NoiseAir
ACOUSTICS & AIR QUALITY

Tel: 0116 272 5908
Email: info@noiseair.co.uk
Web: www.noiseair.co.uk

BARNES HOMES YORKSHIRE LIMITED

NOISE IMPACT ASSESSMENT REPORT

LAND ADJOINING 916 HALIFAX ROAD, HARTSHEAD MOOR, CLECKHEATON BD19 6LR

Client: Barnes Homes Yorkshire Limited

Report Ref: P7795-R1-V1

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Unit 14, Chapel Court, Wervin, Chester, Cheshire, CH2 4BT
The Counting House, High Street, Lutterworth, Leicestershire, LE17 4AY

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REPORT VERSION CONTROL:

Document Reference	Date	Report Prepared by	Report Checked by	Report Authorised by
P7795-R1-V1	01/11/2024	Marius Giddey BEng (Hons)	Joshua McLelland, Ba(Hons), PGDip, AMIOA	M. J. Malone, BSc (Hons), MIOA

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APPENDICES

1 INTRODUCTION

1.1 Overview

1.1.1 By instruction from Barnes Homes Yorkshire Limited ('the client'), NoiseAir was commissioned to undertake a noise impact assessment (NIA) to support a planning application proposing the development of 11 new residential units at the Land Adjoining 916 Halifax Road, Hartshead Moor, Cleckheaton BD19 6LR.

1.1.2 General limitations with respect to this NIA are outlined in **Appendix A**.

1.2 Site Description

1.2.1 At the time of writing, the proposed development site is situated in a residential area in Cleckheaton.

1.2.2 The primary noise sources observed at the site is road traffic noise from the M62 motorway which lies close by to the north-west of the site and the A649 which borders the site to the south.

1.2.3 **Figure 1** presents an ariel photograph of the development site with respect to the local area and its context.

Figure 1: Site Ariel Photograph.

1.3 Development Proposals

1.3.1 At the time of writing, proposals outline the development of 11no. new residential units with associated parking and external amenity areas.

1.3.2 The proposed site plans are shown below in **Figure 2**

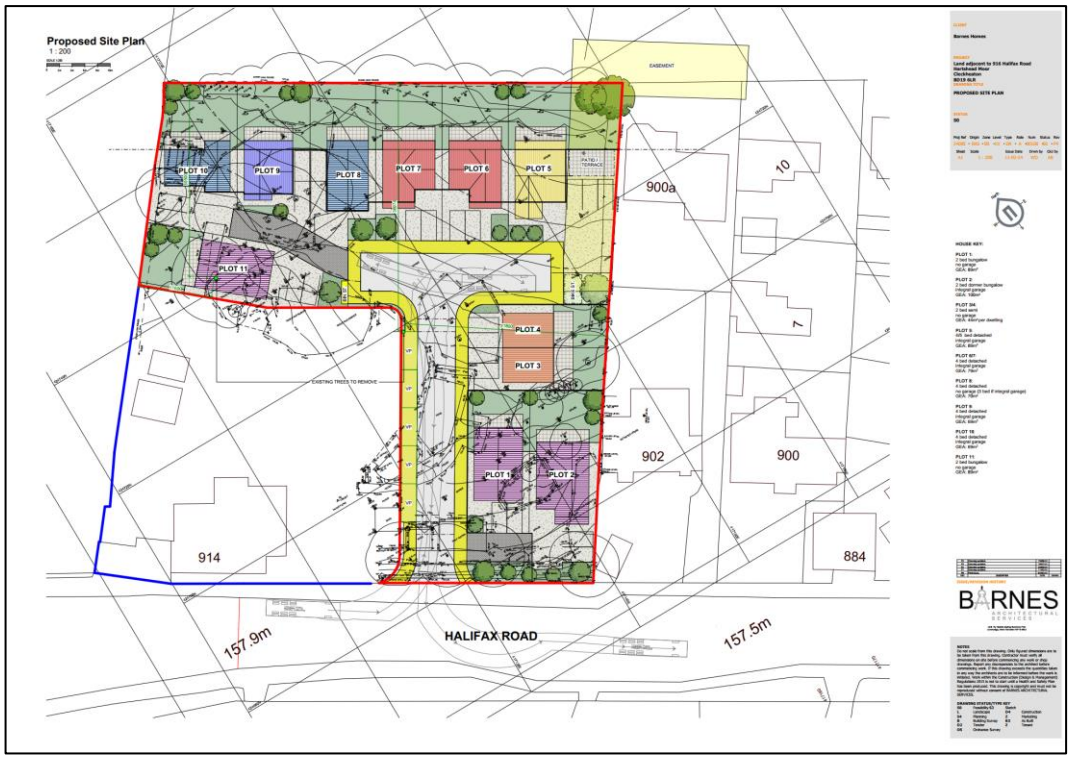

Figure 2: Proposed Site Plans

2 ASSESSMENT METHODOLOGY AND SCOPE OF WORKS

2.1 National Planning Policy Framework [NPPF 2023]

2.1.1 The NPPF sets out the government's planning policies for England and how they are expected to be applied. It aims to achieve sustainable development; stating that planning policies and decisions should prevent unacceptable levels of noise pollution from new and existing development while affirming that National Policy Statements form part of the national planning policy framework and should be considered in planning decisions.

2.2 Noise Policy Statement for England (NPSE)

2.2.1 The Noise Policy Statement for England (NPSE), published in March 2010, states the long-term vision of Government noise policy is to "promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development".

2.2.2 The NPSE sets out the government's overall policy on noise within the context of sustainable development. It introduces three concepts for noise management: avoid significant adverse effects; mitigate and minimise adverse effects; and where possible, contribute to improvements in health and quality of life.

