



Noise Impact Assessment

Southgate - Leeds Road, Huddersfield HD1 1TW

Presented to IB Planning on behalf of Kirklees Council

Issued: 07th June 2021

Delta-Simons Project No. 21-0934.02



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Report Details

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Executive Summary

Site and Report Context	Delta-Simons Environmental Consultants Limited (“Delta-Simons”) was instructed by IB Planning on behalf of Kirklees Council (the “Client”) to carry out a Noise Impact Assessment for Southgate - Leeds Road, Huddersfield HD1 1TW (the “Site”) to inform a planning application for a proposed development of a new flagship Health Innovation Campus for the University of Huddersfield. The Site is surrounded by an arterial road network with Southgate Road and Leeds Road being the dominant noise sources affecting the Site. To the north, south, and east of the Site there are commercial businesses that only operate during the daytime. The Site was formerly occupied by two 11 storey high-rise housing developments, a large sports center, multi-storey car park and various construction buildings, the Site was cleared and re-graded by Kirklees Council in 2016, ready for redevelopment. A temporary council car park occupies part of the cleared Site currently.
Summary	This assessment has been undertaken to identify the key noise sources which may have the potential to impact upon the proposed development. Accordingly, this assessment has been completed with due regard to the National Planning Policy Framework (NPPF) and it's associated National Planning Policy Guidance (NPPG), Building Bulletin 93 (BB93), BS8233:2014 'Guidance on sound insulation and noise reduction for buildings', and 'BS4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'. This assessment has been informed by an attended Noise Survey completed over a weekday period to quantify the existing noise environment that could adversely impact the proposed development. A noise modelling software package (CadnaA) has been utilised to undertake noise model predictions across the undeveloped Site to assess the dominant noise levels. The assessment has shown that the predicted level of noise across the Site can be mitigated to not cause an adverse impact abiding good acoustic design is incorporated for the development.
Conclusions and Recommendations	These assessment results have shown, that appropriate mitigation applied to the development meets the presented noise limits.
This is intended as a summary only. Further detail and limitations of the assessment are provided within the main body of the report.	

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1.0 Introduction

1.1 Appointment

- 1.1.1 Delta-Simons Environmental Consultants Limited (“Delta-Simons”) was instructed by IB Planning on behalf of Kirklees Council (the “Client”) to carry out a Noise Impact Assessment for Southgate - Leeds Road, Huddersfield HD1 1TW (the “Site”) to inform a planning application for a proposed development of a new flagship Health Innovation Campus for the University of Huddersfield.

1.2 Site Location and Description

- 1.2.1 The Site was formerly occupied by two 11 storey high-rise housing developments, a large sports center, multi-storey car park and various construction buildings, the Site was cleared and re-graded by Kirklees Council in 2016, ready for redevelopment. A temporary council car park occupies part of the cleared site.
- 1.2.2 The noise environment is dominated by road traffic noise of Leeds Road and Southgate Road with occasional traffic movements along Old Leeds Road.
- 1.2.3 This assessment has been undertaken to identify the key noise sources associated with the surroundings of the Site which may have the potential to impact the proposed development.

1.3 Proposed Development

- 1.3.1 The Client proposes to develop a Heath Innovation Centre for the University of Huddersfield. There are to be 7 newly build proposed buildings covering a Site area is approximately 75,000m².
- 1.3.2 It is understood the development has the potential to operate during the day and evening periods (i.e. 07:00 - 23:00) over the week.
- 1.3.3 The indicative proposed Site layout is shown in **Figure 1**.
- 1.3.4 The standard limitations associated with this assessment are presented in **Appendix A**.
- 1.3.5 A glossary of terms used in this report is provided in **Appendix B**.

2.0 Legislation, Policy, and Guidance

2.1 Planning Policy

- 2.1.1 The National Planning Policy Framework (NPPF, 2019), Reference [1], sets out the Government's economic, environmental and social planning policies for England and "The purpose of the planning system is to contribute to the achievement of sustainable development." The core principles of sustainable development are based on economic, social and environmental objectives which are all relevant to noise generating and noise sensitive development, and the emphasis is placed on achieving well-designed places. This would include the application of good acoustic design to promote health and well-being, with a high standard of amenity for existing and future users.
- 2.1.2 With respect to noise, Paragraph 180 states that "Planning policies and decisions should 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 wider area to impacts that could arise from the development." With specific reference to noise, they should:
- ▲ *"Mitigate and reduce to a minimum potential adverse impact resulting 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;"*
- 2.1.3 The guidance contained within the NPPF further determines that consideration should be given to the Noise Policy Statement for England (DEFRA, March 2010).

