5	66.5
16/01/2025	05:00:00	55.3	46.9	69.7
16/01/2025	05:15:00	56.0	48.3	68.1
16/01/2025	05:30:00	57.8	50.6	72.0

Start date	Start time	L _{Aeq,15mins} (dB)	L _{AF90,15mins} (dB)	L _{AFmax} (dB)
16/01/2025	05:45:00	59.2	50.5	72.9
16/01/2025	06:00:00	58.9	50.5	73.3
16/01/2025	06:15:00	58.9	51.7	70.7
16/01/2025	06:30:00	59.5	52.5	76.1
16/01/2025	06:45:00	61.2	54.1	73.1

Table 9 – Analysis of L_{AFmax} Events (Ranked Highest to Lowest)

id	Start date	Start time	L _{AFmax} (dB)
1	16/01/2025	06:30:00	76.1
2	16/01/2025	06:00:00	73.3
3	16/01/2025	02:00:00	73.2
4	16/01/2025	06:45:00	73.1
5	16/01/2025	05:45:00	72.9
6	16/01/2025	05:30:00	72.0
7	16/01/2025	00:45:00	71.8
8	16/01/2025	00:30:00	71.7
9	16/01/2025	06:15:00	70.7
10	16/01/2025	02:15:00	70.3
11	16/01/2025	04:15:00	70.2
12	16/01/2025	03:00:00	70.1
13	16/01/2025	05:00:00	69.7
14	15/01/2025	23:00:00	69.6
15	16/01/2025	04:00:00	69.1
16	15/01/2025	23:30:00	69.1
17	16/01/2025	01:45:00	68.9
18	16/01/2025	02:45:00	68.2
19	16/01/2025	05:15:00	68.1
20	16/01/2025	01:00:00	67.9
21	16/01/2025	03:45:00	67.6
22	15/01/2025	23:45:00	67.5
23	16/01/2025	00:00:00	67.5
24	16/01/2025	04:30:00	66.9
25	15/01/2025	23:15:00	66.5
26	16/01/2025	04:45:00	66.5
27	16/01/2025	00:15:00	62.8

id	Start date	Start time	L _A F _{max} (dB)
28	16/01/2025	02:30:00	61.9
29	16/01/2025	01:15:00	61.7
30	16/01/2025	01:30:00	60.1
31	16/01/2025	03:30:00	59.9
32	16/01/2025	03:15:00	55.1