2.2.3 It also establishes a hierarchy of noise management actions: avoid; reduce; remedy; mitigate; compensate.

2.2.4 The NPSE also introduces the below categories with respect to 'adverse impacts'.

'NOEL – No Observed Effect Level

- This is the level below which no effect can be detected. In simple terms, below this level, there is no detectable effect on health and quality of life due to the noise.

LOAEL – Lowest Observed Adverse Effect Level

- This is the level above which adverse effects on health and quality of life can be detected.

SOAEL – Significant Observed Adverse Effect Level

- This is the level above which significant adverse effects on health and quality of life occur.'

2.2.5 The NPSE states that significant adverse effects on health and quality of life should be avoided. Where the impact lies somewhere between LOAEL and SOAEL, it requires that all reasonable steps are taken to mitigate and minimise the adverse effects of noise. In this regard, a certain degree of impact between LOAEL and SOAEL would be acceptable in

terms of planning policy, provided that the impact has been mitigated and minimised by design.

2.3 Planning Practice Guidance - Noise [PPG 2019]

2.3.1 PPG 2019 provides guidance on how noise should be considered in planning decisions. It was published in 2014 and updated in 2019. The document advises on how to avoid, mitigate, or minimise adverse effects of noise through good acoustic design and appropriate conditions or obligations.

2.3.2 **Table 1** summarises the noise exposure hierarchy outlined within the PPG.

Table 1: National Planning Practice Guidance noise exposure hierarchy

Perception	Increasing Effect Level	Action
Not noticeable	No Observed Effect	No specific measures required
Noticeable and not intrusive	No Observed Adverse Effect	No specific measures required
Lowest Observed Effect Level		
Noticeable and intrusive	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Effect Level		
Noticeable and disruptive	Significant Observed Adverse Effect	Avoid
Noticeable and very disruptive	Unacceptable Adverse Effect	Prevent

2.4 Scope of Works

2.4.1 The location of the development site is at the edge of existing residential areas with road traffic noise due to the M62 motorway and the A649 being the predominant source of noise. Therefore, it is reasoned that the NIA should consider noise from road traffic primarily.

2.4.2 The scope of this assessment includes consideration of noise at the façades of the proposed residential dwellings where noise sensitive areas might be located, in terms of the potential impact of local noise sources and the identification of mitigation measures where necessary.

2.4.3 Furthermore, noise is considered in external amenity areas where they are proposed.

2.5 Assessment Criteria

2.5.1 In order to achieve noise levels which are considered to be in alignment with the planning approaches and policies discussed in Section 2.1, it is considered that all efforts are made to ensure that future occupants are unlikely to be exposed to noise levels which might breach the LOEL criteria.

2.5.2 It should be noted however that planning guidance does not preclude development where the LOEL is likely to be breached in certain circumstances as long as reasonable efforts are made to mitigate and reduce such an effect.

2.5.3 It is therefore considered that the noise assessment and subsequent criteria should be undertaken in accordance with Pro-PG:2017 Planning and Noise, a summary of which is provided below.

2.6 Pro-PG – Planning & Noise [Pro-PG 2017]

2.6.1 Pro-PG:2017 Planning and Noise provides professional practice guidance in relation to new residential development exposed to noise from transport sources. It provides practitioners with a recommended approach to the management of noise within the planning system in England.

2.6.2 The guidance reflects the Government's overarching National Planning Policy Framework, the Noise Policy Statement for England, and Planning Practice Guidance (including PPG-Noise) and draws on other authoritative sources of guidance. It provides advice for Local Planning Authorities and developers, and their professional advisers, on achieving good acoustic design in and around new residential developments.

2.6.3 Pro-PG:2017 adopts a two-stage approach to assessment:

- **Stage 1** – an initial noise risk assessment of the proposed development site; and,
- **Stage 2** – a systematic consideration of four key elements.

2.6.4 The four key elements to be undertaken in parallel during Stage 2 of the recommended approach are:

- **Element 1** – demonstrating a "Good Acoustic Design Process";
- **Element 2** – observing internal "Noise Level Guidelines";
- **Element 3** – undertaking an "External Amenity Area Noise Assessment"; and,
- **Element 4** – consideration of other relevant issues.

2.6.5 Internal noise level guidelines are set out in Figure 2 of Pro-PG:2017 which have been reproduced in **Table 2**.

Table 2: Summary of internal noise guidelines.

Activity	Location	0700 – 2300 hours	2300 – 0700 hours
Resting	Living Room	35 dB $L_{Aeq,16hour}$	-
Dining	Dining room / area	40 dB $L_{Aeq,16hour}$	-
Sleeping (daytime resting)	Bedroom	35 dB $L_{Aeq,16hour}$	30 dB $L_{Aeq,8hour}$ 45 dB L_{AMax}

2.6.6 There are multiple notes outlined within Pro-PG:2017 with respect to **Table 2** which should be considered in full however the main points for consideration are outlined below:

- The table provides recommended internal $L_{Aeq,T}$ target levels for overall noise in the design of a building. These are the sum total of structure-borne noise and airborne noise sources.
- The internal $L_{Aeq,T}$ target levels shown in the table are based on the existing guidelines issued by the World Health Organisation (WHO) and assume normal diurnal fluctuation in external noise.
- The internal $L_{Aeq,T}$ target levels are based on annual average data and do not have to be achieved in all circumstances. For example, it is normal to exclude occasional events, such as fireworks night or New Year's Eve.
- Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. In most circumstances in noise-sensitive rooms at night (e.g. bedrooms) good acoustic design can be used so that individual noise events do not normally exceed 45dB $L_{Amax,F}$ more than 10 times a night. However, where it is not reasonably practicable to achieve this guideline then the judgement of acceptability will depend not only on the maximum noise levels but also on factors such as the source, number, distribution, predictability and regularity of noise events.
- Designing the site layout and the dwellings so that the internal target levels can be achieved with open windows in as many properties as possible demonstrates good acoustic design. Where it is not possible to meet internal target levels with windows open, internal noise levels can be assessed with windows closed, however any façade openings used to provide whole dwelling ventilation (e.g. trickle ventilators) should be assessed in the "open" position and, in this scenario, the internal L_{Aeq} target levels should not normally be exceeded.
- Where development is considered necessary or desirable, despite external noise levels above WHO guidelines, the internal L_{Aeq} target levels may be relaxed by up to 5 dB and reasonable internal conditions still achieved.