2.2 Noise Policy Statement for England (NPSE)

- 2.2.1 The NPPF is consistent with the Noise Policy Statement for England (NPSE, 2010), Reference [2], which states three policy aims are 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.*
- The long-term policy vision and aims are designed to enable decisions to be made regarding what is an acceptable noise burden to place on society."*
- 2.2.2 The NPSE Explanatory Note provides further guidance on defining 'significant adverse effects' and 'adverse effects' using the following key phrases.
- NOEL** – No Observed Effect Level
- 2.2.3 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
- 2.2.4 This is the level above which adverse effects on health and quality of life can be detected.
- 2.2.5 Extending these concepts for the purpose of this NPSE leads to the concept of a significant observed adverse effect level.
- SOAEL** – Significant Observed Adverse Effect Level
- 2.2.6 The level above which significant adverse effects on health and quality of life occur.
- 2.2.7 The NPSE recognises that it is not possible to have single objective noise-based measures that define the SOAEL, LOAEL and NOAEL that are applicable to all sources of noise in all situations. The levels are likely to be different for different noise sources, receptors and at different times of the day.

- 2.2.8 The NPPF and associated NPSE provide the concepts for defining various levels of effect, but do not translate these into actual noise levels. Instead it is up to individual Local Authorities to interpret the concepts of the NPPF and NPSE and translate them into noise level criteria for development to be applied in their area.

2.3 Planning Practice Guidance – Noise

- 2.3.1 The Planning Practice Guidance for noise (updated December 2014) Reference [3] broadly considers the same issues as demonstrated within both the NPPF and the NPSE with regards to noise within the planning realm.
- 2.3.2 The information detailed within the PPG indicates that noise should be considered when:
- ▲ New developments may create additional noise; and/or
 - ▲ New developments would be sensitive to the prevailing acoustic environment.
- 2.3.3 The guidance indicates that Local Planning Authorities should take account of the acoustic environment and in doing so consider:
- ▲ Whether or not a significant adverse effect is occurring or likely to occur;
 - ▲ Whether or not an adverse effect is occurring or likely to occur; and
 - ▲ Whether or not a good standard of amenity can be achieved.
- 2.3.4 The impact of noise is rated within the policy document in terms of the relative 'Observed Effect Level', defined in line with the criteria summarised within paragraph 2.3.3 above. Based upon this the Planning Practice Guidance provides a matrix of likely average response, replicated below in **Table 1**.

Table 1 - Planning Practice Guidance – Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing Effect Level	Action
No Observed Adverse Effect Level			
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
Lowest Observed Adverse Effect Level			
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
Significant Observed Adverse Effect Level			

Perception	Examples of Outcomes	Increasing Effect Level	Action
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

2.3.5 A number of British Standards, International Standards and Codes of Practice contribute to the methodology of noise impact assessment in the UK. Those relevant to this impact assessment are summarised below.

2.4 Professional Practice Guidance on Planning and Noise (ProPG)

- 2.4.1 The document ProPG: Planning & Noise – Professionals Practice Guidance on Planning & Noise', Reference [7], provides guidance to practitioners on the recommended approach to the management of noise within the planning system in England.
- 2.4.2 The new guidance the overall aim of delivering sustainable development by promoting good health and well-being through the effective management of noise. The guidance aims to complement the national planning policy and encourages the use of good acoustic design at the earliest phase of the planning process.
- 2.4.3 The ProPG guidance is relevant to assess the impact of noise on the proposed residential development rather than determining the assessment of the impact of noise from the development upon the existing area. The guidance is applicable to new residential development which would be exposed predominantly to noise from existing transport sources and follows a risk-based approach.

2.5 Local Planning Policy

- 2.5.1 Local Planning Policy LP15 of Kirklees Local Plan Strategy and Policies states:
"Proposals for residential uses (including student accommodation) within the defined town centres as set out on the Policies Map will be supported subject to:
d.) the protection of the amenity of existing residents and future occupiers of the proposed residential use in accordance with amenity and design policies within the plan, and will in particular consider matters such as privacy, noise and air quality;"

2.6 Consultation

- 2.6.1 A consultation exercise was undertaken with Kirklees Council on the 28th May 2021 to discuss the noise monitoring locations and assessment methodology. The Environmental health office agreed on the assessment methodology and noise monitoring locations.

