
Noise Impact Assessment

Proposed Residential Development – Parkmount Rd, Manchester

Client: AEW Architects

Reference: 21.157.1.R2

Issue Date: 6 September 2023



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EXECUTIVE SUMMARY

This Assessment has been undertaken to identify and assess any surrounding noise-generating activities which may have the potential to constrain the proposed noise-sensitive development.

Accordingly, this Assessment has been completed with due regard to the National Planning Policy Framework and its associated National Planning Policy Guidance in addition to appropriate British Standards and guidance documents relevant to the assessment of noise impacts.

This Assessment has shown that, with regards to road traffic noise within internal habitable rooms, various living room and bedroom windows will require alternative ventilation as per the schedule set out in Appendices 7 and 8 of this Assessment which accord with the requirements of the AVO Design Guide. In addition, any bedroom located on the western façades of plots 1 to 18 will require upgraded glazing that provides a sound reduction of at least 35dB R_w.

This Assessment has shown that, with regards to road traffic noise in external amenity space, all garden areas achieve the 55dB L_{Aeq 16hr} criteria following the implementation of noise mitigation measures.

The existing noise climate around the Site is sufficiently low enough which affords noise levels in external and internal habitable areas of the Site which accord with the 'No Observed Effect Level' as detailed in the PPG and as such noise should not be deemed to be a determining factor in the granting of planning permission for this Site.

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1 INTRODUCTION

1.1 Appointment

- 1.1.1 Professional Consult Limited was instructed by AEW Architects ('the Applicant'), to prepare a Noise Impact Assessment ('the Assessment') in support a proposed residential development ('the Development') located at Parkmount Road in Manchester M9, to be referred to hereafter as 'the Site'.

1.2 Purpose of Assessment

- 1.2.1 The Development has the potential to be adversely impacted by noise from road traffic movements on Rochdale Road to the west of the Site.
- 1.2.2 Accordingly, this Assessment has been completed with due regard to the National Planning Policy Framework and its associated National Planning Policy Guidance in addition to appropriate British Standards and guidance documents relevant to the assessment of noise impacts.
- 1.2.3 All acronyms used within this report are defined in the Glossary presented in Appendix 2.

1.3 The Development

- 1.3.1 The Development will comprise of 24 residential dwellings with associated infrastructure.

1.4 The Site, Locality & Soundscape

- 1.4.1 The Site is comprised of open land and is bordered by Parkmount Road to the north, Rochdale Road to the west, Shepherd St to the south and existing residential dwellings to the east.
- 1.4.2 The soundscape on the Site is dominated by road traffic noise from vehicles using Rochdale Road to the west.

1.5 Limitations

- 1.5.1 The limitations of this report are presented in Appendix 1.

1.6 Confidentiality

- 1.6.1 Professional Consult has prepared this report solely for the use of the Client. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Professional Consult; a charge may be levied against such approval.

2 POLICY & GUIDANCE

2.1 National Planning Policy Framework & National Planning Practice Guidance

- 2.1.1 The Government updated the National Planning Policy Framework (NPPF) on 20th July 2021 and its associated National Planning Practice Guidance (NPPG) on 24th June 2021. Together, the NPPF and NPPG set out what the Government expects of local authorities. The overall aim is to ensure the planning system allows land to be used for new homes and jobs, while protecting valuable natural and historic environments.
- 2.1.2 The NPPG adds further context to the NPPF and it is intended that the two documents should be read together.
- 2.1.3 Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.
- 2.1.4 Local planning authorities' plan-making and decision making should take account of the acoustic environment and in doing so consider:
- ② Whether or not a significant adverse effect is occurring or likely to occur;
 - ② Whether or not an adverse effect is occurring or likely to occur; and
 - ② Whether or not a good standard of amenity can be achieved.
- 2.1.5 In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.
- 2.1.6 The Observed Effect Levels are as follows:
- ② Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur;
 - ② Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected; and
 - ② No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.
- 2.1.7 Table 1 summarises the noise exposure hierarchy, based on the likely average response.

Table 1. Noise Exposure Hierarchy

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

2.1.8 The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.

2.1.9 These factors include:

- ② The source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day - this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night;
- ② For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise;
- ② the spectral content of the noise and the general character of the noise. The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.

2.1.10 More specific factors to consider when relevant:

- ② where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration;
- ② Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on

windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can be found in the Building Regulations; and

- ② If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

2.2 BS8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’

Noise Criteria Limits

- 2.2.1 The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.
- 2.2.2 The standard suggests suitable internal noise levels within different types of buildings, including dwellings, as shown in Table 2.

Table 2. BS8233:2014 Internal Target Noise Levels

Criterion	Typical Situation	Design $L_{Aeq,T}$ (dB)
Suitable resting / sleeping conditions	Living Room	35
	Bedroom*	30
*For a Reasonable standard in bedrooms at night, individual noise events (measured with fast time weighting) should not exceed 45dB L_{max}		

- 2.2.3 BS8233 goes on to recommend noise levels for gardens as follows:

“It is desirable that the external noise level does not exceed 50dB $L_{Aeq,T}$, with an upper guideline value of 55dB $L_{Aeq,T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors might be warranted”.

- 2.2.4 BS8233 goes on to say:

“In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces but should not be prohibited”.

- 2.2.5 With regards to external noise within balcony areas, BS8233: 2014 provides the following advice:

“Other locations, such as balconies, roof gardens and terraces, are also important in residential buildings where normal external amenity space might be limited or not available, i.e. in flats, apartment blocks, etc. In these locations, specification of noise limits is not necessarily appropriate. Small balconies may be included for uses such as drying washing or growing pot plants, and noise limits should not be necessary for these uses. However, the general guidance on noise in amenity space is still appropriate for larger balconies, roof gardens and terraces, which might be intended to be used for relaxation. In high-noise areas, consideration should be given to protecting these areas by screening or building design to achieve the lowest practicable levels”

Ventilation Requirements

- 2.2.6 Where a partially open window cannot be relied upon to provide an adequate level of facade sound insulation performance, it is necessary to consider alternative ventilation for habitable rooms. Section 8.4.5.4 within BS8233 states:

“The Building Regulations’ supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant’s choice.

