Noise Impact Assessment

Heybeck Lane, Chidswell

Presented to **CC Projects**

Issued: December 2019

Delta-Simons Project No. 18-0864.03

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Report Details

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Delta-Simons Contact	Simon Johnson

Quality Assurance

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1	Final	December 2019	-	Weigang Wei PhD MIOA	Nick Conlan BEng MIOA	Simon Johnson Principal Consultant

About us

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Specialising in Environment, Health & Safety and Sustainability, Delta-Simons provide support and advice within the property development, asset management, corporate and industrial markets. Operating from ten locations - Lincoln, Birmingham, Bristol, Dublin, Durham, Leeds, London, Manchester, Norwich and Nottingham - we employ over 75 environmental professionals, bringing experience from across the private consultancy and public sector markets.

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This report has been prepared by Apex Acoustics as term framework suppliers of acoustics services to and on behalf of Delta-Simons.

Executive Summary

Scope of Works	Delta-Simons, working with our approved technical specialist Apex Acoustics was instructed by CC Projects (the 'Client') to undertake a noise survey and assessment of the potential noise impact on the proposed development Site in support of the outline planning application.
Proposed Development	The proposed Site is located to the south of Heybeck Lane and east of Leeds Road. The development consists of dwelling houses and related landscaping and infrastructure only.
Results	Noise levels affecting the proposed Site have been measured at various locations. The noise impact across the whole Site has been modelled and calculated. Based on the noise survey and calculations, the initial assessment indicates that this Site is likely to be exposed to a noise environment at Low Risk level according ProPG. A proper acoustic design process has been identified. Close board fences and potential façade sound insulation treatments have been proposed to mitigate the potential adverse impacts. With these mitigation measures, the adverse impacts of noise will be mitigated and the guideline values for internal noise environment and external amenity spaces are achieved.
Further recommendations	None, assuming proposed noise mitigation is adopted in the final design.
This is intended as a summary only. Further detail and limitations of the assessment is provided within the main body of the Report.	

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1. Introduction

1.1. Context and purpose

1.1.1. The Site is approximately 17 hectares (ha) of land to the north east of Chidswell, West Yorkshire. A residential development has been proposed at the junction of Leeds Road and Heybeck Lane, Chidswell. The Site location is shown in Figure 1.

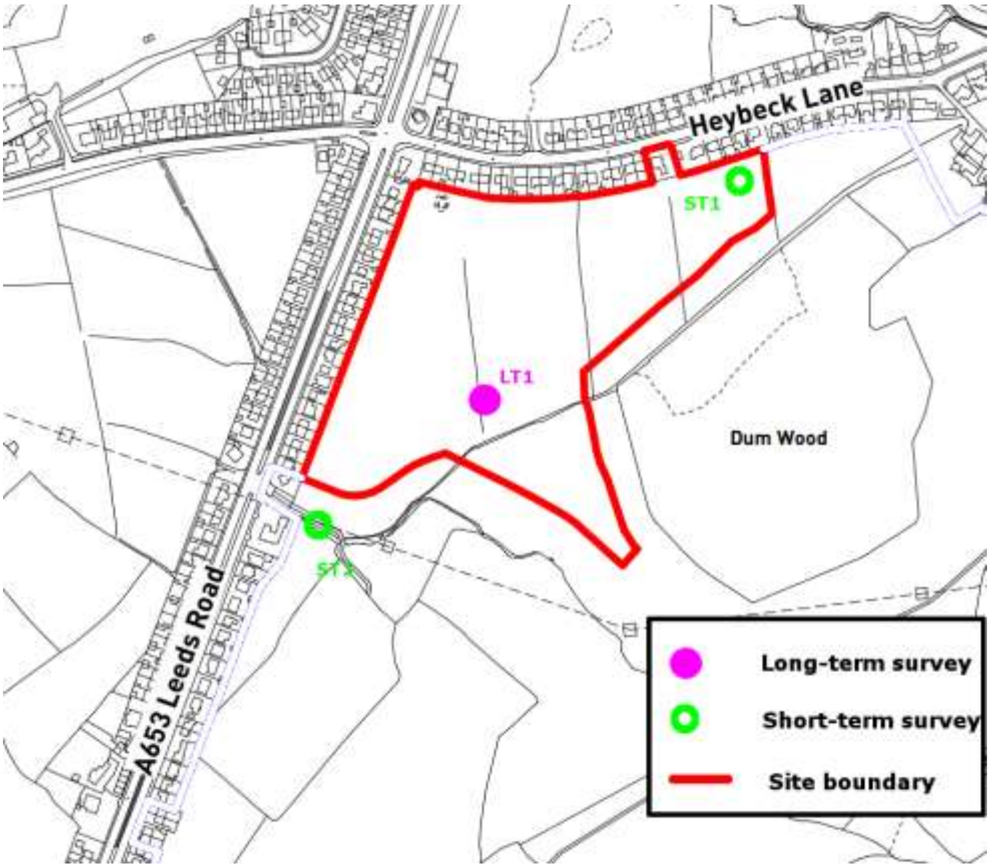

Figure 1: Site location, and noise measurement position

1.1.2. This report presents the evaluation of the existing risk for noise impacting on the proposed Site and outlines an acoustic design process to reduce the risks of increasing adverse effects in support of the outline planning application.