2.6.7 The guidelines presented in **Table 2** reflect and extend current practice contained in BS 8233:2014.

2.6.8 In terms of external amenity noise assessment, Pro-PG:2017 again draws upon guidelines set presented by the WHO and also presented in BS 8233:2014.

2.6.9 BS 8233:2014 states that "the acoustic environment of external amenity areas that are an intrinsic part of the overall design should always be assessed and noise levels should ideally not be above the range 50 – 55 dB $L_{Aeq,16hr}$". The standard continues… "These guideline

values may not be achievable in all circumstances where development might be desirable. In such a situation, development should be designed to achieve the lowest practicable noise levels in these external amenity spaces but should not be prohibited."

3 ACOUSTIC SURVEY

3.1 Noise Monitoring

3.1.1 NoiseAir conducted unattended noise monitoring between 1st October 2024 and 3rd October 2024 at the development site. Unattended noise monitoring was undertaken at the monitoring location ML1 as presented in **Figure 3**. ML1 was positioned approximately 2 m above the ground and 100 m from the M62 motorway.

Figure 3: Approximate noise monitoring location

3.1.2 The noise measurements were made using a Class 1, integrating sound level meter (SLM).

3.1.3 The acoustic equipment was calibrated to comply with Section 4.2 of BS 7445-1:2003[1], before and after the noise monitoring periods.

3.1.4 The SLM was calibrated upon installation and collection of the survey and found to have negligible drift (~0.1 dB).

Table 3: Summary of SLM used for survey and associated field calibration

SLM (Serial No.)	Preamp (Serial No.)	Microphone (Serial No.)	Calibrator (Serial No.)	Start Calibration	End Calibration	Drift
NOR140 (1402826)	NOR1209 (15455)	NOR1225 (168289)	SVAN-SV30A (10818)	-26.2	-26.1	0.1

3.1.5 Weather conditions were monitored throughout the survey and were considered to be favourable throughout the entire duration of the measurements.

[1] BS 7445-2003 "Description and measurement of environmental noise – Part 1: Guide to quantities and procedures.

3.2 Measured Sound Levels

3.2.1 **Figure 4** details a level vs time graph of the recorded L_{Amax}, L_{Aeq} and L_{A90} sound level over 15-minute time periods for ML1 over the entire measurement duration.

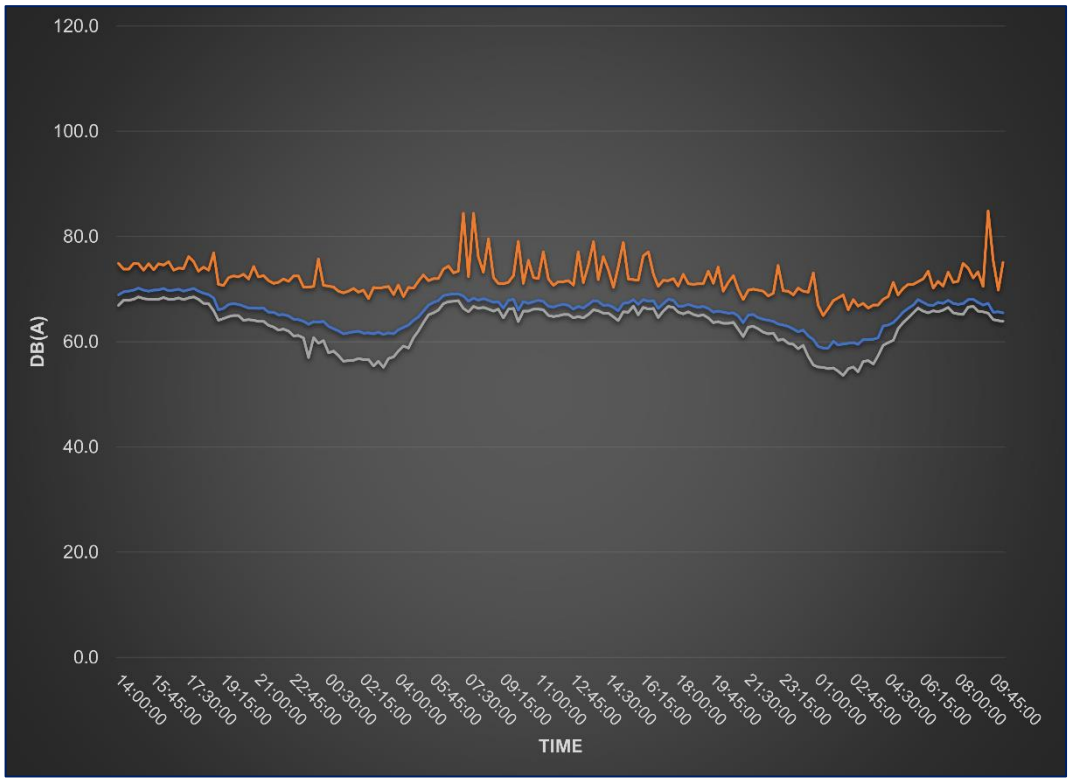

Figure 4: Level vs. time graph showing L_{Amax}, L_{Aeq} and L_{A90} sound levels – ML1

3.2.2 The results for each of the monitoring locations during the daytime and night-time periods are presented in **Table 4** below.