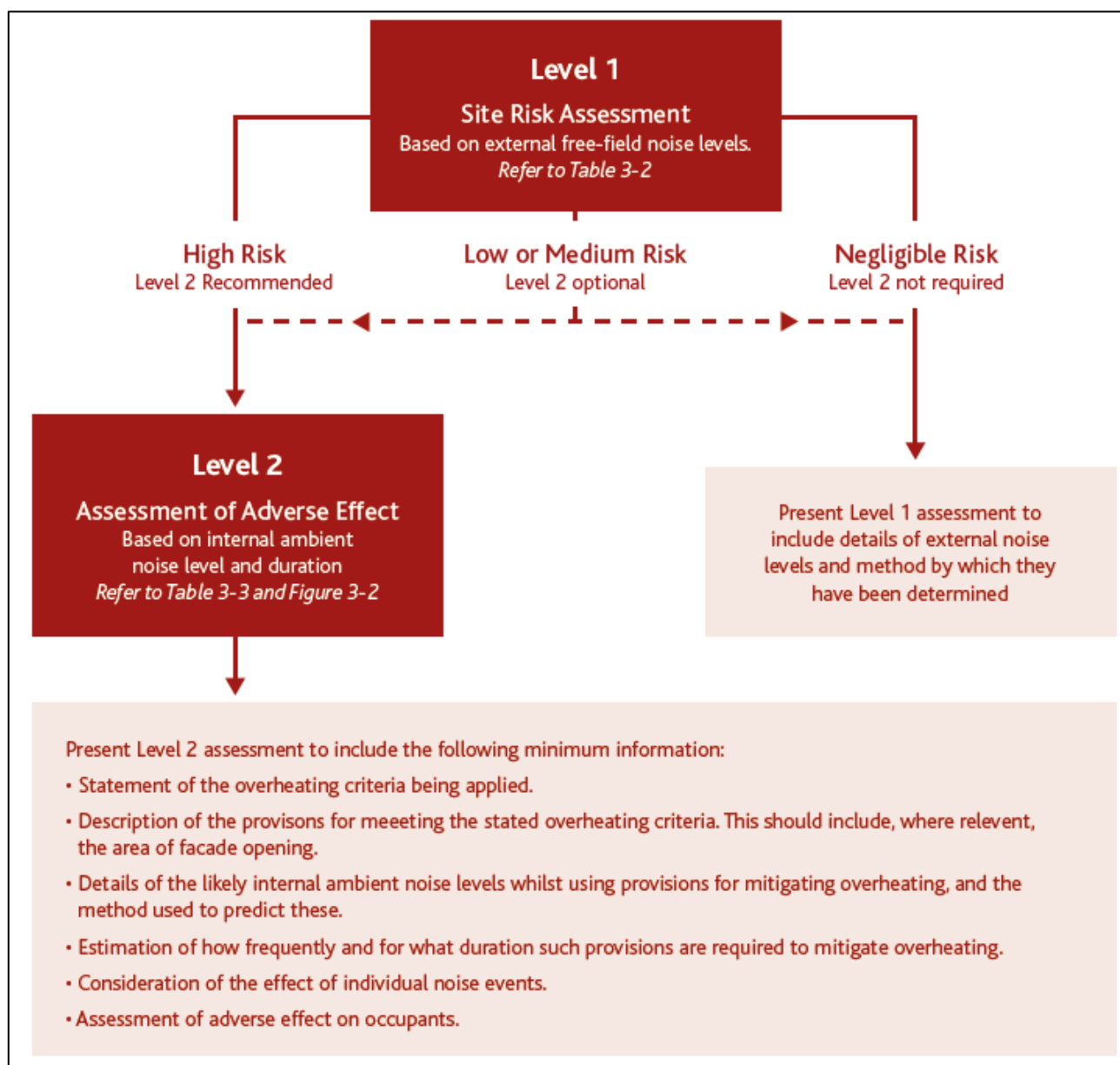
Alternatively, acoustic ventilation units (see 7.7.2 below) are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans.”

Section 7.7.2 states:

“NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level.”

2.3 INSTITUTE OF ACOUSTICS AND ASSOCIATION OF NOISE CONSULTANTS (2020) ACOUSTICS VENTILATION & OVERHEATING: RESIDENTIAL DESIGN GUIDE

2.3.1 The Acoustics Ventilation and Overheating (AVO) Residential Design Guide provides an approach as to how the competing aspects of thermal and acoustic comfort can be managed. The AVO Guide aims to assist designers to adopt an integrated approach to the acoustic design within the context of the ventilation and thermal comfort requirements. The AVO Guide provides a method for assessing the impact of opening windows and providing whole house ventilation due to the impact of noise via a two-level noise assessment procedure, as below:



2.3.2 A level 1 risk assessment is based on external free-field noise levels with the assumption of a partially opened window in use for mitigation of overheating. A level 1 assessment is appropriate for scenarios where the risk to a development is deemed 'Negligible'. 'Low' and 'Medium' risk sites only require a level 2 assessment on an optional basis in order to give further confidence in the suitability of internal noise conditions.

2.3.3 The noise levels suggested in Tables 3 and 4 assume steady road traffic noise source but can be adapted for other transport sources.

Table 3. Guidance for Level 1 Site Risk Assessment for Transportation Noise Sources Relating to Overheating Condition

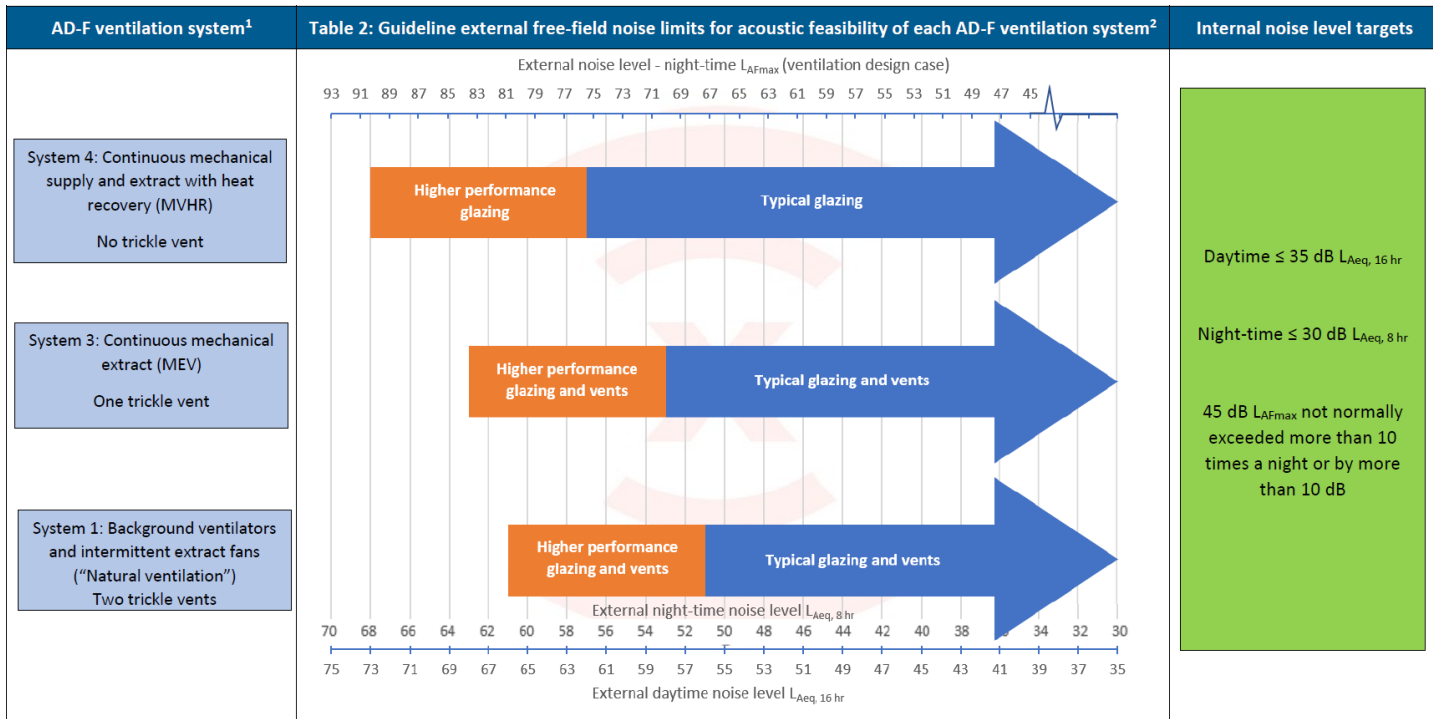
Risk Category for Level 1 Assessment - External		Risk Level	Potential Effect Without Mitigation	Recommendation for Level 2 Assessment
Daytime Noise Level, $L_{Aeq,t}$ (07:00 – 23:00)	Night-time Noise Level, $L_{Aeq,t}$ (23:00 – 07:00)			
$\geq 65\text{dB}$	$\geq 55\text{dB}$	High	Increasing risk of adverse effect	Recommended
$>55\text{dB}$ & $<63\text{dB}$	>45 & $<55\text{dB}$	Medium		Optional
$>50\text{dB}$ & $<55\text{dB}$		Low		
$\leq 50\text{dB}$	$\leq 45\text{dB}$	Negligible	Use of opening windows as means of mitigating overheating is not likely to result in in adverse effect	Not required