2.7 British Standard 8233:2014

- 2.7.1 British Standard 8233:2014 'Guidance on Sound Insulation and Noise Reduction for Buildings' (BS 8233), Reference [4], provides guidance for the control of noise in and around buildings which may affect sensitive receptors. The guidance provided within the document is applicable to the design of new buildings or refurbished buildings undergoing a change of use but does not provide guidance on assessing the effects of changes in the external noise levels to occupants of an existing building.

- 2.7.2 The guidance provided includes appropriate internal and external noise level criteria, which are applicable to dwellings exposed to steady external noise sources. It is stated that it is desirable for internal ambient noise levels not to exceed the criteria set out in **Table 2** below.

Table 2 - Guideline Indoor Ambient Noise Levels Defined in BS 8233:2014

Activity	Typical Situations	Guideline upper limit L_{AeqT} dB	
		07:00 to 23:00	23:00 to 07:00
Resting	Living Rooms	35	--
Dining	Dining Room / Area	40	--
Sleeping (daytime resting)	Bedroom	35	30

- 2.7.3 Furthermore, Table 4 of BS 8233 states:

“Regular individual noise events (for example, scheduled aircraft or passing trains) can cause sleep disturbance. A guideline value may be set in terms of SEL or $L_{Amax, F}$, depending on the character and number of events per night. Sporadic noise events could require separate values.”

- 2.7.4 With regards to individual noise events, BS 8233 states that:

“A guideline value may be set in terms of SEL or $L_{Amax, F}$, depending on the character and number of events per night. Sporadic noise events could require separate values.”

- 2.7.5 The superseded version of the standard (1999 version) suggested a night-time level of '45 dB $L_{Amax, fast}$ ' which should not 'normally' be exceeded, and which concurs with current World Health Organisation guidelines.
- 2.7.6 It is recognised within the standard that where development is desirable “these criteria may be relaxed by up to 5 dB and reasonable internal conditions still achieved”.
- 2.7.7 BS 8233 also advises on external noise limits in areas of a property such as gardens or balconies as follows:

“For traditional external areas that are used for amenity space, such as gardens and patios, it is desirable that the external noise level does not exceed 50 dB $L_{Aeq, T}$, with an upper guideline value of 55 dB $L_{Aeq, T}$ which would be acceptable in noisier environments. However, it is also recognized 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, such as the convenience of living in these locations or making efficient use of land resources to ensure developments needs can be met, might be warranted.”

2.8 BS4142:2014+A1:2019 'Methods for rating and assessing industrial and commercial sound'

- 2.8.1 This Standard describes methods for rating and assessing sound of an industrial or commercial nature which includes:

- ▲ Sound from industrial and manufacturing processes;
- ▲ Sound from fixed installations which comprise mechanical and electrical plant and equipment;
- ▲ Sound from the loading and unloading of goods and materials at industrial and / or commercial premises; and
- ▲ Sound from mobile plant and vehicles that is an intrinsic part of the overall sound emanating from processes or premises, such as that from forklift trucks, or that from train or ship movements on or around an industrial or commercial Site.

- 2.8.2 The procedure detailed in the Standard compares the measured or predicted noise level 'the specific noise level' from any of the above detailed noise sources with the background sound level at a residential dwelling. The measured background sound level at a receptor should be reliable and should not necessarily ascertain a lowest measured background sound level, but rather to quantify what is 'typical'.
- 2.8.3 The specific noise level also acknowledges the following reference time intervals depending upon whether the noise source operates during daytime or night-time periods:
- ▲ Daytime (07:00 - 23:00): 1 hour; and
 - ▲ Night-time (23:00 - 07:00): 15 minutes.
- 2.8.4 There are a number of 'character corrections' which can be attributed to the specific sound level, either subjectively or objectively, depending upon the 'acoustic features' of the sound level under investigation. These character corrections vary in their weighting depending upon the severity of the acoustic feature, as follows (with regards to the subjective method):

Tonality

- ▲ +2dB: where the tonality is just perceptible;
- ▲ +4dB: where the tonality is clearly perceptible; and
- ▲ +6dB: where the tonality is highly perceptible.

Impulsivity

- ▲ +3dB: where the impulsivity is just perceptible;
- ▲ +6dB: where the impulsivity is clearly perceptible; and
- ▲ +9dB: where the impulsivity is highly perceptible.

Intermittency

- ▲ +3dB: where the intermittency is readily distinctive against the acoustic environment.