Appendix 4 Proposed Development Drawings

A4.0 PROPOSED DEVELOPMENT DRAWINGS

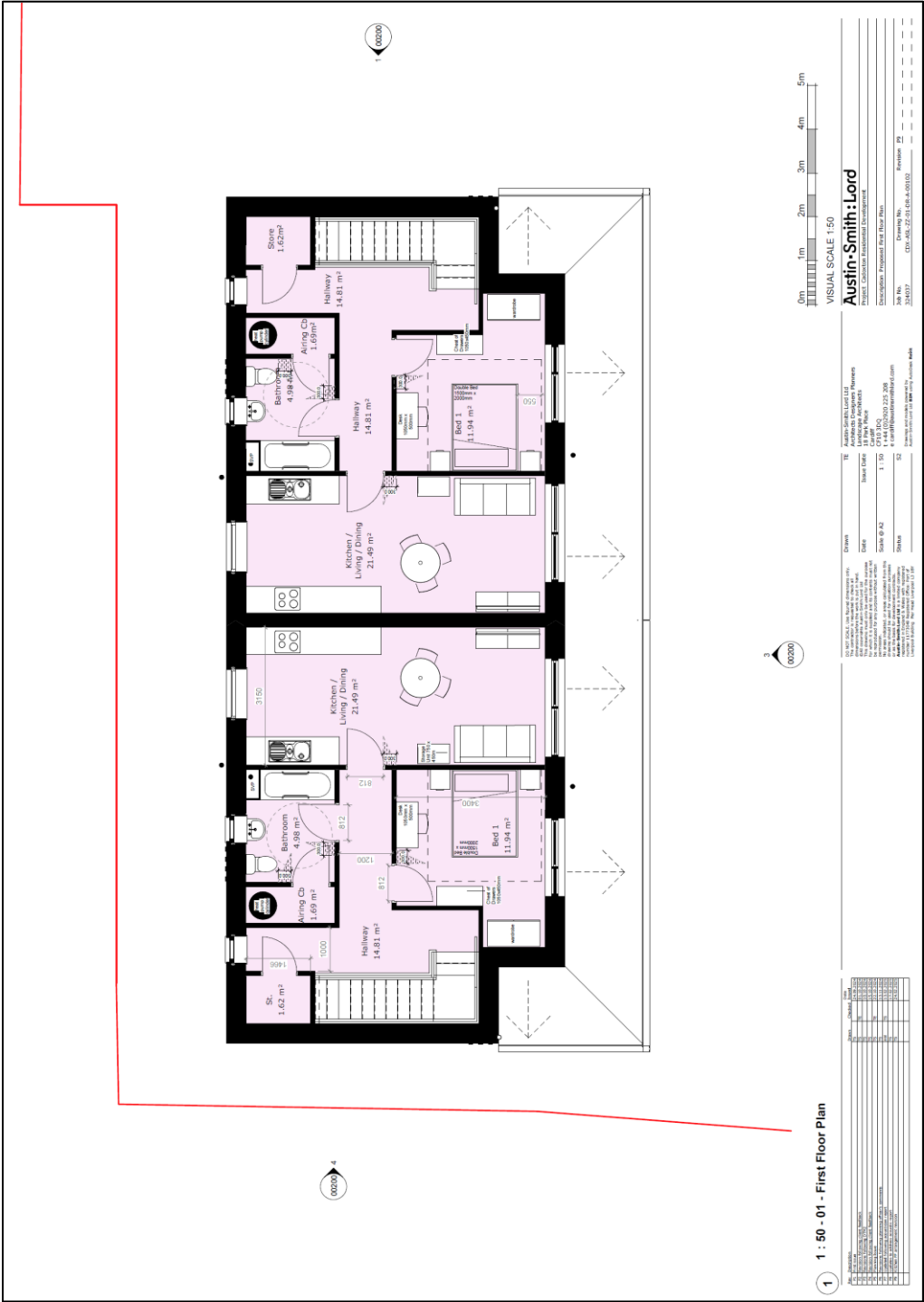
Figure 3 – Proposed Development Layout



Figure 4 – Proposed Ground Floor Layout



Figure 5 – Proposed First Floor Layout



Appendix 5 3D Acoustic Model Details

A5.0 3D ACOUSTIC MODEL DETAILS

A5.1 ASSUMPTIONS MADE IN MODEL

A5.1.1 The ground attenuation was modelled as hard with a ground factor value of 0.0.

A5.1.2 Acoustic barriers were modelled as reflective.

A5.1.3 Atmospheric conditions were modelled as:

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

A5.2 PREDICTION OF NOISE LEVELS ACROSS PROPOSED DEVELOPMENT SITE

A5.2.1 As the site is relatively complex and comprises multiple dwellings, a 3D acoustic CAD model of the proposed development is constructed to aid in the identification of potential areas or plots that may not meet the stated criteria. This process minimises unnecessary schemes of mitigation.

A5.2.2 EMS B&K Predictor V2019 Software was utilised to model the road traffic noise levels across the whole of site. This noise prediction software allows for the investigation of noise emissions in complex or large outdoor environments. The software can be used to analyse industrial noise sources and traffic measurements to the latest European and U.K. Standards.

A5.2.3 A major advantage of using this method is the ability to remodel changes and alterations to the site and/or sources.

A5.3 CAD MODEL CONSTRUCTION

A5.3.1 Topographical information for the site was obtained from the online site 'DataMapWales' in the form of Digital Terrain Model data (2m resolution). The 'DataMapWales' platform has been developed as a partnership between Welsh Government and Natural Resources Wales. It serves as a hub for data and information covering a wide spectrum of topics, but primarily around the environment.