2.3.4 A level 2 assessment will be carried out when the risk of adverse effect is ‘High’ or it is deemed appropriate for a ‘low’ or ‘medium’ risk site. An increase in internal ambient noise level can cause a change in human behaviour. At high levels this creates situations where occupants can no longer open windows for ventilation due to high external noise levels. A level 2 assessment identifies these situations and allows for appropriate alternative ventilation systems to be recommended.

Table 4. Guidance for Level 2 Assessment of Noise from Transport Noise Sources Relating to Overheating Condition

Internal Ambient Noise Level			Example of Outcome
Daytime $L_{Aeq,t}$ (07:00 – 23:00)	Night-time $L_{Aeq,t}$ (23:00 – 07:00)	Individual Noise Events During 23:00 – 07:00	
$>50\text{dB}$	$>42\text{dB}$	Normally exceeds $65\text{dB } L_{Af,max}$	Noise causes a material change in behaviour eg. having to keep windows closed most of the time
Increasing noise level			Increasing the likelihood of impact on reliable speech communication during the daytime or sleep disturbance at night

2.3.5 The Table below details guideline external free-field noise limits and determines the appropriate AD-F ventilation system (Systems 1 – 4).



Approved Document O of the Building Regulations 2010

2.3.6 This approved document supports Part O of Schedule 1 to the Building Regulations 2010 and took effect on 15th June 2022 for use in England.

2.3.7 Section 3 of the approved document details the requirements for noise ingress into a bedroom and states the following:

‘In locations where external noise may be an issue (for example, where the local planning authority considered external noise to be an issue at the planning stage), the overheating mitigation strategy should take account of the likelihood that windows will be closed during sleeping hours (11pm to 7am).

Windows are likely to be closed during sleeping hours if noise within bedrooms exceeds the following limits.

- a. 40dB $L_{Aeq,T}$, averaged over 8 hours (between 11pm and 7am); and*
- b. 55dB L_{AFmax} , more than 10 times a night (between 11pm and 7am).’*

2.3.8 The above internal noise criteria levels are higher than those presented in BS8233:2014 and so the trigger point for alternative ventilation for bedrooms, where required, will be dictated primarily by the assessment which considers compliance with the BS8233:2014 internal noise criteria levels. Nevertheless, compliance with the above noise criteria levels will be observed where the internal average and maximum noise levels with a partially open window, or where recommended appropriate alternative ventilation for the bedroom, results in noise levels not exceeding the above noise criteria levels.

2.3.9 The ‘night-time façade noise levels’ presented in the rear of this Assessment includes an assessment confirming whether compliance is achieved with the above average noise criteria level presented in the approved document. The ‘Mitigation’ section of this Assessment considers the maximum noise levels and whether compliance is achieved.

2.4 Local Authority Guidance and Criteria – Manchester City Council’s Environmental Health Department

2.4.1 Consultation was provided to Manchester City Council on Tuesday 16th May 2023 which stated:

‘We have been appointed by a client to complete a Noise Impact Assessment in support of the proposed residential development on a parcel of land located off Princedom St and Jonas St in Harpurhey, Manchester M9.

The site is likely to be impacted by noise generated by road traffic movements on Princedom Street. We will complete a Noise Impact Assessment in line with the guidance presented in BS8233:2014. Where exceedances of any noise criteria are identified, we will recommend appropriate and reasonable mitigation measures to ensure that adopted noise level criteria is not exceeded.

Professional Consult will issue a Noise Impact Assessment which will be suitable in accompanying the scheme planning application.

If you could please confirm your agreement to the above methodology or provide any commentary that would be appreciated.’

2.4.2 A response was received on Wednesday 17th May providing details of the Council’s document ‘Planning & Noise – Technical Guidance’, issued October 2022.

2.5 Manchester City Council – Planning & Noise – Technical Guidance October 2022

2.5.1 Section 3.7.1.1 of the Guidance Document provides the following noise criteria which must be adhered to at new residential development, with regards to transportation noise:

- ② Bedrooms (night time - 23.00 - 07.00): 30 dB L_{Aeq} (individual noise events should not normally exceed 45 dB $L_{Amax,F}$ by more than 10 times);
- ② Living Rooms (daytime - 07.00 - 23.00): 35 dB L_{Aeq} ; and
- ② Gardens and terraces (daytime): 55 dB L_{Aeq} .

2.5.2 Section 3.7.1.5 (Industrial / commercial developments) of the Guidance Document provides the following advice for commercial or industrial noise impacts upon residential dwellings:

'BS 4142 should be used to assess the likely impact of noise from industrial and commercial sources at noise sensitive premises (section 3.5). One of the indications of the impact of a BS 4142 assessment is the lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context.'

The Council consider that new developments should contribute and enhance the area in which they are located and where possible i.e. prevent 'noise creep', contribute to the improvement of people's health and quality of life as per the NPSE. With this in mind, the design objective should be:

The development should be designed so as to achieve a rating level of 5dB (L_{Aeq}) below the typical background (LA_{90}) level at the nearest noise sensitive location.'