Table 4: Average Measured Daytime and Night-time Noise Levels

Monitoring Location	Time	Measured Noise Level
		dB $L_{Aeq,16hour}$ / dB $L_{Aeq,8hour}$ / dB L_{AFmax}
ML1	07:00-23:00	67.0 – 68.4
	23:00-07:00	63.4 – 64.5
	23:00-07:00	71.0 – 72.0

4 3D SOUND MODEL

4.1 Overview

4.1.1 A 3D sound model has been constructed in SoundPLAN™ to model the noise from nearby roads and calculate the predicted sound pressure levels at the façades of the proposed residential dwellings. The model uses the calculation method from ISO 9613-2:1996[2] to account for the distance between the source and receiver and any screening or reflections provided by the surrounding buildings.

4.1.2 The model is based on and calibrated against road traffic noise data collected during the survey as presented in Section 3 of this report.

4.2 3D Sound Model

4.2.1 A noise contour plot illustrating the propagation of the sound from source to receptor during the daytime ($L_{Aeq,16hour}$) and night time ($L_{Aeq,\ 8hour}$) condition is given in **Figure 5** and **Figure 6.**

Figure 5: Noise contour plot during the daytime – $L_{Aeq,16hour}$.

[2] ISO9613-2:1996 "Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation"

Figure 6: Noise contour plot during the night-time – $L_{Aeq,8hour}$.

4.2.2 The L_{AfMax} noise level exceeded more than 10 times in one night contour map is presented in **Figure 7**.

Figure 7: Noise contour plot during the night-time – L_{AfMax}.

4.2.3 **Figure 8** and **Table 5** detail the façades investigated and the predicted worst-case noise levels as calculated at the development site.

Figure 8: Receiver Locations.

Table 5: Predicted Receptor Noise Levels

Receptor Number	Facade	Floor	dB $L_{Aeq,16hours}$ Daytime	dB $L_{Aeq,8hours}$ Night-Time	dB L_{Amax}
1	North-East	2.FL	68.7	64.7	71.1
2	North-East	2.FL	68.6	64.6	70.1
3	North-East	2.FL	67.7	63.7	69.2
4	North-East	2.FL	67.1	63.1	68.6
5	North-East	2.FL	66.3	62.3	67.8
6	North-East	2.FL	65.7	61.7	68.6
7	North-West	GF	66.9	62.8	68.0
8	West	1.FL	63.3	59.1	67.9
9	West	1.FL	63.0	58.8	64.0
10	South	GF	60.8	55.7	55.3
11	South	GF	60.5	55.2	55.1

5 PRO-PG:2017 SITE NOISE RISK ASSESSMENT AND ACOUSTIC DESIGN STATEMENT

5.1 Pro-PG:2017 Stage 1 Risk Assessment of Noise Levels

5.1.1 Based on the results of the 3D sound model and in accordance with Pro-PG:2017, a Site Noise Risk Assessment (SNRA) has been conducted. The SNRA assesses the initial risk of noise to have an adverse impact on a proposed development based on the overall measured levels with no mitigation in place.

5.1.2 Given the relatively (and uniformly) low levels of noise that have been calculated across the development site, the worst-case results have been compared to the information provided on Figure 1 of Pro-PG:2017.

Table 6: Stage 1 Risk Assessment of Noise Levels

Receptor Point	Façade	Daytime Noise Level (dB L_{Aeq})	Risk of Adverse Effect	Night-time Noise Level (dB L_{Aeq})	Risk of Adverse Effect
1	Rear	69	Medium	65	High

5.1.3 **Table 6** indicates that during the daytime and night-time periods, proposed receptors of the development can be categorised as being at a '**Medium'** to '**High'** risk of adverse impact.

5.1.4 The Site Noise Risk Assessment shows that local noise mitigation and good acoustic design will be required to ensure that the potential risk of the noise impact is minimised, and guideline internal and external noise levels are achieved.

5.1.5 In accordance with Pro-PG:2017, a Stage 2 full noise assessment, which includes an acoustic design statement, is required to ensure future residents are protected and a good acoustic design has been implemented.

5.2 Pro-PG:2017 Stage 2 – Site Noise Risk Assessment

5.2.1 The results of the Pro-PG:2017 Stage 1: Initial Site Noise Risk Assessment shows that receptors at the proposed development are likely to be at a **'Medium'** to '**High'** risk of experiencing an adverse noise impact, with no mitigation in place. Therefore, an assessment against the criteria in WHO and BS 8233:2014 has been undertaken with reference to the general sound levels at the site.

5.2.2 This section forms the Stage 2 Acoustic Design Statement.

5.3 Assessment of Daytime Noise Levels in Outdoor Living Areas

5.3.1 At the time of writing, plans indicate external amenity to the rear of each plot.

5.3.2 Analyses of the 3D sound model at ground floor level indicates the likely noise levels within the proposed garden areas. Results are shown below in **Table 7**.

Table 7: Predicted Receptor Noise Levels at External Amenity Areas	
Receptor Number	**dB $L_{Aeq,16hours}$ Daytime**
1	68.4
2	67.4
3	66.7
4	66.0
5	65.6
6	65.1
7	66.9
8	61.7
9	60.6
10	60.8
11	60.5

5.3.3 The analysis indicates that all amenity areas are likely to exceed the upper WHO guideline level of 55 dB(A) for people being seriously annoyed.

5.3.4 We would therefore recommend that the garden area fencing is upgraded to acoustic barrier specifications and the height increased to at least 2.5 m if considered viable. An acoustic barrier is likely to reduce outdoor amenity area noise by 5-10 dB(A) typically depending on location.