- A5.3.2 The topographical data was imported into the CAD software and used to construct the 3D terrain for the site.
- A5.3.3 'OS Open Zoomstack' was used as a background image for the model. 'OS Open Zoomstack' provides a single, customisable basemap of Great Britain made freely available in partnership with the UK government. The data was obtained from 'www.ordnancesurvey.co.uk' under the Open Government Licence (OGL) and contains OS data © Crown copyright and database right 2023.
- A5.3.4 A revised site layout drawing, '26CA05-ASL-02-ZZ-M2-A-00 - Site Plan', was provided by FCHA to be used as a background for the model to locate the noise sources, proposed buildings and measurement position accurately.
- A5.3.5 A 'road item' was positioned centrally along the A4230 using the basemap as a guide.
- A5.3.6 The modelling software defines a 'road item' as 'a line source used for modelling the sound level emissions of vehicles on a road'.
- A5.4 **CAD MODEL CALIBRATION**
- A5.4.1 A 24hr noise survey was conducted 4m from the nearside kerb alongside the A4230.
- A5.4.2 A noise receiver was positioned in the model at the position of the actual measurement location used during the 24hr road traffic noise survey.
- A5.4.3 The model assumes that the measured noise levels during the 24hr survey are attributable to the road traffic. All other noise sources are assumed to be insignificant when compared to the primary noise source.
- A5.4.4 The daytime $L_{Aeq,16hr}$ and night time $L_{Aeq,8hr}$ noise levels at the measurement position are determined from the 24hr survey data using B&K 7820 Evaluator software.
- A5.4.5 The vehicle flow for the 'road item' was then adjusted until the calculated noise level at the receiver equals the period $L_{Aeq,t}$ level determined using the procedures detailed above.
- A5.4.6 The software calculations for road noise propagation follow the procedures set out in CRTN [6] and TRL Method 3 for non-motorway roads [7].

A5.4.7 When the calculated noise level at the receiver equals the level determined from the survey data, the noise emission level for the road has been determined.

A5.5 CAD MODEL PREDICTION

A5.5.1 Once the model calibration exercise is completed, the proposed development buildings are placed into the model using the site layout drawing as a guide (see Appendix 4).

A5.5.2 The proposed development will have habitable rooms located on both the ground floor level and first floor level (see Appendix 4). The height of the ground floor receptor is modelled at 1.5m and the height of the first-floor receptor is modelled at 4.5m.

A5.5.3 Individual receptors are placed 0.1m in front of each habitable room within the development to calculate the external free-field noise levels at each room. A noise contour grid covering the whole site is constructed to display the external free field noise levels within amenity areas. Each grid is a collection of receivers set 1m apart at a height of 1.5m.

A5.5.4 Using EMS B&K Predictor V2019 software, noise propagation calculations were made for each receiver using the calibrated noise source emissions as described above. External amenity area noise levels were calculated using the 1.5m high grid covering the proposed site.

A5.5.5 Calculations are made for both the daytime and night time periods for all receivers with separate contour maps generated for each assessment period.

A5.5.6 The results of the assessment are presented in the form of easily understood noise contour maps and are shown in Appendix 6.

A5.5.7 These contour maps indicate the free field noise levels across the whole of the proposed development with each contour colour boundary assigned a noise level so that areas of the proposed development that comply with each of the criteria can be easily identified.

A5.6 NOISE CONTOUR MAPS

A5.6.1 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 site at a height of 1.5m. The daytime and night time contours are colour coded to identify each of the TAN 11 NEC bands for easy site categorisation.*
- *External free-field road traffic noise levels across the proposed development (including buildings) at a height of 1.5m. Areas where the external amenity criteria are satisfied are indicated in green for ease of identification.*