1.1.3. This report also describes: the methods used to assess the effects; the baseline conditions currently existing at the site; the mitigation measures required; and the likely residual effects after these measures have been adopted.

1.2. Appointment

1.2.1. Delta-Simons, working with our approved technical specialist Apex Acoustics was instructed by CC Projects (the 'Client') to undertake a noise survey and assessment of the potential noise impact on the proposed development Site in support of the outline planning application.

1.2.2. The scope of the appointment includes:

- Measurement of the existing noise environment at various locations;
- Assessment to determine the potential site risk; and

- Based on the layout, calculate the noise impact and provide a scheme for the mitigation of noise.

1.3. Limitations

1.3.1. The standard limitations associated with this assessment are presented in Appendix A.

1.3.2. This assessment is based upon an applied general design informed by professional experience of dealing with residential sites and those designs required by the Client; we have not taken into account specific requirements of an end user. As a result, it is understood that any design or operational changes may require further planning submissions once an end user is established.

2. Guidance

2.1. National Planning Policy Framework

2.1.1. The National Planning Policy Framework (NPPF, 2019) Reference [1], sets out the Government's planning policies for England and how these should be applied. It provides a framework within which locally prepared plans for housing and other development can be produced. In respect of noise, Paragraph 170, 180 and 182 of the NPPF states the following:

Paragraph 170:

"*e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution…"*

Paragraph 180:

"Planning policies and decisions should also ensure that new development is appropriate for its location taking into account the likely effects (including cumulative effects) of pollution on health, living conditions and the natural environment, as well as the potential sensitivity of the site or the wider area to impacts that could arise from the development. In doing so they should:

- *mitigate and reduce to a minimum potential adverse impacts resulting from noise from new development – and avoid noise giving rise to significant adverse impacts on health and the quality of life;*
- *identify and protect tranquil areas which have remained relatively undisturbed by noise and are prized for their recreational and amenity value for this reason; … "*

Paragraph 182:

"Planning policies and decisions should ensure that new development can be integrated effectively with existing businesses and community facilities (such as places of worship, pubs, music venues and sports clubs). Existing businesses and facilities should not have unreasonable restrictions placed on them as a result of development permitted after they were established. Where the operation of an existing business or community facility could have a significant adverse effect on new development (including changes of use) in its vicinity, the applicant (or 'agent of change') should be required to provide suitable mitigation before the development has been completed."

2.2. Noise Policy Statement for England (NPSE)

2.2.1. The NPPF is consistent with the Noise Policy Statement for England (NPSE), Reference [2], which states three policy aims as follows:

"Through the effective management and control of environmental, neighbour and neighbourhood noise within the context of Government policy on sustainable development:

- *avoid significant adverse impacts on health and quality of life;*
- *mitigate and minimise adverse impacts on health and quality of life; and*
- *where possible, contribute to the improvement of health and quality of life."*

2.2.2. The NPSE defines adverse noise impact as follows:

- No Observed Effect Level (NOEL)

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.

- Lowest Observed Adverse Effect Level (LOAEL)

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

- Significant Observed Adverse Effect Level (SOAEL)

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

2.2.3. The first two aims of the NPPF and the NPSE require that no significant adverse impact should occur and that, where a noise level which falls between a level which represents the lowest observable adverse effect and a level which represents a significant observed adverse effect, then according to the explanatory notes in the statement:

"… all reasonable steps should be taken to mitigate and minimise adverse effects on health and quality of life whilst also taking into consideration the guiding principles of sustainable development. This does not mean that such effects cannot occur."

2.3. Local Planning Consultation Guidance

2.3.1. The local planning guidance 'West Yorkshire Planning Consultation Guidance: Noise & Vibration', Reference [3], reflects the noise-related guidance contained within the NPPF and NPSE.