5.3.5 The acoustic barrier should imperforate and have a surface density of not less than 10 kg/m2.

5.4 Assessment of Daytime and Night-time Noise Levels in Living Rooms and Bedrooms

5.4.1 The predicted noise levels at the façades of the worst-case proposed building structures, as detailed in **Table 5** for the daytime and night-time period, together with the level of attenuation required in accordance with BS 8233: 2014, are presented in **Table 8**.

Table 8: Level of Attenuation Required to Achieve the Internal Noise Guideline Levels.				
Façade	**Daytime ($L_{Aeq,16hours}$) / Night-Time ($L_{Aeq,8hours}$ / L_{Amax})**	**Worst Case Noise Level at the Façade of the Property (dB(A))**	**BS 8233:2014 Target Internal Level (dB(A))**	**Worst Case Level of Attenuation Required (dB(A))**
All	Daytime $L_{Aeq,16hours}$	69	35	34
	Night-Time $L_{Aeq,8hours}$	65	30	35
	Night-Time L_{Amax}	71	45	26

5.5 Building Envelope Performance – Windows Open

5.5.1 The sound performance requirements for bedrooms, living and dining rooms at the development during the daytime and night-time in rooms with windows closed are summarised in Section 6.

5.5.2 However, with windows open, the attenuation provided by the façade will be approximately 10-15 dB(A). This would potentially allow the recommended internal noise limit to be exceeded in most rooms at the development during certain parts of a typical day / night.

5.5.3 **Table 9** shows the level of exceedance for partially open windows at the front, rear and side facades.

Table 9: Summary of Internal Noise Levels with Windows Partially Open (based on a Partially Open Window Providing up to 15 dB(A) Attenuation).

Receptor	Room Type	Day / Night	Yes / No	Excess (dB)
1	Living/Dining/Kitchen Room	Day	No	+19
	Bedroom	Night	No	+20

5.5.4 It is considered that in many circumstances, such as urban/ sub-urban developments, an exceedance of up to 5 dB(A) in accordance with BS 8233:2014 is likely to be acceptable to future residents and therefore is unlikely to breach the LOEL criteria discussed in Section 2 of this report.

5.5.5 According to these criteria, the proposed dwellings are unlikely to achieve the recommended internal noise levels when relying solely on a partially open window.

5.5.6 Where exceedances are likely to be greater than +5 dB, on occasions, this may be acceptable to a resident, but when quiet conditions are required, the resident should be able to close the windows whilst maintaining adequate ventilation.

6 SOUND INSULATION SCHEME

6.1 Building Envelope Requirements – Windows Closed

6.1.1 Proposals for the development site at the time of writing outline residential use to the first floor and above. Noise sensitive rooms are proposed to all facades of the property. Therefore, internal noise levels are required to not exceed 35 dB L_{Aeq} during the daytime hours in all rooms, 30 dB L_{Aeq} during the night-time in bedrooms and not typically exceed 45 dB L_{Amax} during the night-time hours in bedrooms.

6.1.2 When assessing sound levels in habitable areas of the proposed development, the sound attenuation provided by the overall building facade should be considered. To mitigate sound levels, the composition of the building facade can be designed to provide the level of attenuation required. Glazing is generally the building element which attenuates noise the least, so the proportion of glazing in a building facade is an important consideration when assessing overall sound attenuation. Additionally, any façade penetrations should also be considered such as for ventilation, e.g., trickle ventilation.

6.1.3 Based on the design details forwarded, worst case façade attenuation calculations have been undertaken in accordance with BS EN ISO 12354-3:2017.

6.1.4 Calculations assuming a passive ventilation strategy have been undertaken and presented in this section. **Table 10** presents a summary of the different elements for living rooms and bedrooms.

Table 10: Summary of Building Envelope Performance Requirements - Passive Ventilation

Façade	Room Type	Wall R_w+C_{tr} (dB)	Glazing R_w+C_{tr} (dB)	Ventilation $D_{ne,w}+C_{tr}$ (dB) (2500EA)
All	Living Room	52	33	41
	Bedrooms			

6.1.5 It should be noted that the acoustic performance values stated are for guidance and based on information provided at the time of writing, changes to location, size and orientation of rooms/ facades can have impacts on the calculated internal noise levels and subsequently the required acoustic performance criteria.

6.1.6 **Table 11** below provides a typical example summary for each elements type outlined in **Table 10** above.

Table 11: Summary of Building Element - Typical Examples		
Element Type	**Acoustic Performance**	**Typical Example**
Wall	52 dB R_w+C_{tr}	Concrete / Brick exterior wall with min. 100 mm insulated (60 kg / m3 rockwool) cavity constructed with timber studwork and resilient bars with min. 10 mm plasterboard lining
Window	Up to 33 dB R_w+C_{tr}	10 mm pane, 12 mm air/ argon filled cavity, 6 mm pane
Acoustic Slot Vent (Window)	41 dB $D_{ne,w+}Ct_r$ (1 no. per room)	Titon TA5225 (V75) + TA5206 (C75) 2500EA

6.1.7 It should be noted that the examples provided in **Table 11** are for guidance only, however any adopted solution must achieve the acoustic performance values presented in **Table 10**.

6.2 Ventilation Requirements

6.2.1 It is recommended that the acoustic ventilation proposed at the site should, as a minimum, comply with Building Regulations 2010 Approved Document F1 2021 Means of Ventilation and British Standard BS5925 1991: “Code of Practice for Ventilation Principles and Designing for Natural Ventilation”. Acoustic ventilation is only recommended for noise sensitive rooms, which are bedrooms and living/ dining rooms.

6.2.2 Where a passive ventilation system is incorporated into the design, ventilators should be acoustically treated for habitable rooms to all facades. Ventilation openings to these rooms should match or exceed the minimum values set out in **Table 10**.

6.2.3 The implementation of the recommended glazing would ensure that the required internal daytime and night-time noise limits are achieved.