Appendix 6 Modelling Results

A6.0 MODELLING RESULTS

Figure 6 – TAN 11 Noise Exposure Category (NEC), Daytime

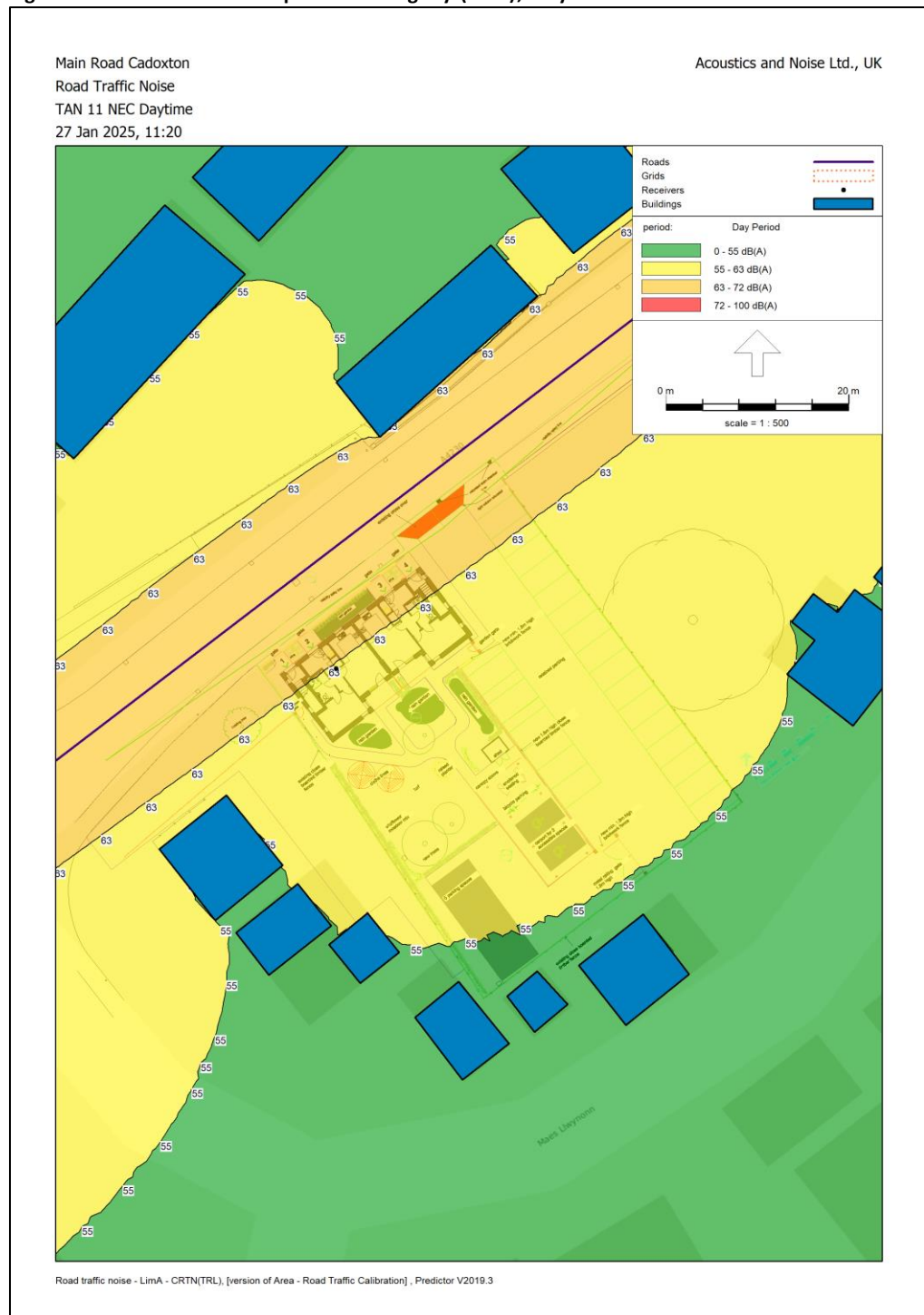


Figure 7 – TAN 11 Noise Exposure Category (NEC), Night Time



Figure 8 – Road Traffic Noise across External Amenity Areas, Daytime



Table 10 – Detailed External Free-field Road Traffic Noise Levels at Habitable Rooms