2.3.2. The noise assessment criteria described in this guidance is shown as follows:

- The Planning Authority will normally support refusal where the noise impact on sensitive receptors exceeds SOAEL, however mitigating factors such as the local authority's on-going support of local regeneration will be taken into consideration.
- The Planning Authority will normally recommend conditions to mitigate noise impacts where the noise levels exceed the LOAEL but are lower than the SOAEL criterion.

2.4. Professional Practice Guidance on Planning and Noise (ProPG)

2.4.1. The ProPG, Reference [4], provides guidance to practitioners on the recommended approach to the management of noise within the planning system in England for transportation noise sources.

2.4.2. The document draws together guideline limits for internal noise levels from external transport sources from other sources of guidance, including BS 8233, Reference [5], and the World Health Organisation (WHO) Guidelines for Community Noise.

2.4.3. The guidance outlines a recommended approach for assessing noise impacting on new residential development, outlining a risk based 2-stage assessment approach, which are:

- Stage 1 – an initial noise risk assessment to classify the proposed site as negligible, low, medium or high risk; and
- Stage 2 – preparation and delivery of an Acoustic Design Statement (ADS) for sites identified as low, medium or high risk at Stage 1.

2.4.4. Regarding the Stage 1 noise risk assessment, ProPG states:

"The noise risk assessment may be based on measurement or prediction (or a combination) as appropriate, and should aim to describe noise levels over a "typical worst case" 24 hour day either now or in the foreseeable future. It may often be useful to liaise with the LPA regarding the most appropriate typical worst case scenario for the particular site. Care should be taken so that the risk assessment includes the combined free-field noise level from all relevant sources of transport noise that affect the site. The assessment may also include industrial/commercial noise where this is present but is "not dominant."

2.4.5. For Stage 2, four key elements are considered for the ADS, these are:

- Element 1 – demonstrating a ‘Good Acoustic Design Process’;
- Element 2 – observing internal ‘Noise Level Guidelines’;
- Element 3 – undertaking an ‘External Amenity Noise Assessment’; and
- Element 4 – Consideration of ‘Other Relevant Issues’.

2.5. Adopted assessment methodology

2.5.1. As the ProPG document draws together guideline limits from other sources of guidance, including BS 8233 and the World Health Organisation (WHO), noise level from the ProPG assessment approach is adopted for the noise assessment in this report.

3. Initial Site noise risk assessment

3.1. Noise risk classification scale

3.1.1. Figure 2 below is reproduced from ProPG and shows the criteria for risk classification. The scale is based on 16-hour daytime or 8-hour night-time noise levels. The noise risks of day or night are assessed separately in the following section.