3 NOISE SURVEYS

3.1 Road Traffic Noise Survey

3.1.1 Professional Consult has completed noise measurements as follows:

- ② **Noise Measurement Position 1:** Located 4m from the nearside kerb of Rochdale Road between 13:15 – 16:15 on Wednesday 17th May 2023. Noise sources at the measurement location comprised solely continuous road traffic movements on Rochdale Road. In the northern part of the Site, intermittent noise from vehicles using Parkmount Road is audible, albeit to a much lower level than vehicles using Rochdale Road. Accordingly, it was not considered necessary to undertake a road traffic noise measurement for Parkmount Road.

3.1.2 Table 5 presents the measured road traffic noise levels:

Table 5. Summary of Measured Road Traffic Noise Levels

Table 3: Summary of Measured Road Traffic Noise Levels				
Measurement Position	Period	Measured Sound Pressure Level (dB)		
		L _{Aeq,1hr}	L _{A10,1hr}	L _{Amax,fast}
1	17/05/2023 13:05	64.6	67.2	79.5
	17/05/2023 14:05	66.7	67	
	17/05/2023 15:05	63.7	66.5	
*10 th highest L _{Amax,fast}				

3.2 Noise Survey Equipment

3.2.1 The following equipment was used for the noise and vibration surveys.

Table 6. Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No	Serial No.	Calibration Due Date
NMP1	Sound Level Meter	01dB Fusion	12211	19 January 2024
	Pre-amplifier	01dB PRE22	1915082	
	Microphone	GRAS 40CD	331766	
	Calibrator	01dB CAL-31	89095	29 June 2023

3.2.2 The sound level meters were field calibrated prior to and following the noise surveys and there was no drift beyond the allowable limit of 1dB.

3.2.3 Table 7 indicates a summary of the measured weather conditions.

Table 7. Range of Measured Wind Speeds

Period	Range of Measured Wind Speeds (m/s)	Rainfall Recorded?
All periods	0 – 0.6	No

4 NOISE IMPACT ASSESSMENT

4.1 Road Traffic

4.1.1 For the purposes of this assessment, the daytime and night-time average ($L_{Aeq,T}$) noise levels have been calculated based on the shortened measurement procedure detailed in CRTN. The respective daytime and night-time noise levels have been derived using the following calculations:

- Calculation of the $L_{A10,18hr}$ noise level by using the following formula:

$$L_{10,18hr} = L_{10,3hr} - 1dB$$

- Calculation of the $L_{Aeq,16hr}$ noise level by using the following formula:

$$L_{eq,16hr} = L_{10,18hr} - 2dB$$

- Derivation of the night-time $L_{Aeq,8hr}$ noise level by using the following formula:

$$L_{night} (L_{eq,8hr}) = (0.90 \times L_{10,18hr}) - 3.77dB$$

4.1.2 Table 8 calculates the daytime and night-time noise levels for Parkmount Road.

Table 8. Calculation of Road Traffic Noise Levels

Measurement Position	Period	Calculated $L_{Aeq,t}$ (dB)	10 th Highest Measured $L_{Amax,fast}$ (dB)	Distance from Centre of Road (m)
NMP1	Daytime (07:00 – 23:00)	63.9	-	7.5
	Night-Time (23:00 – 07:00)	55.5	79.5	

4.1.3 For the purposes of this assessment, Professional Consult has used noise modelling software CadnaA to determine the impact of noise from Parkmount Road at the proposed residential dwellings. A noise model has therefore been constructed in order to calculate façade noise levels and external noise levels in amenity areas.

4.1.4 The following inputs have been included in the model:

- Proposed Scheme Layout;
- Site elevations have been taken as existing;
- Existing buildings or features that provide shielding from the road have been included in the model;
- Noise Measurement Position 1 has been used in order to calibrate the noise model;
- A floor height of 3m has been assumed for all proposed dwellings which is a standard separation distance between ground and first floors in a typical dwelling;
- A reflection order of 2 has been used in all calculations;
- The dwellings have been taken to be 7.5m to apex for the 2-storey dwellings and 10.5m for the 3-storey dwellings; and,

- ② Noise levels generated using ISO 9613-1 and ISO 9613-2 “Acoustics – Attenuation of sound during propagation outdoors” as incorporated into CadnaA software.

External Noise Impact in Garden Areas of Proposed Dwellings

- 4.1.5 In order to assess noise levels in external amenity areas across the Site, a grid noise map was calculated (Figure 1 of Appendix 4) in the noise model. The grid noise map shows that the majority of all garden areas fall below the adopted 55dB $L_{Aeq,16hr}$ criteria noise level. It should be noted that this is due to the implementation of good acoustic design along the western boundary of the Site. However, parts of the garden areas of plots 1, 8 and 18 exceed the 55dB $L_{Aeq,16hr}$ and so the the following section recommends appropriate mitigation measures in order to achieve the 55dB $L_{Aeq,16hr}$ noise criteria.

Internal Noise Impact for Proposed Dwellings

- 4.1.6 With regards internal noise levels, BS8233:2014 suggests that standard thermal double glazing will afford 33dB R_w of sound reduction, however this is for the pink noise spectrum and the same configuration will afford 30dB R_w+C_{tr} for average noise levels from road traffic noise and so this value has been used to calculate internal noise levels. With regard to the maximum noise level ($L_{Amax,fast}$), the value of 33dB R_w has been used. BS8233:2014 also goes on to recommend that a partially open window provides approximately 15dB of attenuation.
- 4.1.7 Professional Consult uses a library database of glazing configurations issued by Saint Gobain and the glazing configuration 6mm glass / 12mm air space / 6mm glass affords 30dB $R_w + C_{tr}$ and 33dB R_w respectively.
- 4.1.8 Appendix 7 calculates the average daytime noise levels at the various facades of the plots and determines the requirement for upgraded glazing or alternative ventilation. Appendix 7 indicates that standard thermal double glazing will be adequate in controlling external noise to meet the internal noise criteria limits. However, a number of living rooms will require alternative ventilation and so the following section considers appropriate noise mitigation.
- 4.1.9 Appendix 8 calculates the average night-time noise levels at the various facades of the plots and determines the requirement for upgraded glazing or alternative ventilation for bedrooms. Appendix 8 indicates that standard thermal double glazing will be adequate in controlling external noise to meet the internal noise criteria limits. However, a number of bedrooms will require alternative ventilation and so the following section considers appropriate noise mitigation.
- 4.1.10 It is also necessary to consider maximum noise levels, for the night-time period for bedrooms only, in addition to the average noise levels. The measured 10th highest maximum noise level for the Parkmount Road was 79.5dB at 7.5m from the centre of the road. Based on a 33dB reduction for standard thermal glazing the internal noise levels will be exceeded by 1.5dB at Plots 1 to 18. Therefore, upgraded glazing is required for and bedrooms located on the western façade of plots 1 to 18, and so the following section considers appropriate noise mitigation.
- 4.1.11 Table 9 below calculates the internal noise level at the closest proposed façade with a partially open window and compares the predicted noise level to the internal $L_{Amax,fast}$ criteria in BS8233 and Part O.