Description	Storey	Daytime L _{Aeq,16hr} (dB)	Night L _{Aeq,8hr} (dB)
Plot 1 Bed	First Floor	39.0	31.8
Plot 1 Front Kitchen	First Floor	63.9	55.4
Plot 1 Living Rear	First Floor	39.0	31.8
Plot 4 Living Rear	First Floor	39.0	31.8
Plot 2 Bed North East	Ground Floor	37.1	30.0
Plot 2 Bed Rear	Ground Floor	39.7	32.5
Plot 2 Bed South West	Ground Floor	57.2	49.0
Plot 2 Front Kitchen	Ground Floor	60.4	52.1
Plot 2 Living Rear	Ground Floor	36.1	29.1
Plot 3 Bed North East	Ground Floor	58.7	50.5
Plot 3 Bed Rear	Ground Floor	40.3	33.1
Plot 3 Bed South West	Ground Floor	37.0	30.0
Plot 3 Front Kitchen	Ground Floor	60.6	52.3
Plot 3 Living Rear	Ground Floor	36.2	29.1
Plot 4 Bed	First Floor	39.2	32.0
Plot 4 Front Kitchen	First Floor	63.9	55.4

Appendix 7 Relevant Guidance

A7.0 RELEVANT GUIDANCE

A7.1 Technical Advice Note 11 (TAN11) [1]

A7.1.1 The requirements for the assessment of noise impact on a proposed development site are detailed in TAN11 (Noise). This document prescribes the measurement methods and standards to be used for the noise survey. The results of the survey are separated into day and night periods which are compared with four Noise Exposure Categories (NECs).

A7.2 Noise Exposure Categories for Dwellings (NECs)

When assessing a proposal for residential development near a source of noise, local planning authorities should determine into which of the four noise exposure categories the proposed site falls, taking account of both day and night-time noise levels. Local planning authorities should then have regard to the advice in the appropriate NEC, as shown in Table 11.

Table 11 – Planning Advice as per TAN11

NEC	Planning Advice
A	<i>Noise need not be considered as a determining factor in granting planning permission, although the noise level at the high end of the category should not be regarded as a desirable level.</i>
B	<i>Noise should be taken into account when determining planning applications and, where appropriate, conditions imposed to ensure an adequate level of protection against noise.</i>
C	<i>Planning permission should not normally be granted. Where it is considered that permission should be given, for example because there are no alternative quieter sites available, conditions should be imposed to ensure a commensurate level of protection against noise.</i>
D	<i>Planning permission should normally be refused.</i>

A7.2.1 The noise exposure category for the site is the measured noise level compared with the range of noise levels as shown in Table 12.

Table 12 – Free-Field Noise Levels Corresponding to the NECs, $L_{Aeq,T}$ dB

Noise source		Noise Exposure Category			
		A	B	C	D
Road traffic	0700-2300	<55	55-63	63-72	>72
	2300-0700	<45	45-57	57-66	>66
Rail traffic	0700-2300	<55	55-66	66-74	>74
	2300-0700	<45	45-59	59-66	>66
Air traffic	0700-2300	<57	57-66	66-72	>72
	2300-0700	<48	48-57	57-66	>66
Mixed Sources	0700-2300	<55	55-63	63-72	>72
	2300-0700	<45	45-57	57-66	>66

A7.2.2 Maximum noise event values $L_{A\max}$ of 82dB were analysed as per Note 2 [1].

“Note 2: Night-time noise levels 2300-0700): sites where individual noise events regularly exceed 82dBLAmax (5 time weighting) several times in any hour should be treated as being in NEC C, regardless of the $L_{Aeq,8H}$ (except where the $L_{Aeq,8H}$ already puts the site in NEC D)”.

A7.2.3 Mixed sources refer to any combination of road, rail, air and industrial noise sources. The ‘mixed source’ values detailed in Table 12 are based on the lowest numerical values of the single source limits in the table. The ‘mixed source’ NEC should only be used where no individual noise source is dominant.

A7.3 **Planning Policy Wales [2]**

A7.3.1 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’.