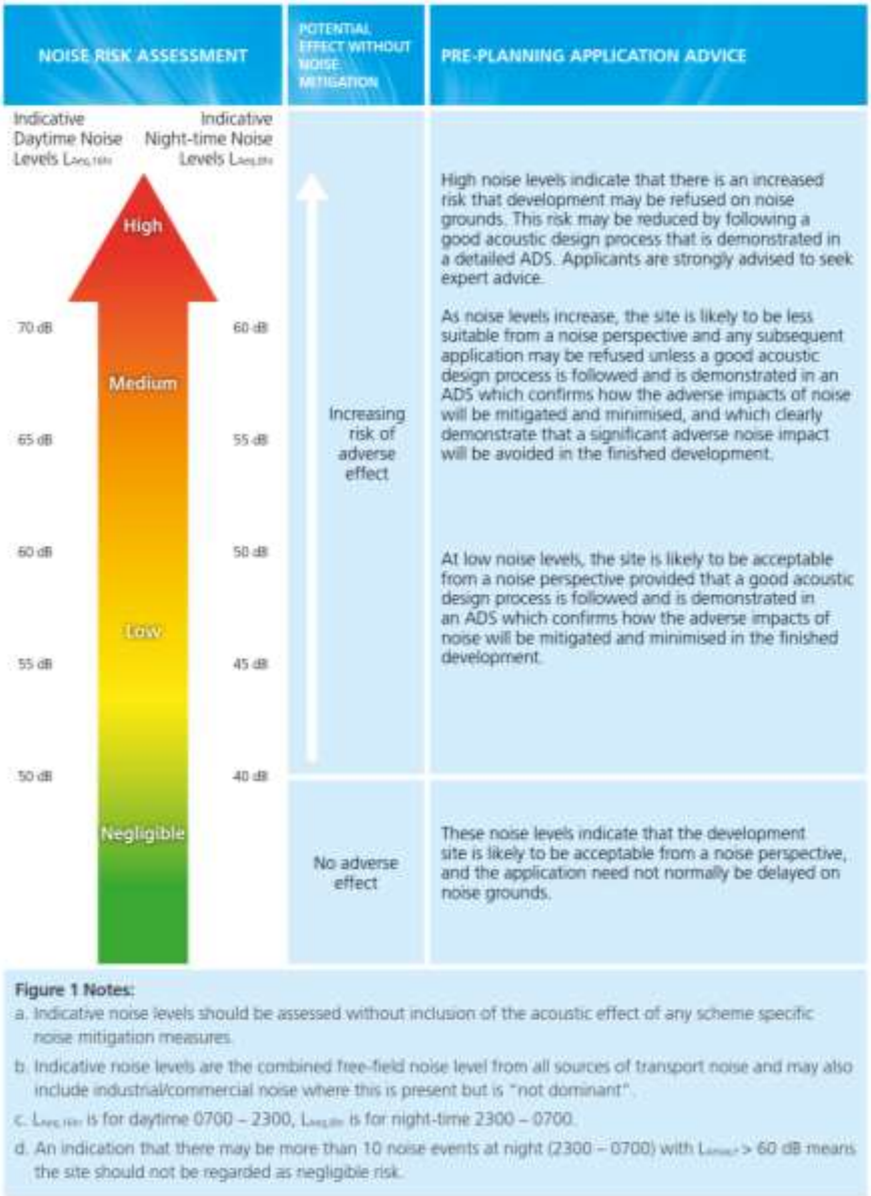

Figure 2: ProPG noise risk criteria

3.2. Noise survey

3.2.1. Short term measurements for the existing acoustic environment were made for 1 hour on 23rd October 2019 at two positions, ST1 and ST2. ST1 was close to Heybeck Lane and ST2 was close to Leeds Road as shown in Figure 1.

3.2.2. Long term measurement was made from 23rd October to 25th October 2019 at LT1 as shown in Figure 1.

3.2.3. The microphone was located 1.5 metres above ground level and away from other reflecting surfaces such that the measurements are considered free-field.

3.2.4. Data was recorded in 1/3-octave band frequencies at one-second intervals throughout the measurement periods.

3.2.5. The equipment used is listed in Table 1.

Table 1: Equipment used

Equipment	Model	Serial no.
Sound Level Meter	NTi XL2	A2A-11084-E0
Calibrator	Larson Davis CAL 200	10665
Sound Level Meter	NTi XL2	A2A-11062-E0
Calibrator	Larson Davis CAL 200	13403

3.2.6. Both meters and calibrators had current calibration certificates traceable to national standards. The sound level meter had been calibrated within the last two years and the calibrator has been calibrated within the last year; calibration certificates are available on request.

3.2.7. The equipment was field-calibrated before and after the measurements with no significant drift in sensitivity noted.

Figure 3: Measurement in progress at position ST1

Figure 4: Measurement in progress at position ST2

Figure 5: Measurement in progress at position LT1

3.3. Measured noise levels

3.3.1. The measured ambient sound levels for the existing acoustic environment are shown in Table 2.

Table 2: Summary of the measured ambient noise levels

Position	Parameter	Measured ambient noise level, dB	Measured noise risk
LT1	Day $L_{Aeq,16hr}$	53	Low
	Night $L_{Aeq,8hr}$	47	Low
ST1	Day $L_{Aeq,1hr}$	47	Negligible
ST2	Day $L_{Aeq,1hr}$	53	Low

3.4. Noise risk

3.4.1. Based on the measured noise levels, the development Site is likely to be exposed to a Low Risk noise environment as shown in Table 3.

Table 3: Noise risk and the corresponding pre-planning application advice

Noise risk	Potential effect without noise mitigation	Pre-planning application advice
Low	Adverse effect on heath and quality of life	At low noise levels, the Site is likely to be acceptable from a noise perspective provided that a good acoustic design process is followed and is demonstrated in an acoustic design statement which confirms how the adverse impacts of noise will be mitigated and minimised in the finished development

3.4.2. As a higher than negligible risk is identified, a ProPG Stage 2 assessment is required to show a ‘good acoustic design process’ to mitigate the risk for a potential adverse effect.

4. Good acoustic design process

4.1. Acoustic design process

4.1.1. The details of the good acoustic design process are shown in Table 4. The building layout, ventilation strategy, building elements, and noise environment in external amenity spaces are included.