Table 9. Maximum Noise Level Assessment - Bedrooms

Road	Applicable Standard / Guidance Document	10 th Highest Measured Max Noise Level L_{Amax} (dB)	Measurement Distance to Centre (m)	Distance to Closest Proposed Dwelling (m)	Sound Reduction for Partially Open Window (dB)	Calculated Max Internal Noise Level L_{Amax} (dB)	Max Internal Noise Criteria Level L_{Amax} (dB)	Difference +/- (dB)
Parkmount Road	BS8233:2014	79.5	7.5	7.5	-13	66.5	45	+21.5

	AD-O	79.5	7.5	7.5	-13	66.5	55	+11.5
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4.1.12 Table 11 shows that with a partially open window, the maximum noise level will exceed criteria of BS8233 by 21.5dB for the closest façade to the Parkmount Road. The following Section recommends suitable mitigation measures.

5 MITIGATION

5.1 Road Traffic

- 5.1.1 With regards to external average noise levels in garden areas the previous section has shown that parts of the garden areas of plots 1, 8 and 18 exceed the 55dB $L_{Aeq,16hr}$. As such, a noise barrier is recommended for the edges of garden areas, the height of the barrier required to achieve 55dB $L_{Aeq,16hr}$ is 1.8m. With the noise barriers in place, the garden areas achieve 55dB $L_{Aeq,16hr}$ across the entire garden area.
- 5.1.2 Figure 1 of Appendix 6 shows the location of the proposed barriers. The acoustic barriers should have a minimum mass of 15kg/m², be free from holes and be sealed at their base.
- 5.1.3 With regards to internal average noise levels in habitable rooms, the previous section has indicated that various living room and bedroom windows will require alternative ventilation as per the schedule set out in Appendices 8 and 9 of this Assessment which accord with the requirements of the AVO Design Guide.
- 5.1.4 With regards to maximum noise levels in bedrooms, the previous section has shown that any bedrooms located on the western façade of plots 1 to 18 will require upgraded glazing provides a reduction of 35dB_{RW}. For the remaining plots that are set back further from the road standard thermal double glazing will be sufficient.
- 5.1.5 It has been shown that any bedroom window located on the western façade of plots 1 to 18 will require the recommended alternative ventilation. This is in line with the recommendations made in Appendices 7 and 8 of this Assessment.

6 CONCLUSION

- 6.1.1 Professional Consult Limited was instructed by AEW Architects, to prepare a Noise Impact Assessment in support of a proposed residential development located at Parkmount Road in Manchester M8.
- 6.1.2 The Site is comprised of open land and is bordered by Parkmount Road to the north, Rochdale Road to the west, Shepherd St to the south and existing residential dwellings to the east.
- 6.1.3 The soundscape on the Site is dominated by road traffic noise from vehicles using Rochdale Road to the west.
- 6.1.4 The Development will comprise of 24 residential dwellings with associated infrastructure.
- 6.1.5 The Development has the potential to be adversely impacted by noise from road traffic movements on Rochdale Road to the west of the Site.
- 6.1.6 Accordingly, this Assessment has been completed with due regard to the National Planning Policy Framework and its associated National Planning Policy Guidance in addition to appropriate British Standards and guidance documents relevant to the assessment of noise impacts.
- 6.1.7 This Assessment has shown that, with regards to road traffic noise within internal habitable rooms, various living room and bedroom windows will require alternative ventilation as per the schedule set out in Appendices 8 and 9 of this Assessment which accord with the requirements of the AVO Design Guide. In addition, any bedroom located on the western façades of plots 1 to 18 will require upgraded glazing that provides a sound reduction of at least 35dB R_w.
- 6.1.8 This Assessment has shown that, with regards to road traffic noise in external amenity space, all garden areas achieve the 55dB L_{Aeq 16hr} criteria following the implementation of noise mitigation measures.
- 6.1.9 The existing noise climate around the Site is sufficiently low enough which affords noise levels in external and internal habitable areas of the Site which accord with the 'No Observed Adverse Effect Level' as detailed in the PPG and as such noise should not be deemed to be a determining factor in the granting of planning permission for this Site.

APPENDIX 1: LIMITATIONS

This report and its findings should be considered in relation to the terms of reference and objectives agreed between Professional Consult Limited and the Client.

The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

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APPENDIX 2: GLOSSARY OF ACOUSTIC TERMINOLOGY

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table 1: Typical Sound Pressure Levels

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

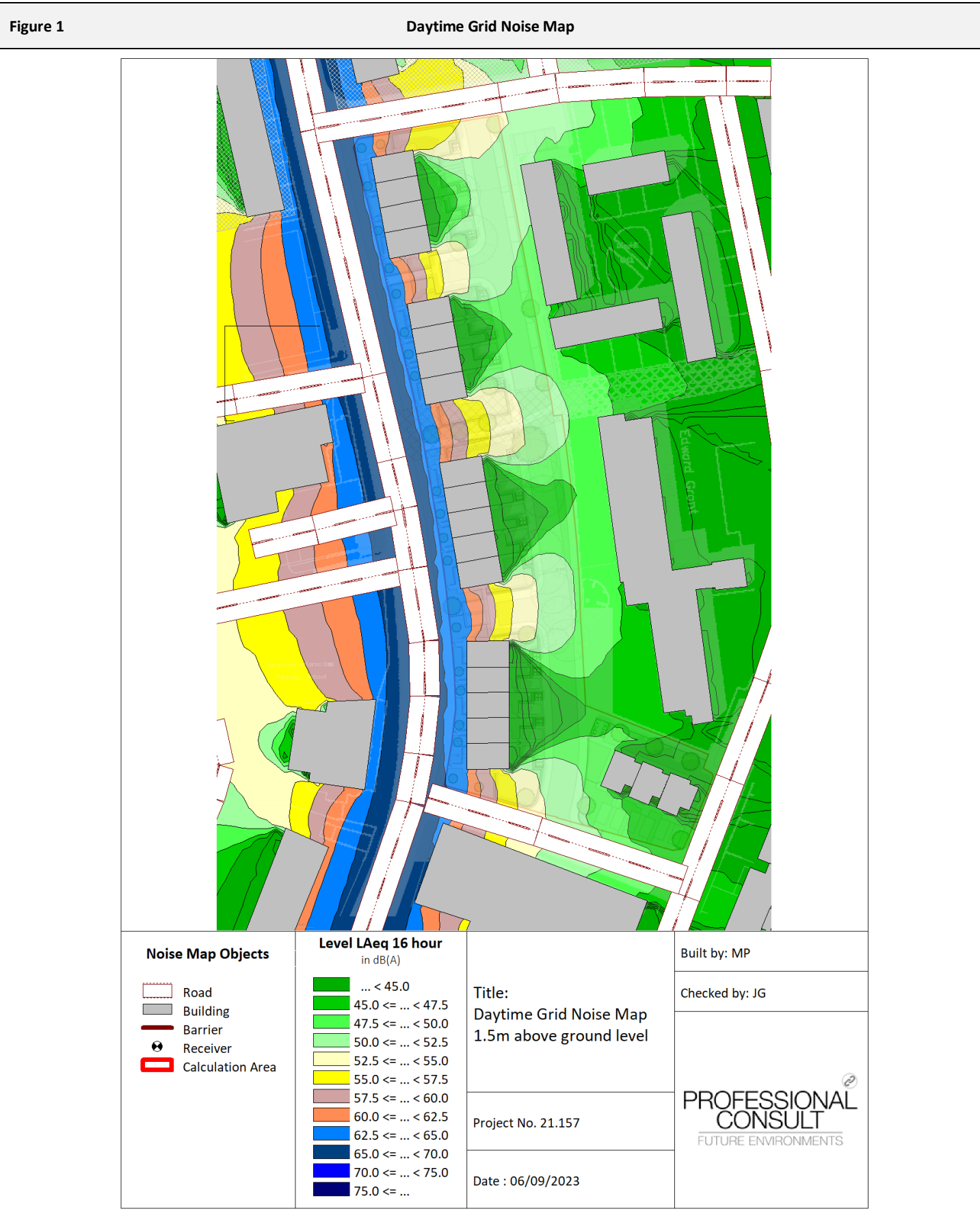
Table 2: Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10 ⁻⁵ Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
L _{Aeq, T}	L _{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L _{Amax}	L _{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L _{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L ₁₀ & L ₉₀	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L ₁₀ is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L ₉₀ is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L ₁₀ index to describe traffic noise.
Free-field Level	2A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX 3: SITE LOCATION PLAN & NOISE MEASUREMENT POSITION