- A7.3.2 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.
- A7.3.3 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.
- A7.3.4 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.
- A7.3.5 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)*'.
- A7.3.6 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.
- A7.3.7 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.

- A7.3.8 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.
- A7.3.9 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.
- A7.3.10 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.
- A7.4 **Noise and Soundscape Action Plan [3]**
- A7.4.1 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.
- A7.5 **ProPG: Planning & Noise [4]**
- A7.5.1 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.
- A7.5.2 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).

- A7.5.3 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.
- A7.5.4 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.*
- A7.5.5 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.
- A7.5.6 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.

- A7.5.7 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.
- A7.5.8 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.
- A7.6 **BS 8233 - Guidance on Sound Insulation and Noise Reduction for Buildings [5]**
- A7.6.1 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.
- A7.6.2 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.”.
- A7.6.3 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.
- A7.6.4 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 13 below.

Table 13 – 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 $L_{Aeq,8hrs}$

- A7.6.5 The guidelines also provide scope for relaxing these values by up to 5 dB and still achieve reasonable internal conditions.
- A7.6.6 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.
- A7.6.7 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).
- A7.6.8 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.
- A7.6.9 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.
- A7.6.10 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.

- A7.6.11 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 [9].
- A7.6.12 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.
- A7.6.13 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.
- A7.6.14 BS 8233 also states in section 7.7.2 that “...regular individual noise events can cause sleep disturbance. A guideline value may be set in terms of SEL of $L_{Amax,F}$ depending on the character and number of events per night...”
- A7.6.15 However, BS 8233 does not quantify what the L_{Amax} guideline value should be and therefore this assessment anticipates that any L_{Amax} criteria will make reference to the value presented in the W.H.O. guidelines [8].
- A7.7 **Calculation of Road Traffic Noise (CRTN) [6]**
- A7.7.1 This memorandum describes the procedures for calculating noise from road traffic. These procedures are necessary to enable entitlement under the Noise Insulation Regulations to be determined but they also provide guidance appropriate to the calculation of traffic noise for more general applications e.g. environmental appraisal of road schemes, highway design and land use planning.
- A7.7.2 Road traffic noise levels are expressed in terms of the index, $L_{A10,t}$ dB. The value of $L_{A10,t}$ is the noise level exceeded for just 10% of the time over the time period t. For the purposes of CRTN, the time period, t, is 18 hours (06:00 – 00:00 hrs).
- A7.7.3 The procedures for calculating traffic noise, as described in the memorandum, comprise five main stages:
- Division of road into a number of segments;
 - Calculation of the Basic Noise Level (BNL), at a reference distance of 10m from the nearside carriageway edge, for each road segment using traffic flow data (number of vehicles, speed, %HGV);

- For each segment, calculate the noise level at the reception point (1m from exposed façade) by considering the distance to the reception point, ground attenuation and any screening from barriers and or buildings.
- Correction to the calculated noise level to account for site layout features including reflections from nearby buildings and facades and the source segment size;
- Calculate the total noise level at the reception point by combining the contributions from all road segments.

A7.7.4 The aim of this memorandum is to enable prediction in as many situations as possible, covering both free and non-free flowing traffic. Prediction is the preferred calculation technique and in complex situations is best carried out using appropriate computer software.

A7.7.5 In addition, CRTN describes a shortened measurement procedure for determining the noise level from the road, $L_{A10,18h}$ dB, based on measurements made over three consecutive hours between 10:00 and 17:00 hours.

A7.7.6 Using $L_{A10,3h}$ as the arithmetic mean of the three consecutive values of the hourly $L_{A10,1h}$, the value of $L_{A10,18h}$ can be calculated from the relation:

$$L_{A10,18h} = L_{A10,3h} - 1 \text{ dB}$$

A7.8 **Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping [7]**

A7.8.1 The UK national method for calculating road traffic noise is described in the document 'Calculation of Road Traffic Noise' (CRTN) [6]. The noise index derived using these procedures, L_{A10} is however, different from the more commonly used descriptor for environmental noise, $L_{Aeq,T}$.