Table 4: Summary of adopted good acoustic design processes considered in this report

Element	Adopted good acoustic design process
Site and building layouts	Site perimeter houses will provide noise reduction effect to the houses further away from the road.
Mitigation measures	Close board timber fences along the west and north boundary close to the Leeds Road and Heybeck Lane are recommended. This will provide shielding from road traffic noise to the internal noise levels in the proposed houses and to the external amenity spaces.
Ventilation and overheating	**Whole building and extract ventilation** Through the consideration of site and building layouts and proposals for the close board fences, all Approved Document F (AD-F), Reference [9], ventilation systems are feasible for this development. The acoustic requirements for the ventilators may vary due to different ventilation systems. **Purge ventilation** Based on the noise measurements and initial calculations, open windows can be used to provide purge ventilation as required in AD-F. **Control of overheating** Overheating risk is likely to be low as the proposed dwellings are low rise buildings, located away from city centres and in north of England. Considering the low risk of overheating and the noise across the site we consider that opening windows can be used to control overheating within the dwellings.
Building elements	A scheme for the façade sound insulation has been proposed as identified in Table 8.
External amenity space	Noise levels within the external amenity spaces are calculated with and without mitigation measures. Without additional mitigation measures, the noise levels within the amenity spaces for the houses close to the roads, exceed 55 dB $L_{Aeq,16hr}$. Therefore, close board fences of 2 m high to the western boundary and northern boundary of the Site is proposed to reduce noise impact on the outdoor amenity areas.

4.2. Recommended mitigation measures

4.2.1. The initial calculation indicates that the noise levels in gardens located close to Leeds Road and Heybeck Lane slightly exceed the guideline noise level of 55 dB $_{LAeq,16hr}$. Therefore, close board timber fences along the west and north boundary are recommended to provide suitable noise level in gardens facing Leeds Road and Heybeck Lane. The typical locations and specification of the close board fences are shown in Figure 6.

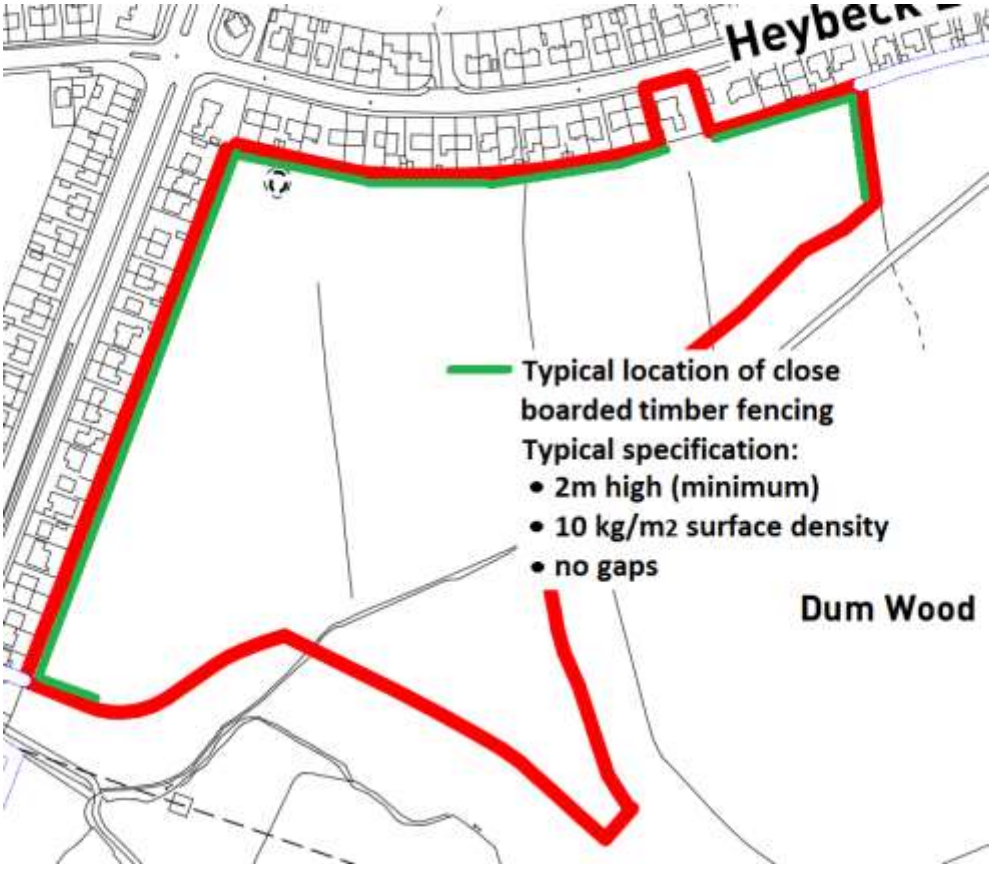

Figure 6: Proposed close board fences to the west and north boundary

5. Achieving internal noise levels

5.1. Internal ambient noise level criteria

5.1.1. The internal ambient noise level criteria outlined in ProPG are shown in Table 5. The values are in line with BS 8233 and World Health Organisation guidelines.