APPENDIX 4: DAYTIME GRID NOISE MAP



APPENDIX 5: NIGHT-TIME GRID NOISE MAP



APPENDIX 6: DAYTIME GRID NOISE MAP – WITH MITIGATION



APPENDIX 7: DAYTIME FAÇADE NOISE LEVELS - GROUND FLOOR

Plot	Floor	Façade Direction	Calculated LAeq,16hr at Façade (dB)	Glazing Sound Reduction Index (Rw) (Standard Thermal)	Calculated Noise Level Inside Room (dB)	Criteria (dB)	Difference +/- (dB)	Required Sound Insulation Performance for Glazing (Rw +Ctr) (dB)	Calculated Internal Noise Level with a Partially Open Window (dB)	Alternative Ventilation Required?	Acoustics Ventilation & Overheating Assessment - Appropriate AD-F System	Example Alternative Ventilation Scheme
Plot 1	Ground	E	42.2	30	12.2	35	-22.8	7.2	29.2	No	N/A	N/A
Plot 1	Ground	N	58.5	30	28.5	35	-6.5	23.5	45.5	Yes	ADF System 3	Centralised / decentralised MEV System
Plot 1	Ground	W	63.5	30	33.5	35	-1.5	28.5	50.5	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 2	Ground	W	63.5	30	33.5	35	-1.5	28.5	50.5	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 2	Ground	E	42.3	30	12.3	35	-22.7	7.3	29.3	No	N/A	N/A
Plot 3	Ground	W	63.6	30	33.6	35	-1.4	28.6	50.6	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 3	Ground	E	42.3	30	12.3	35	-22.7	7.3	29.3	No	N/A	N/A
Plot 4	Ground	W	63.7	30	33.7	35	-1.3	28.7	50.7	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 4	Ground	S	58.1	30	28.1	35	-6.9	23.1	45.1	Yes	ADF System 3	Centralised / decentralised MEV System
Plot 4	Ground	E	41.8	30	11.8	35	-23.2	6.8	28.8	No	N/A	N/A
Plot 5	Ground	E	42	30	12	35	-23	7	29	No	N/A	N/A
Plot 5	Ground	N	56.7	30	26.7	35	-8.3	21.7	43.7	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 5	Ground	W	63	30	33	35	-2	28	50	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 6	Ground	W	63.2	30	33.2	35	-1.8	28.2	50.2	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 6	Ground	E	41.5	30	11.5	35	-23.5	6.5	28.5	No	N/A	N/A
Plot 7	Ground	W	63.3	30	33.3	35	-1.7	28.3	50.3	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 7	Ground	E	41.2	30	11.2	35	-23.8	6.2	28.2	No	N/A	N/A
Plot 8	Ground	W	63.4	30	33.4	35	-1.6	28.4	50.4	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 8	Ground	S	58.2	30	28.2	35	-6.8	23.2	45.2	Yes	ADF System 3	Centralised / decentralised MEV System
Plot 8	Ground	E	40.6	30	10.6	35	-24.4	5.6	27.6	No	N/A	N/A
Plot 9	Ground	E	41	30	11	35	-24	6	28	No	N/A	N/A
Plot 9	Ground	N	58	30	28	35	-7	23	45	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 9	Ground	W	63.5	30	33.5	35	-1.5	28.5	50.5	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 10	Ground	W	63.6	30	33.6	35	-1.4	28.6	50.6	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 10	Ground	E	39.7	30	9.7	35	-25.3	4.7	26.7	No	N/A	N/A
Plot 11	Ground	W	63.5	30	33.5	35	-1.5	28.5	50.5	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 11	Ground	E	39.2	30	9.2	35	-25.8	4.2	26.2	No	N/A	N/A
Plot 12	Ground	W	63.6	30	33.6	35	-1.4	28.6	50.6	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 12	Ground	E	39	30	9	35	-26	4	26	No	N/A	N/A
Plot 13	Ground	W	63.4	30	33.4	35	-1.6	28.4	50.4	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 13	Ground	S	58.5	30	28.5	35	-6.5	23.5	45.5	Yes	ADF System 3	Centralised / decentralised MEV System
Plot 13	Ground	E	37.9	30	7.9	35	-27.1	2.9	24.9	No	N/A	N/A
Plot 14	Ground	E	34.3	30	4.3	35	-30.7	-0.7	21.3	No	N/A	N/A
Plot 14	Ground	N	57.4	30	27.4	35	-7.6	22.4	44.4	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 14	Ground	W	63.2	30	33.2	35	-1.8	28.2	50.2	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 15	Ground	W	63.4	30	33.4	35	-1.6	28.4	50.4	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 15	Ground	E	35.8	30	5.8	35	-29.2	0.8	22.8	No	N/A	N/A
Plot 16	Ground	W	63.4	30	33.4	35	-1.6	28.4	50.4	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 16	Ground	E	36.2	30	6.2	35	-28.8	1.2	23.2	No	N/A	N/A
Plot 17	Ground	W	63.3	30	33.3	35	-1.7	28.3	50.3	Yes	ADF System 4	MVHR without Trickle Ventilators
Plot 17	Ground	E	36	30	6	35	-29	1	23	No	N/A	N/A
Plot 18	Ground	W	63.1	30	33.1	35	-1.9	28.1	50.1	Yes	ADF System 4	MVHR without Trickle Ventilators