6.2.4 It should be further noted that the glazing configurations within this report are for guidance only. Similar products to those used in NoiseAir calculations may achieve a similar level of sound reduction, however this should be verified by the manufacturer.

6.2.5 **Table 10** demonstrates that adequate ventilation can be achieved with passive ventilation.

7 CONCLUSIONS

7.1 Overview

7.1.1 By instruction from Barnes Homes Yorkshire Limited, NoiseAir was commissioned to undertake a noise impact assessment to support a planning application proposing the development of 11 new residential units.

7.2 Conclusions

7.2.1 The results of the Pro-PG:2017 Stage 1: Initial Site Noise Risk Assessment shows that receptors at the proposed development are likely to be at a '**Medium'** to '**High'** risk of experiencing an adverse noise impact, with no mitigation in place.

7.2.2 Calculations show that to achieve a reasonable internal acoustic environment in habitable rooms with closed windows as specified within BS 8233:2014, the building envelope constructions should be selected to meet the sound reduction index (SRI) values presented in **Table 10** and **Table 11**

7.2.3 **Table 10** demonstrates that adequate ventilation can be achieved with passive ventilation.

APPENDIX A - REPORT LIMITATIONS

This Report is presented to Barnes Homes Yorkshire Limited and may not be used or relied on by any other person or by the client in relation to any other matters not covered specifically by the scope of this report.

Notwithstanding anything to the contrary contained in the report, NoiseAir Limited is obliged to exercise reasonable skill, care and diligence in the performance of the services required by Barnes Homes Yorkshire Limited and NoiseAir shall not be liable except to the extent that it has failed to exercise reasonable skill, care and diligence, and this report shall be read and construed accordingly.

This report has been prepared by NoiseAir Limited. No individual is personally liable in connection with the preparation of this report. By receiving this report and acting on it, the client or any other person accepts that no individual is personally liable whether in contract, tort, for breach of statutory duty or otherwise.

The conclusions and recommendations contained in this report are based upon information provided by others and upon the assumption that all relevant information has been provided by those parties from who it has been requested and that such information is accurate. Information obtained by NoiseAir Limited has not been independently verified by NoiseAir Limited unless otherwise stated in the report and should be treated accordingly.

Where assessments of works or costs identified in this report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

Where / if estimates and projects are made within this report, are made based on reasonable assumptions as of the date of this report, such statements however by their very nature involve risks and uncertainties that could cause actual results to differ materially from the results predicted. NoiseAir Limited specifically does not guarantee or warrant any estimates or projects contained in this report.

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APPENDIX B – NOISE INGRESS CALCULATIONS

BS 8233:2014 - Noise Ingress Calculation

Term	Description	Value
S_f	Total facade area (m^2)	10.64
S_{wi}	Window area (m^2)	2.70
S_{ew}	External wall area (Sf - Swi) (m^2)	7.94
S_{rr}	Area of the ceiling (m^2)	10.26
S	Total area exposed to noise ingress (Sf + Srr)	20.90
x	Room length (x)	2.70
y	Room width (y)	3.80
z	Room height (z)	2.80
V	Room Volume (m^3)	28.73
K	Facade Measuremet Correction	0.00
A0	Ref. qbs area (m2)	10.00
k	k=3 in BS 8233:2014 + Tollerance	3.00
	Number of vents	2.00
r	Distance to window / vent (m)	0.00
d	Angle of incidence (deg)	180.00

Project: Land Adjoining 916 Halifax Road, Cleckheaton
Description: Daytime North Façade
by: MG

Results: **22** dB L_{Aeq} **NR 22**

Term	Description	Description of noise level	Octave Band Centre Frequency (Hz) 63	125	250	500	1000	2000	4000	8000	Broadband dB(A) 63-8k	dB(A) 125-2k
$L_{eq,ff}$	Free-field L_{eq} outside room		44	35	28	36	42	35	16	-2	47	43

Term	Description	Specification										$D_{n,e,w}$	Rw	C	Ctr	Rw + Ctr	Comments
												$D_{n,e,w}$	R_w	C	C_{tr}		Comments
$D_{n,e}$	$D_{n,e}$ of **each** venitlator:	30 dB Dne,w+Ctr Titon Trimvent Select E18 vent & GS18 grille	29	35	35	35	27	32	35	35	-	-	31	-	-	-1		Dnew (C;Ctr) = 31 (-1;-1 - Vent Open), Free Area = 4200
	Cumulative $D_{n,e}$ for all venitilators		26	32	32	32	24	29	32	32								
R_{wi}	SRI of glazing/window:	30 dB Rw+Ctr 8:12:6 mm	17	23	23	30	39	36	43	43	-	-	-	34	-1	-4	30	solaglas
	SRI of external wall:	47 dB Rw+Ctr BS8233 Example - Brick and block external wall	34	40	44	45	51	56	56	56	-	-	-	51	-1	-4		0.0
R_{rr}	SRI of roof and ceiling:	39 dB Rw+Ctr BS8233 Example (with 3 dB uplift for sound incident on roof)	25	31	37	43	48	52	52	52	-	-	-	44	-2	-5		0.0

Term	Description	Type / Comment /Source								dB(A) 63-8k	dB(A) 125-2k
$L_{eq,2}$	Internal L_{eq}		28	13	5	9	21	9	-12	-30	22	22
$L_{max,2}$	Internal L_{max}		-16	-22	-23	-27	-21	-25	-28	-28	-18	-18
Leq	via Vent		21	6	0	7	21	9	-12	-30	22	22
	via Window		24	9	3	3	1	-4	-29	-47	6	5
	via Wall		12	-3	-13	-7	-7	-19	-37	-56	-4	-5
	via Ceiling		19	4	-8	-7	-6	-17	-35	-54	-2	-3
	via All		27	12	5	9	21	10	-12	-30	22	22