5.1.2. As no regular individual noise events were identified during the attended short-term surveys and unattended long-term survey, the maximum noise level is not considered in this report. When the night-time internal noise level $L_{Aeq,8hr}$ is below the guideline value, it is unlikely the external noise source would cause any sleep disturbance.

Table 5: ProPG internal ambient noise level criteria

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

5.2. Calculated noise levels on the proposed buildings

5.2.1. Based on the proposed Site layout and mitigation measures, the noise transmission and propagation on the proposed buildings modelled using proprietary software CadnaA, Reference [6]. The model assumes noise propagation outdoors according to ISO 9613, Reference [7], and the parameters and assumptions are shown in Table 6.

Table 6: Modelling parameters and assumptions

Parameter	Details
Model dimensions	British Transverse Mercator coordinates
Site location and layout	Architects drawings, Reference [8]
Topography	Modelled with no changes in topography
Receptor positions	Noise level contours at 1.5 m and 4 m high are calculated
Building and fence absorption coefficient	1 dB per reflection
G, Ground factor	Mixed hard ground and porous ground
Max. order of reflections	Two

5.2.2. The calculated highest day and night-time noise level at the façades of each building are shown in Table 7. The calculated maximum noise levels are shown in Table 7.

Table 7: Calculated noise level on the façade of the proposed development

Position	Parameter	dBA	125	250	500	1000	2000
Most exposed building	Day $L_{Aeq,16hr}$	57	40	45	49	55	49
	Night $L_{Aeq,8hr}$	51	34	39	44	49	43

5.3. Façade sound insulation

5.3.1. Based on a 13-dB difference between external free-field noise levels and internal noise levels through a partially open window, the proposed noise level limits are calculated to be exceeded in houses at the west and north Site perimeter.

5.3.2. The required façade sound insulation of the development is therefore considered with windows closed for these areas, and alternative provision should be made for background ventilation and control of overheating.

5.3.3. Opening windows may still be acceptable to provide purge ventilation as described by Approved Document F (AD-F), Reference [9], given that the activities requiring purge ventilation are typically short in duration, such as painting and decorating, or removing smoke from burning toast.

5.3.4. The proposed development will be required to meet Part F of the Building Regulations with regards to ventilation provision, as described in AD-F.

5.3.5. A suitable ventilation strategy may be AD-F System 1 Background ventilators and intermittent extract fans, AD-F System 3 (continuous mechanical extract (MEV)), or AD-F System 4 (continuous mechanical supply and extract with heat recovery (MVHR)). Should the latter system be implemented, trickle vents are not required.

5.3.6. It should be emphasised that the above is not intended to constitute a ventilation strategy design, which is the responsibility of the mechanical engineers.

5.3.7. Ventilation system design should be carefully considered. Research has shown that annoyance caused by noise from poorly designed systems frequently results in occupants curtailing the operation of the ventilation system. Such action leads to inadequate ventilation resulting in poor air quality, which is well correlated with a range of adverse health effects.

5.3.8. The minimum glazing and ventilator performances to habitable rooms are presented in Table 8 are calculated to be required to reduce noise levels to below the LOAEL for internal noise levels.

Table 8: Potential façade sound insulation treatments

Façade	Glazing performance	Façade vent performance	Performance for more than one vent per room	Potential AD-E ventilation strategy
All	≥ 23 dB R_w+C_{tr}	≥ 31 dB $D_{ne,w}+C_{tr}$	If 'N' number of vents are required per room, the acoustic performance of each vent should be increased to 31 dB + 10 log (N) D_{new} + C_{tr}	**AD-F System 1 or 3**
		No trickle vent required		AD-F System 4

5.3.9. The calculation method for façade sound insulation is in accordance with BS 8233 and the principles of BS EN 12354-3, Reference [10].

5.3.10. From ISO 16283, Reference [11], the reverberation time is typically 0.5 seconds across the relevant frequency range for a furnished living room. This value is used for both living rooms and bedrooms.

5.3.11. Since construction details are currently unavailable for the proposed development, for the calculations bedrooms are assumed to have a window area of 1.5 m^2 and a volume of 25 m^3, while living rooms are assumed to have a window area of 2 m^2 and a volume of 40 m^3.

5.3.12. The sound reduction of other elements of the building facade is considered to be much higher than that of the glazing and ventilation provision. Therefore, noise penetration through the other façade elements is disregarded as relatively insignificant.

5.3.13. Calculated internal noise levels based on manufacturer's test data for the example glazing and ventilation products listed in the summary table are presented in Table 9.