A7.8.2 Defra therefore commissioned TRL Limited to develop an interim computational method to convert $L_{A10,18h}$ to $L_{Aeq,t}$ to be used in the UK.

A7.8.3 For UK conditions, TRL recommends that the best interim approach is to adapt CRTN by applying an 'end correction' to obtain the relevant EU indices from calculated values of L_{A10} .

- A7.8.4 Three methods are described dependant on the detail of traffic data available:
- *Method 1: Where the user has available hourly traffic data;*
 - *Method 2: Where detailed hourly traffic data is not available, but the user has, or can estimate, traffic data for the relevant day, evening and night time periods;*
 - *Method 3: Where detailed hourly or period traffic data is not available, but the user has, or can estimate, traffic data for the full 18hr time period.*
- A7.8.5 Each method allows CRTN to calculate the $L_{A10,18hr}$ using the available data and then convert to the relevant period $L_{Aeq,T}$ using defined relationships.
- A7.9 **Guidelines for Community Noise, W.H.O. [8]**
- A7.9.1 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.
- A7.9.2 The objective of the World Health Organization (WHO) is '*the attainment by all peoples of the highest possible level of health*'.
- A7.9.3 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.
- A7.9.4 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 14 below.

Table 14 – 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)

- A7.9.5 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.
- A7.9.6 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.
- A7.9.7 For a restful sleep, the W.H.O. guidelines further recommend that the indoor sound pressure levels should not exceed approximately 45 dB L_{Amax} more than 10 to 15 times per night.
- A7.9.8 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} and 60 dB L_{Amax} so that people may sleep with the windows open...the noise reduction from outside to inside with the windows partly open is 15dB”.
- A7.10 **BS EN 12354 Part 3, Airborne Sound Insulation against Outdoor Sound [9]**
- A7.10.1 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.

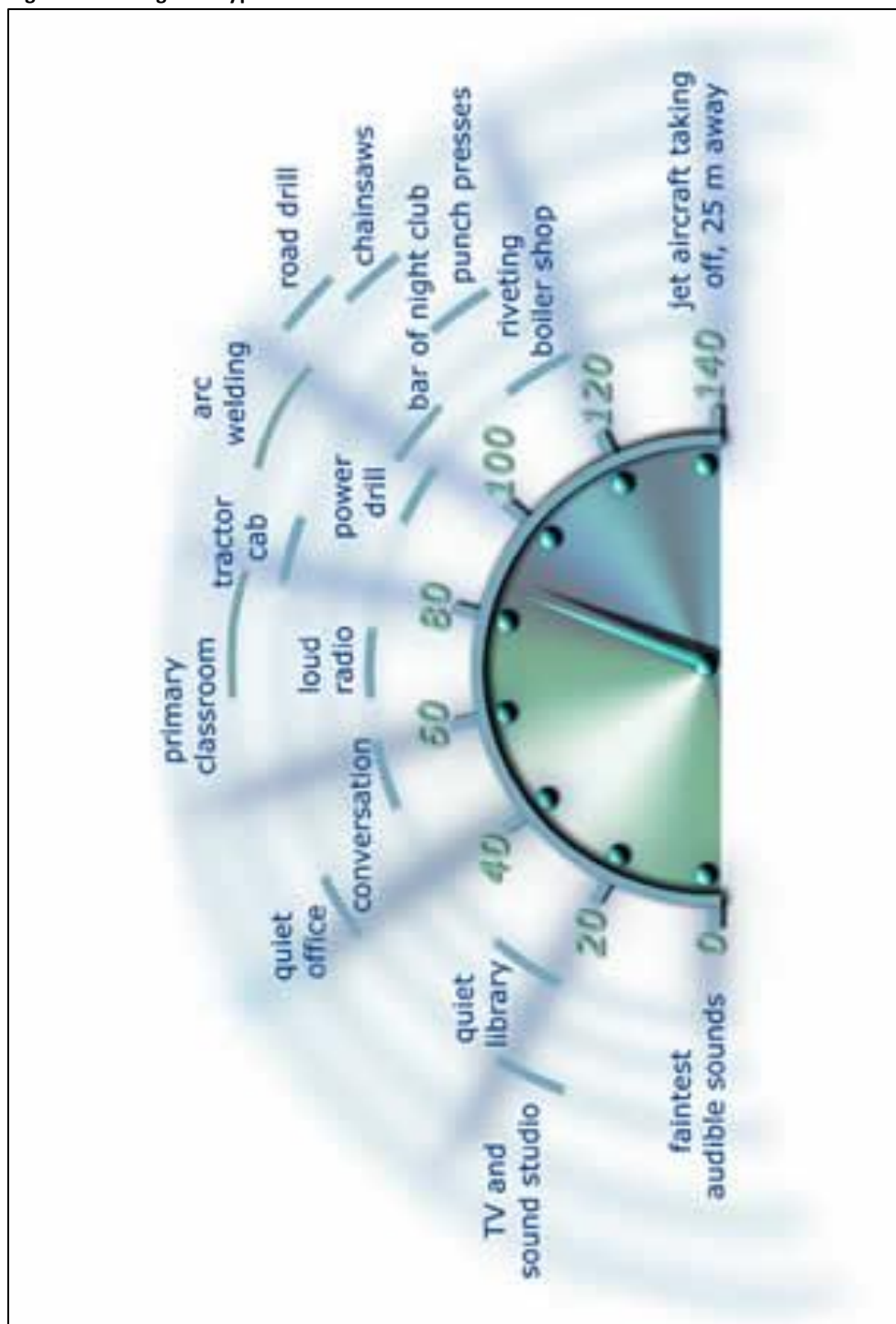
The calculation is based on the sound reduction index of the different elements from which the façade is constructed. Calculations can be carried out for frequency bands or single number ratings.