BS 8233:2014 - Noise Ingress Calculation

Term	Description	Value
S_f	Total facade area (m^2)	10.64
S_{wi}	Window area (m^2)	2.70
S_{ew}	External wall area (Sf - Swi) (m^2)	7.94
S_{rr}	Area of the ceiling (m^2)	10.26
S	Total area exposed to noise ingress (Sf + Srr)	20.90
x	Room dimension x	2.70
y	Room dimension y	3.80
z	Room dimension z	2.80
V	Volume of receiving room (m^3)	28.73
K	Facade Measuremet Correction	0.00
A0	Ref. qbs area (m2)	10.00
k	k=3 in BS 8233:2014 + Tollerance	3.00
	No. of vents in external wall	2.00
r	Distance to window / vent (m)	0.00
d	Angle of incidence (deg)	180.00

Project: Land Adjoining 916 Halifax Road, Cleckheaton
Description: Night-time North Façade
by: MG

Results: **18** dB L_{Aeq} **NR 18**
44 dB LA_{max}

Term	Description	Description of noise level	Octave Band Centre Frequency (Hz) 63	125	250	500	1000	2000	4000	8000	Broadband dB(A) 63-8k	dB(A) 125-2k
$L_{eq,ff}$	Free-field L_{eq} outside room		40	31	24	32	38	31	12	-6	43	39
L_{max}	Free-field L_{max} outside room		66	57	50	58	64	57	38	20	69	65

Term	Description	Specification										$D_{n,e,w}$		Rw		C	Ctr	Rw + Ctr	Comments
												$D_{n,e,w}$		R_w		C	C_{tr}		Comments
$D_{n,e}$	$D_{n,e}$ of **each** venitlator:	30 dB Dne,w+Ctr Titon Trimvent Select E18 vent & GS18 grille	29	35	35	35	27	32	35	35	-	-	31		-		-	-1		Dnew (C;Ctr) = 31 (-1;-1 - Vent Open), Free Area = 4200
	Cumulative $D_{n,e}$ for all venitilators		26	32	32	32	24	29	32	32										
R_{wi}	SRI of glazing/window:	30 dB Rw+Ctr 8:12:6 mm	17	23	23	30	39	36	43	43	-	-	-		34		-1	-4	30	solaglas
	SRI of external wall:	47 dB Rw+Ctr BS8233 Example - Brick and block external wall	34	40	44	45	51	56	56	56	-	-	-		51		-1	-4		0.0
R_{rr}	SRI of roof and ceiling:	39 dB Rw+Ctr BS8233 Example (with 3 dB uplift for sound incident on roof)	25	31	37	43	48	52	52	52	-	-	-		44		-2	-5		0.0

Term	Description	Type / Comment /Source								dB(A) 63-8k	dB(A) 125-2k
$L_{eq,2}$	Internal L_{eq}		24	9	1	5	17	5	-16	-34	18	18
$L_{max,2}$	Internal L_{max}		49	35	27	31	43	31	10	-8	44	44
Leq	via Vent		17	2	-4	3	17	5	-16	-34	18	18
	via Window		20	5	-1	-1	-3	-8	-33	-51	2	1
	via Wall		8	-7	-17	-11	-11	-23	-41	-60	-8	-9
	via Ceiling		15	0	-12	-11	-10	-21	-39	-58	-6	-7
	via All		23	8	1	5	17	6	-16	-34	18	18

APPENDIX C – GLOSSARY

A-weighted sound pressure, p_A	Value of overall sound pressure, measured in pascals (Pa), after the electrical signal derived from a microphone has been passed through an A-weighting network. *NOTE: The A-weighting network modifies the electrical response of a sound level meter with frequency in approximately the same way as the sensitivity of the human hearing system.*
A-weighted sound pressure level, L_{pA}	Quantity of A-weighted sound pressure in decibels (dBA).
Acoustic environment	Sound from all sound sources as modified by the environment [BS ISO 12913-1:2013].
Ambient sound	Totally encompassing sound in a given situation at a given time, usually composed of sound from many sources near and far. *NOTE: The ambient sound comprises the residual sound and the specific sound when present.*
Ambient sound level, $L_a = L_{Aeq,T}$ (BS 4142:2014)	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.*
Background sound	Underlying level of sound over a period, *T*, which might in part be an indication of relative quietness at a given location.
Background sound level, $L_{A90,T}$ (BS 4142:2014)	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.
Break-in	Noise transmission into a structure from outside.
Break-out	Noise transmission from inside a structure to the outside.
Cross-talk	Noise transmission between one room and another room or space via a duct or other path.
C_{tr}	Correction term applied against the sound insulation single-number values (R_w, D_w, and $D_{nT,w}$) to provide a weighting against low frequency performance. *NOTE: The reference values used within the C_{tr} calculation are based on urban traffic noise.*
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$	Value of the A-weighted sound pressure level in decibels (dB) of a continuous, steady sound that, within a specified time interval, T, has the same mean-squared sound pressure as the sound under consideration that varies with time.
Equivalent continuous A-weighted sound pressure level, $L_{Aeq,T}$ (BS 4142:2014)	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.
Equivalent sound absorption area of a room, A	Hypothetical area of a totally absorbing surface without diffraction effects, expressed in square metres (m2), which, if it were the only absorbing element in the room, would give the same reverberation time as the room under consideration
Facade level	Sound pressure level 1 m in front of the façade. *NOTE: Facade level measurements of L_{pA} are typically 1 dB to 2 dB higher than corresponding free-field measurements because of the reflection from the facade.*
Free-field level	Sound pressure level away from reflecting surfaces. *NOTE: Measurements made 1.2 m to 1.5 m above the ground and at least 3.5 m away from other reflecting surfaces are usually regarded as free-field. To minimize the effect of reflections the measuring position has to be at least 3.5 m to the side of the reflecting surface (i.e. not 3.5 m from the reflecting surface in the direction of the*