Table 9: Calculated internal noise levels

Position	Room type	Calculated internal noise levels	
		$L_{Aeq,16hr}$	$L_{Aeq,8hr}$
Most exposed building	Living room	30	--
	Bedroom	31	26

6. External amenity areas

6.1. ProPG external noise level guidelines

6.1.1. The ProPG outlines five criteria that are to inform an external amenity area noise assessment, shown as follows.

i) 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;

ii) 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 $L_{Aeq,16hr}$;

iii) 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.

iv) Whether or not external amenity spaces are an intrinsic part of the overall design, consideration of the need to provide access to a quiet or relatively quiet external amenity space forms part of a good acoustic design process.

v) Where, despite following a good acoustic design process, significant adverse noise impacts remain on any private external amenity space (e.g. garden or balcony) then that impact may be partially offset if the residents are provided, through the design of the development or the planning process.

6.2. External noise assessment

6.2.1. Without mitigation, noise levels exceed 55 dB $L_{Aeq,16hr}$ in the gardens close to the west and north site perimeter.

6.2.2. Therefore, close board fences are recommended, and the locations and specifications are shown in Figure 6.

6.2.3. With the recommended close board fences, the noise levels in all gardens are below 55 dB $L_{Aeq,16hr}$.

6.2.4. It is therefore considered that external amenity noise levels are mitigated as far as reasonably practicable, in line with the aims of the NPPF and NPSE.

7. Other relevant issues

7.1.1. The proposed development was assessed following relevant guidance in ProPG, which is in line with national planning policy.

7.1.2. Noise level limits of relevant national and international guidance have been reviewed and the appropriate noise level limits have been adopted.

7.1.3. It is understood that the proposed development has no specific target occupant, therefore it is to be assumed that any potential occupant may choose to reside at the completed development.

7.1.4. The internal noise level and external amenity noise criteria considered in this report is considered appropriate for minimising potential adverse impacts from the noise sources identified.

7.1.5. The Heybeck Lane development is adjacent to another larger proposed development on Leeds Road which is in the process of being submitted for planning, but is considered as part of this assessment.

7.1.6. The larger Leeds Road development includes areas for employment which will form a boundary at the south west corner of the Heybeck Lane development.

7.1.7. The larger development will need to consider noise levels generated which impact the existing residential properties on Leeds Road, and that is likely to be sufficient to protect residential properties within the Heybeck Lane development.

7.1.8. Mitigation in the form of noise limits and business uses may be required for the Leeds Road development depending on final design.

8. Conclusion

8.1.1. Noise levels affecting the proposed development have been measured at various locations. Noise assessment has been carried out following the guidance of ProPG.

8.1.2. The initial noise assessment indicates that the site is exposed to a low risk noise environment. As the risk is above negligible, a ProPG Stage 2 detailed assessment was undertaken.

8.1.3. Close board fences and potential façade sound insulation treatments have been recommended in this report to mitigate the potential adverse impacts.

8.1.4. With these mitigation measures, the adverse impacts of noise will be mitigated and the guideline values for internal noise environment and external amenity spaces are achieved.

9. References

1. National Planning Policy Framework, Ministry of Housing, Communities & Local Government, February 2019.
2. Noise Policy Statement for England, Department for Environment, Food and Rural Affairs, March 2010.
3. West Yorkshire planning consultation guidance, Noise & Vibration May 2016.
4. ProPG: Planning & Noise professional practice guidance on planning & noise – New residential development May 2017.
5. BS 8233: 2014, Guidance on sound insulation and noise reduction for buildings.
6. CadnaA environmental noise modelling software, version 2020, Datakustik GmbH.
7. ISO 9613: Acoustics - Attenuation of sound during propagation outdoors.
8. Heybeck Lane, Proposed Site Plan, drawing no. 00-101, revision A, September 2019.
9. Approved Document F – Ventilation, 2010 edition incorporating 2010 and 2013 amendments.
10. BS EN 12354-3:2000, Building Acoustics – Estimation of acoustic performance of buildings from the performance of elements – Part 3: Airborne sound insulation against outdoor sound.
11. BS EN ISO 16283-1:2014 Acoustics – Field measurement of sound insulation in buildings and of building elements – Part 1: Airborne sound insulation.

Appendix A Limitations

The recommendations contained in this Report represent Delta-Simons professional opinions, based upon the information listed in the Report, exercising the duty of care required of an experienced Environmental Consultant. Delta-Simons does not warrant or guarantee that the Site is free of hazardous or potentially hazardous materials or conditions.

Delta-Simons obtained, reviewed and evaluated information in preparing this Report from the Client and others. Delta-Simons conclusions, opinions and recommendations has been determined using this information. Delta-Simons does not warrant the accuracy of the information provided to it and will not be responsible for any opinions which Delta-Simons has expressed, or conclusions which it has reached in reliance upon information which is subsequently proven to be inaccurate.