- A7.10.2 The results of the calculation can be used to determine the indoor sound pressure level due to external sound sources such as road traffic.
- A7.10.3 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'*.
- A7.10.4 The indoor A-weighted sound pressure level can be determined from calculation in frequency bands for the appropriate frequency range, applying the A-weighting.
- A7.10.5 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 [10], 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.
- A7.11 **ISO 9613 [11]**
- A7.11.1 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
- A7.11.2 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.

Appendix 8 Range of Typical Sound Levels

A8.0 RANGE OF TYPICAL SOUND LEVELS

Figure 9 – Range of Typical Sound Levels



Appendix 9 Glossary of Acoustic Terms

A9.0 GLOSSARY OF ACOUSTIC TERMS

A9.1 Acoustic environment:

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

A9.2 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.

A9.3 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.

A9.4 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

A9.5 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.

A9.6 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.

A9.7 Rating level, $L_{A,r,Tr}$:

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

A9.8 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.

A9.9 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

A9.10 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

A9.11 Specific sound level, $L_s = L_{Aeq,Tr}$:

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

A9.12 Specific sound source:

Sound source being assessed

- A9.13 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.
- A9.14 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.
- A9.15 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.
- A9.16 Free Field:**
A sound field in which no significant sound reflections occur.
- A9.17 L_{Amax} :**
The maximum 'A-weighted' level of sound recorded during a sound event. The time weighting used (fast or Slow) should be stated.
- A9.18 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.
- A9.19 Frequency:**
The number of cycles per second of a vibration usually expressed in units of Hertz, Hz

A9.20

Hertz:

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

Appendix 10 References

A10.0 REFERENCES:

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- 7 PR/SE/451/02, 'Converting the UK traffic noise index $L_{A10,18h}$ to EU noise indices for noise mapping', TRL
- 8 "Guidelines for Community Noise", Berglund, Lindvall, Schwela, World Health Organization, 1999
- 9 BS EN 12354-3, "Building acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound", British Standards, 2017
- 10 BS EN ISO 717-1:1997, 'Acoustics - Rating of sound insulation in buildings and of building elements, Part 1: Airborne sound insulation', British Standards
- 11 ISO 9613 Acoustics – Attenuation of sound propagation outdoors Parts 1 & 2