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Plot 18	Ground	S	57.1	30	27.1	35	-7.9	22.1	44.1	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 18	Ground	E	34.2	30	4.2	35	-30.8	-0.8	21.2	No	N/A	N/A
Plot 19 - 20	Ground	N	41.8	30	11.8	35	-23.2	6.8	28.8	No	N/A	N/A
Plot 19 - 20	Ground	W	48.8	30	18.8	35	-16.2	13.8	35.8	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 20	Ground	S	48	30	18	35	-17	13	35	No	N/A	N/A
Plot 21 - 22	Ground	N	41.8	30	11.8	35	-23.2	6.8	28.8	No	N/A	N/A
Plot 21 - 22	Ground	SW	46.7	30	16.7	35	-18.3	11.7	33.7	No	N/A	N/A
Plot 23 - 24	Ground	N	41.2	30	11.2	35	-23.8	6.2	28.2	No	N/A	N/A
Plot 23 - 24	Ground	S	45.6	30	15.6	35	-19.4	10.6	32.6	No	N/A	N/A
Plot 23 - 24	Ground	E	31.7	30	1.7	35	-33.3	-3.3	18.7	No	N/A	N/A
Plot 19 - 20	1st	N	42.7	30	12.7	35	-22.3	7.7	29.7	No	N/A	N/A
Plot 19 - 20	1st	W	49.4	30	19.4	35	-15.6	14.4	36.4	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 19 - 20	1st	S	48.6	30	18.6	35	-16.4	13.6	35.6	Yes	ADF Systems 1 or 2	Acoustic-grade Trickle Ventilator
Plot 21 - 22	1st	N	42.6	30	12.6	35	-22.4	7.6	29.6	No	N/A	N/A
Plot 21 - 22	1st	SW	47.4	30	17.4	35	-17.6	12.4	34.4	No	N/A	N/A
Plot 23 - 24	1st	N	42.1	30	12.1	35	-22.9	7.1	29.1	No	N/A	N/A
Plot 23 - 24	1st	S	46.3	30	16.3	35	-18.7	11.3	33.3	No	N/A	N/A
Plot 23 - 24	1st	E	34.5	30	4.5	35	-30.5	-0.5	21.5	No	N/A	N/A

APPENDIX 8: NIGHT-TIME FAÇADE NOISE LEVELS – 1ST FLOOR

Plot	Façade Direction	Calculated LAeq,8hr at Façade (dB)	Glazing Sound Reduction Index (Rw) (Standard Thermal)	Calculated Noise Level Inside Room (dB)	Criteria (dB)	Difference +/- (dB)	Required Sound Insulation Performance for Glazing (Rw +Ctr) (dB)	Calculated Internal Noise Level with a Partially Open Window (dB)	Alternative Ventilation Required?	Do Average Night-time Internal Noise Levels Achieve Compliance with AD-O?	Acoustics Ventilation & Overheating Assessment - Appropriate AD-F System	Example Alternative Ventilation Scheme
Plot 1	1st	E	34.7	30	4.7	30	-25.3	4.7	21.7	No	Yes	N/A
Plot 1	1st	N	50.5	30	20.5	30	-9.5	20.5	37.5	Yes	Yes	ADF Systems 1 or 2
Plot 1	1st	W	55.4	30	25.4	30	-4.6	25.4	42.4	Yes	Yes	ADF System 3
Plot 2	1st	W	55.4	30	25.4	30	-4.6	25.4	42.4	Yes	Yes	ADF System 3
Plot 2	1st	E	35.1	30	5.1	30	-24.9	5.1	22.1	No	Yes	N/A
Plot 3	1st	W	55.4	30	25.4	30	-4.6	25.4	42.4	Yes	Yes	ADF System 3
Plot 3	1st	E	35.1	30	5.1	30	-24.9	5.1	22.1	No	Yes	N/A
Plot 4	1st	W	55.5	30	25.5	30	-4.5	25.5	42.5	Yes	Yes	ADF System 3
Plot 4	1st	S	50.2	30	20.2	30	-9.8	20.2	37.2	Yes	Yes	ADF Systems 1 or 2
Plot 4	1st	E	34.3	30	4.3	30	-25.7	4.3	21.3	No	Yes	N/A
Plot 5	1st	E	34.5	30	4.5	30	-25.5	4.5	21.5	No	Yes	N/A
Plot 5	1st	N	48.8	30	18.8	30	-11.2	18.8	35.8	Yes	Yes	ADF Systems 1 or 2
Plot 5	1st	W	54.9	30	24.9	30	-5.1	24.9	41.9	Yes	Yes	ADF System 3
Plot 6	1st	W	55	30	25	30	-5	25	42	Yes	Yes	ADF System 3
Plot 6	1st	E	34.3	30	4.3	30	-25.7	4.3	21.3	No	Yes	N/A
Plot 7	1st	W	55.1	30	25.1	30	-4.9	25.1	42.1	Yes	Yes	ADF System 3
Plot 7	1st	E	34.1	30	4.1	30	-25.9	4.1	21.1	No	Yes	N/A
Plot 8	1st	W	55.2	30	25.2	30	-4.8	25.2	42.2	Yes	Yes	ADF System 3
Plot 8	1st	S	50.3	30	20.3	30	-9.7	20.3	37.3	Yes	Yes	ADF Systems 1 or 2
Plot 8	1st	E	33.2	30	3.2	30	-26.8	3.2	20.2	No	Yes	N/A
Plot 9	1st	E	34.2	30	4.2	30	-25.8	4.2	21.2	No	Yes	N/A
Plot 9	1st	N	50.1	30	20.1	30	-9.9	20.1	37.1	Yes	Yes	ADF Systems 1 or 2
Plot 9	1st	W	55.3	30	25.3	30	-4.7	25.3	42.3	Yes	Yes	ADF System 3
Plot 10	1st	W	55.4	30	25.4	30	-4.6	25.4	42.4	Yes	Yes	ADF System 3
Plot 10	1st	E	33.3	30	3.3	30	-26.7	3.3	20.3	No	Yes	N/A
Plot 11	1st	W	55.4	30	25.4	30	-4.6	25.4	42.4	Yes	Yes	ADF System 3
Plot 11	1st	E	32.8	30	2.8	30	-27.2	2.8	19.8	No	Yes	N/A
Plot 12	1st	W	55.3	30	25.3	30	-4.7	25.3	42.3	Yes	Yes	ADF System 3
Plot 12	1st	E	32.6	30	2.6	30	-27.4	2.6	19.6	No	Yes	N/A
Plot 13	1st	W	55.2	30	25.2	30	-4.8	25.2	42.2	Yes	Yes	ADF System 3
Plot 13	1st	S	50.5	30	20.5	30	-9.5	20.5	37.5	Yes	Yes	ADF Systems 1 or 2
Plot 13	1st	E	30.9	30	0.9	30	-29.1	0.9	17.9	No	Yes	N/A
Plot 14	1st	E	27.9	30	-2.1	30	-32.1	-2.1	14.9	No	Yes	N/A
Plot 14	1st	N	49.5	30	19.5	30	-10.5	19.5	36.5	Yes	Yes	ADF Systems 1 or 2
Plot 14	1st	W	55	30	25	30	-5	25	42	Yes	Yes	ADF System 3
Plot 15	1st	W	55.1	30	25.1	30	-4.9	25.1	42.1	Yes	Yes	ADF System 3
Plot 15	1st	E	30.1	30	0.1	30	-29.9	0.1	17.1	No	Yes	N/A
Plot 16	1st	W	55.1	30	25.1	30	-4.9	25.1	42.1	Yes	Yes	ADF System 3
Plot 16	1st	E	30.5	30	0.5	30	-29.5	0.5	17.5	No	Yes	N/A
Plot 17	1st	W	55.1	30	25.1	30	-4.9	25.1	42.1	Yes	Yes	ADF System 3
Plot 17	1st	E	30.3	30	0.3	30	-29.7	0.3	17.3	No	Yes	N/A
Plot 18	1st	W	54.9	30	24.9	30	-5.1	24.9	41.9	Yes	Yes	ADF System 3
Plot 18	1st	S	49.1	30	19.1	30	-10.9	19.1	36.1	Yes	Yes	ADF Systems 1 or 2
Plot 18	1st	E	27.8	30	-2.2	30	-32.2	-2.2	14.8	No	Yes	N/A
Plot 19 - 20	1st	N	34.4	30	4.4	30	-25.6	4.4	21.4	No	Yes	N/A
Plot 19 - 20	1st	W	41.1	30	11.1	30	-18.9	11.1	28.1	No	Yes	N/A
Plot 19 - 20	1st	S	40.2	30	10.2	30	-19.8	10.2	27.2	No	Yes	N/A
Plot 21 - 22	1st	N	34.3	30	4.3	30	-25.7	4.3	21.3	No	Yes	N/A
Plot 21 - 22	1st	SW	39	30	9	30	-21	9	26	No	Yes	N/A
Plot 23 - 24	1st	N	33.7	30	3.7	30	-26.3	3.7	20.7	No	Yes	N/A
Plot 23 - 24	1st	S	37.9	30	7.9	30	-22.1	7.9	24.9	No	Yes	N/A
Plot 23 - 24	1st	E	26.1	30	-3.9	30	-33.9	-3.9	13.1	No	Yes	N/A
Plot 1	2nd	E	35.9	30	5.9	30	-24.1	5.9	22.9	No	Yes	N/A
Plot 1	2nd	N	50.3	30	20.3	30	-9.7	20.3	37.3	Yes	Yes	ADF Systems 1 or 2
Plot 1	2nd	W	54.9	30	24.9	30	-5.1	24.9	41.9	Yes	Yes	ADF System 3