This Report was prepared by Delta-Simons for the sole and exclusive use of the Client and for the specific purpose for which Delta-Simons was instructed. Nothing contained in this Report shall be construed to give any rights or benefits to anyone other than the Client and Delta-Simons, and all duties and responsibilities undertaken are for the sole and exclusive benefit of the Client and not for the benefit of any other party. In particular, Delta-Simons does not intend, without its written consent, for this Report to be disseminated to anyone other than the Client or to be used or relied upon by anyone other than the Client. Use of the Report by any other person is unauthorised and such use is at the sole risk of the user. Anyone using or relying upon this Report, other than the Client, agrees by virtue of its use to indemnify and hold harmless Delta-Simons from and against all claims, losses and damages (of whatsoever nature and howsoever or whensoever arising), arising out of or resulting from the performance of the work by the Consultant.

This assessment is based upon an applied general design informed by experience of dealing with school sites and those designs required by the Client, we have not taken into account specific requirements of an end user. As a result, it is understood that any design or operational changes may require further planning submissions once an end user is established.

Appendix B Noise level contours

Figure 7: Noise level contour of daytime $L_{Aeq,16hr}$ at 1.5 m

Figure 8: Noise level contour of night-time $L_{Aeq,8hr}$ at 4 m high

Appendix C Calculation of façade noise ingress

C.1 Calculation method

C.1.1 The noise level in a room due to sound penetrating a façade element may be calculated according to BS EN 12354-3 and BS 8233 from:

$$L_2 = L_{1,in} - R + 10\log_{10}\frac{S}{V} + 10\log_{10}T + 11$$

Where:

L_2 = Noise level in room, dB;
$L_{1,in}$ = external free-field noise level at the façade, dB;
R = sound reduction index, dB;
S = area of façade portion, m^2;
V = room volume, m^3;
T = reverberation time, s.

C.1.2 For small façade components, such as ventilators, the noise level in a room may be calculated according to the same standards as above from:

$$L_2 = L_{1,in} - D_{n,e} + 10\log_{10}\frac{N}{V} + 10\log_{10}T + 21$$

Where:

$D_{n,e}$ = element normalised sound level difference of the ventilator
N = number of ventilator on the façade of the room

C.1.3 The sound reduction of other the external wall is much higher than that of the glazing and ventilation provision. Therefore noise penetration through the external wall is disregarded as insignificant compared to noise penetration through the glazing and ventilation provision.

C.1.4 The noise penetration through the vents and the glazing is calculated in five octave bands as indicated in BS 8233.

C.2 Calculated internal noise level

C.2.1 The calculated internal noise levels are shown in Table 10 and Table 11 for living room and bedroom respectively. The calculation is based on one trickle vent in each room.

C.2.2 These calculations are based on specific product. Other products with equivalent acoustic performance would also be acceptable.

Table 10: Calculated internal noise level in the worst affected living room

Volume, V / m^3	40
Window area, S / m^2	2
Reverberation Time, T / s	0.5
Number of vents feasible	1

Daytime $L_{Aeq, 16\ hr}$ (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
External free-field noise, L_{1in}	57	40	45	49	55	49
Glazing: 4/12/4 mm, R		24	20	25	35	38
Through window, L_2(a)	24	11	20	19	15	6
RW Simon Framevent, Dn,e		36	33	33	31	29
Through vent, L_2(b)	28	6	14	18	26	22
Total noise through all elements, L_2	30					

Table 11: Calculated internal noise level in the worst affected bedroom

Volume, V / m^3	25
Window area, S / m^2	2
Reverberation Time, T / s	0.5
Number of vents feasible	1

Daytime $L_{Aeq, 16 hr}$ (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
Daytime $L_{Aeq, 16 hr}$ (dB)	57	40	45	49	55	49
External free-field noise, L_{1in}		24	20	25	35	38
Glazing: 4/12/4 mm, R	24	12	21	20	16	7
Through window, L_2(a)		36	33	33	31	29
RW Simon Framevent, Dn,e	30	9	16	20	28	24
Through vent, L_2(b)	31					

Night-time $L_{Aeq, 8 hr}$ (dB)	dB(A)	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
Daytime $L_{Aeq, 16 hr}$ (dB)	51	34	39	44	49	43
External free-field noise, L_{1in}		24	20	25	35	38
Glazing: 4/12/4 mm, R	19	6	15	15	10	1
Through window, L_2(a)		36	33	33	31	29
RW Simon Framevent, Dn,e	25	3	10	15	22	18
Through vent, L_2(b)	26					