	source). Estimates of noise from aircraft overhead usually include a correction of 2 dB to allow for reflections from the ground.
Impact sound pressure level, L_i	Average sound pressure level in a specific frequency band in a room below a floor when it is excited by a standard tapping machine or equivalent.
Indoor ambient noise	Noise in a given situation at a given time, usually composed of noise from many sources, inside and outside the building, but excluding noise from activities of the occupants. *NOTE: The location(s) within the room at which the ambient indoor noise is to be measured or calculated ought to be considered.*
Measurement time interval, T_m (BS 4142:2014)	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.*
Noise criteria	Numerical indices used to define design goals in a given space.
Noise rating, NR	Graphical method for rating a noise by comparing the noise spectrum with a family of noise rating curves.
Normalised impact sound pressure level, L_n	Impact sound pressure level normalized for a standard absorption area in the receiving room. *NOTE: Normalised impact sound pressure level is usually used to characterize the insulation of a floor in a laboratory against impact sound in a stated frequency band.*
Octave band	Band of frequencies in which the upper limit of the band is twice the frequency of the lower limit.
Percentile level, $L_{AN,T}$	A-weighted sound pressure level obtained using time-weighting "F," which is exceeded for *N*% of a specified time interval.
Reference time interval, T_r (BS 4142:2014)	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.*
Residual sound (BS 4142:2014)	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.
Residual sound level, $L_r = L_{Aeq,T}$ (BS 4142:2014)	Equivalent continuous A-weighted sound pressure level of the residual sound at the assessment location over a given time interval, T.
Rating level, $L_{Ar,Tr}$	Equivalent continuous A-weighted sound pressure level of the noise, plus any adjustment for the characteristic features of the noise. *NOTE: This is used in BS 7445 and BS 4142 for rating industrial noise, where the noise is the specific noise from the source under investigation.*
Reverberation time, *T*	Time that would be required for the sound pressure level to decrease by 60 dB after the sound source has stopped.
Sound exposure level, *L*AE	Level of a sound, of 1 s duration, which has the same sound energy as the actual noise event considered.
Sound level difference, *D*	Difference between the sound pressure level in the source room and the sound pressure level in the receiving room.
Sound pressure, *p*	Root-mean-square value of the variation in air pressure, measured in pascals (Pa) above and below atmospheric pressure, caused by the sound.

Sound pressure level, L_p	Quantity of sound pressure, in decibels (dB).
Sound reduction index, *R*	Laboratory measure of the sound insulating properties of a material or building element in a stated frequency band.
Specific sound level, $L_s = L_{Aeq,Tr}$ (BS 4142:2014)	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.
Specific sound source (BS 4142:2014)	Sound source being assessed.
Standardised impact sound pressure level, L'_{nT}	Impact sound pressure level normalized to a reverberation time in the receiving room of 0.5 s.
Standardised level difference, D_{nT}	Difference in sound level between a pair of rooms, in a stated frequency band, normalized to a reference reverberation time of 0.5 s for dwellings.
Ground borne noise	Audible noise caused by the vibration of elements of a structure, for which the vibration propagation path from the source is partially or wholly through the ground. *NOTE Common sources of ground-borne noise include railways and heavy construction work on adjacent construction sites.*
Structure-borne noise	Audible noise caused by the vibration of elements of a structure, the source of which is within a building or structure with common elements. *NOTE Common sources of structure-borne noise include building services plant, manufacturing machinery and construction or demolition of the structure.*
Third octave band	Band of frequencies in which the upper limit of the band is 2% times the frequency of the lower limit.
Weighted level difference, D_w	Single-number quantity that characterizes airborne sound insulation between rooms, but which is not adjusted to reference conditions. *NOTE Weighted level difference is used to characterize the insulation between rooms in a building as they are. Values cannot normally be compared with measurements made under other conditions (see BS EN ISO 717-1).*
Weighted normalised impact sound pressure level, $L'_{n,w}$	Single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies.
Weighted sound reduction index, R_w	Single-number quantity which characterizes the airborne sound insulating properties of a material or
Weighted standardised impact sound pressure level $L'_{nT,w}$	Single-number quantity used to characterize the impact sound insulation of floors over a range of frequencies.
Weighted standardised level difference, $D_{nT,w}$	Single-number quantity that characterizes the airborne sound insulation between rooms.

Symbols

D_w	Weighted level difference (dB)
D_{nT}	Standardized level difference (dB)
$D_{nT,w}$	Weighted standardized level difference (dB)
L_{Amax}	Maximum noise level (dB)
$L_{Ar,Tr}$	Rating level (dB)
L_n	Normalised impact sound pressure level (dB)
L'_{nT}	Standardised impact sound pressure level (dB)
$L'_{nT,w}$	Weighted standardised impact sound pressure level (dB)
$L'_{n,w}$	Weighted normalised impact sound pressure level (dB)
L_p	Sound pressure level (dB)
L_{pA}	A-weighted sound pressure level (dB)
$L_{AN,T}$	Percentile level (dB)
L_{AE}	Sound exposure level (dB)
$LAeq,T$	Equivalent continuous A-weighted sound pressure level (dB)
p	Sound pressure (Pa)
p_A	A-weighted sound pressure (dB)
$p_{A(t)}$	Instantaneous A-weighted sound pressure (Pa)

R	Sound reduction index (dB)
R_w	Weighted sound reduction index (dB)
T	Time interval (also used for reverberation time) (s)
t_0	Reference time interval (s)

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TEL. 0116 272 5908

EMAIL. INFO@NOISEAIR.CO.UK

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