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Plot 1	2nd	S	37.4	30	7.4	30	-22.6	7.4	24.4	No	Yes	N/A
Plot 4	2nd	N	38	30	8	30	-22	8	25	No	Yes	N/A
Plot 4	2nd	W	55	30	25	30	-5	25	42	Yes	Yes	ADF System 3
Plot 4	2nd	S	49.9	30	19.9	30	-10.1	19.9	36.9	Yes	Yes	ADF Systems 1 or 2
Plot 4	2nd	E	35.5	30	5.5	30	-24.5	5.5	22.5	No	Yes	N/A
Plot 5	2nd	E	35.6	30	5.6	30	-24.4	5.6	22.6	No	Yes	N/A
Plot 5	2nd	N	48.7	30	18.7	30	-11.3	18.7	35.7	Yes	Yes	ADF Systems 1 or 2
Plot 5	2nd	W	54.5	30	24.5	30	-5.5	24.5	41.5	Yes	Yes	ADF System 3
Plot 5	2nd	S	37.4	30	7.4	30	-22.6	7.4	24.4	No	Yes	N/A
Plot 8	2nd	N	37.6	30	7.6	30	-22.4	7.6	24.6	No	Yes	N/A
Plot 8	2nd	W	54.7	30	24.7	30	-5.3	24.7	41.7	Yes	Yes	ADF System 3
Plot 8	2nd	S	50.1	30	20.1	30	-9.9	20.1	37.1	Yes	Yes	ADF Systems 1 or 2
Plot 8	2nd	E	34.6	30	4.6	30	-25.4	4.6	21.6	No	Yes	N/A
Plot 13	2nd	N	38.4	30	8.4	30	-21.6	8.4	25.4	No	Yes	N/A
Plot 13	2nd	W	54.7	30	24.7	30	-5.3	24.7	41.7	Yes	Yes	ADF System 3
Plot 13	2nd	S	50.3	30	20.3	30	-9.7	20.3	37.3	Yes	Yes	ADF Systems 1 or 2
Plot 13	2nd	E	33.2	30	3.2	30	-26.8	3.2	20.2	No	Yes	N/A
Plot 14	2nd	E	31.1	30	1.1	30	-28.9	1.1	18.1	No	Yes	N/A
Plot 14	2nd	N	49.2	30	19.2	30	-10.8	19.2	36.2	Yes	Yes	ADF Systems 1 or 2
Plot 14	2nd	W	54.5	30	24.5	30	-5.5	24.5	41.5	Yes	Yes	ADF System 3
Plot 14	2nd	S	38.3	30	8.3	30	-21.7	8.3	25.3	No	Yes	N/A
Plot 18	2nd	N	38.2	30	8.2	30	-21.8	8.2	25.2	No	Yes	N/A
Plot 18	2nd	W	54.5	30	24.5	30	-5.5	24.5	41.5	Yes	Yes	ADF System 3
Plot 18	2nd	S	48.9	30	18.9	30	-11.1	18.9	35.9	Yes	Yes	ADF Systems 1 or 2
Plot 18	2nd	E	31	30	1	30	-29	1	18	No	Yes	N/A
Plot 19 - 20	Ground	N	33.5	30	3.5	30	-26.5	3.5	20.5	No	Yes	N/A
Plot 19 - 20	Ground	W	40.4	30	10.4	30	-19.6	10.4	27.4	No	Yes	N/A
Plot 19 - 20	Ground	S	39.6	30	9.6	30	-20.4	9.6	26.6	No	Yes	N/A
Plot 21 - 22	Ground	N	33.4	30	3.4	30	-26.6	3.4	20.4	No	Yes	N/A
Plot 21 - 22	Ground	SW	38.4	30	8.4	30	-21.6	8.4	25.4	No	Yes	N/A
Plot 23 - 24	Ground	N	32.9	30	2.9	30	-27.1	2.9	19.9	No	Yes	N/A
Plot 23 - 24	Ground	S	37.3	30	7.3	30	-22.7	7.3	24.3	No	Yes	N/A
Plot 23 - 24	Ground	E	23.3	30	-6.7	30	-36.7	-6.7	10.3	No	Yes	N/A