- 2.8.5 Where the assessment is carried out using the objective method, the tonality character correction is either 0dB or 6dB and the impulsivity character correction can range from 0dB up to 9dB in increments of 1dB, depending on the level of impulsivity identified.
- 2.8.6 In addition to the above acoustic features, there is also a penalty for 'other sound characteristics' of +3dB where a sound exhibits characteristics that are neither tonal nor impulsive, though is readily distinctive against the acoustic environment at the receptor.
- 2.8.7 BS4142 goes on to state that the rating level is equal to the specific sound level if there are no such features present or expected to be present.
- 2.8.8 Assessment of the rating level relative to the background noise level can yield the following commentary:
- ▲ Typically, the greater this difference (between the rating level and the background sound level), the greater the magnitude of impact;
 - ▲ A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context;
 - ▲ A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context; and
 - ▲ 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. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact.
- 2.8.9 Whilst the Standard does make various references to it not being intended to assess noise impacts at indoor locations, Section 1.1 does state:
- 'The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident'.

2.8.10 Example 6 in the Standard states:

'In addition to the rating/background sound level comparison shown in Table A.6, the primary concern is the potential for disturbance of residents who could be sleeping with open bedroom windows. Other guidance, such as BS 8233, might also be applicable in this instance'.

2.8.11 Furthermore, Example 8, which considers night-time commercial noise impacts at a dwelling, states:

'BS 8233 indicates that 40 dBA sound level from the plant, equating to an internal level of around 30 dBA or possibly lower, but with some acoustically distinguishing characteristics, may not be suitable for a bedroom.'

2.8.12 With the above in mind, and for a clear need to ensure that any potential commercial or industrial noise impacts do not give rise to sleep disturbance in bedrooms, this assessment will ensure that the predicted rating level (specific sound level including any character corrections) does not exceed 30dB in bedrooms.

2.9 BB93: 2015 Indoor Ambient Noise levels in unoccupied spaces

2.9.1 The building Bulletin 98 2015, provides methodology for suitable indoor ambient noise levels for

- ▲ clear communication of speech between teacher and student
- ▲ clear communication between students
- ▲ learning and study activities

2.9.2 Table 1 of the bulletin specifies upper limits for indoor noise levels in terms $L_{Aeq,30mins}$ during normal teaching hours. Values for refurbishment are also the minimum acceptable standards for alternative performance standards in new buildings. Where a type of room is not listed, the nearest approximation should be used. Where a room is used for more than one purpose, the most onerous should be considered.

Table 3 - Table 1: noise activity and sensitivity levels and upper limits for indoor ambient noise levels

Type of room	Room classification for the purpose of airborne sound insulation in Tables 3a and 3b		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving)	New build	Refurbishment
Nursery school rooms <i>Primary school:</i> classroom, class base, general teaching area, small group room <i>Secondary school:</i> classroom, general teaching area, seminar room, tutorial room, language laboratory	Average	Medium	35	40
<i>Open plan: (See also section 1.8)</i> Teaching area Resource/breakout area	Average	Medium	40	45
Primary music room	High	Medium	35	40
Secondary music classroom ¹ Small and large practice/group room ¹ Performance/recital room ¹	Very high	Low	35	40
Ensemble room ¹ Recording studio ¹	Very high	Low	30	35

Type of room	Room classification for the purpose of airborne sound insulation in Tables 3a and 3b		Upper limit for the indoor ambient noise level $L_{Aeq,30mins}$ dB	
	Activity noise (Source room)	Noise tolerance (Receiving)	New build	Refurbishment
Control room - for recording ¹ Control room - not for recording	High Average	Low Medium	35	40
Lecture room	Average	Medium	35	40
Teaching space intended specifically for students with special hearing and communication needs ²	Average	Low	30	35

2.10 Calculation of Road Traffic Noise, 1988

- 2.10.1 The Calculation of Road Traffic Noise (CRTN) describes the procedures for calculating noise from road traffic. The memorandum uses traffic flows, %HGV's and road speed, amongst other parameters to calculate the noise level in terms of the $L_{A10, 18hr}$. The 18-hour period is defined between 06:00 and 24:00.
- 2.10.2 Within certain limits the following shortened measurement procedure may be used. Measurements of L_{10} are made over any three consecutive hours between 1000 and 1700 hours. Using L_{10} (3-hour) as the arithmetic mean of the three consecutive values of hourly L_{10} , the current value of L_{10} (18-hour) can be calculated from the relation:
- ▲ L_{10} (18-hour) = L_{10} (3-hour) - 1 dB(A).
- 2.10.3 The 2006 DEFRA update to CRTN, 'Method For Converting The UK Road Traffic Noise Index $L_{A10,18h}$ To The EU Noise Indices For Road Noise Mapping', is a guide for converting the calculated $L_{A10, 18hour}$ value into L_{day} , $L_{evening}$ and L_{night} values and subsequently calculating an $L_{Aeq, 16hour}$ for the site, using the following formulae:

Table 4 - Conversion calculations

Non-motorway roads	Motorways
$L_{day} = 0.95 \times L_{A10,18h} + 1.44$ dB	$L_{day} = 0.98 \times L_{A10,18h} + 0.09$ dB
$L_{evening} = 0.97 \times L_{A10,18h} - 2.87$ dB	$L_{evening} = 0.89 \times L_{A10,18h} + 5.08$ dB
$L_{night} = 0.90 \times L_{A10,18h} - 3.77$ dB	$L_{night} = 0.87 \times L_{A10,18h} + 4.24$ dB
$L_{Aeq, 16h} = 10 \log_{10} [1/16] (12 \times 10^{L_{day}/10} + 4 \times 10^{L_{evening}/10})$	

3.0 Scope and Methodology

3.1 Scope

3.1.1 The scope of the assessment has been determined in the following way:

- ▲ Verify the ambient noise environment by undertaking attended noise measurements at the worst-case Site boundaries.
- ▲ Assess the suitability of the Site for development based upon the criteria of BS 8233, and BB93 regarding measured ambient noise levels.
- ▲ Provide advice for suitable mitigation for the proposed development.

3.2 Site Suitability Assessment

- 3.2.1 As a worst-case, noise levels measured at the Site boundary adjacent to Leeds Road, Southgate Road, and Old Leeds Road, were used to consider the noise exposure to future development.
- 3.2.2 Noise grids (at 1.5m height and at 4m height) have been prepared to demonstrate the propagation of noise across the proposed Site.
- 3.2.3 For glazing and ventilation design, worst case receptor points have been placed on the façades of proposed buildings on the boundaries closest to the existing noise sources to determine the amount of sound insulation required to meet BS8233:2014 and BB93 guidance on internal noise levels.

3.3 Plant Noise Limits

- 3.3.1 The proposed Site is adjacent to existing commercial premises situated to the south (i.e. The Design Bank Ltd, TMS Well Being Sports Therapy & Massage, etc). Attended noise measurements were undertaken for 30 minutes during the day and night-time periods in order to quantify the noise environment around these premises.
- 3.3.2 It is understood that the existing premises normally operate between 08:00 am – 17:30 pm Monday to Friday. It was observed during the attended survey that none of these premises operate during the night-time period and that during the daytime period no plant noise of the existing premises could be perceived or identified. Therefore an assessment of existing plant noise has been scoped out.
- 3.3.3 There are no residential receptors within the immediate area of the Site although there are some commercial premises that could be impacted by plant noise during the daytime period assuming there are office-type rooms requiring concentration for the work.
- 3.3.4 At this stage, the exact details and locations of any proposed fixed plant (i.e. chillers units and air handling units) to be installed on the development are not known. Therefore, as a conservative approach a plant noise limit is provided that the development must not exceed when measured in free-field conditions at the closest worst-case commercial receptors to the Site.

4.0 Baseline Noise Survey

4.1 Introduction

- 4.1.1 A noise monitoring survey was undertaken to characterise ambient noise levels currently experienced on the Site.
- 4.1.2 Attended short-term noise monitoring was conducted at two locations for periods of 3 hours to the requirements of the shortened CRTN methodology. Attended measurements were undertaken on Tuesday 18th May 2021.
- 4.1.3 Location CRTN1 measured road traffic noise of Leeds Road, and CRTN2 measured Road traffic noise of Southgate Road. These are two dominant noise sources affecting the Site during the day and night.
- 4.1.4 Additionally, short term spot measurements were undertaken on Tuesday 18th May 2021 and Wednesday 19th May 2021 during the day and night for periods of up to 30 minutes east of the Site along Old Leeds Road.
- 4.1.5 Noise monitoring locations CRTN1, CRTN2 and ST1 are shown in **Figure 2**.

4.2 Noise Measurement Equipment

- 4.2.1 The following noise monitoring equipment was used throughout the survey. Measurements were taken in general accordance with BS 7445-1:2003 'The Description and Measurement of Environmental Noise: Guide to quantities and procedures'.

Table 5 - Measurement Equipment

Measurement Position	Equipment	Model Type	Serial Number	Calibration Due Date
CRTN1	Sound Level Meter	Rion NL-52	00231665	14 October 2022
	Pre-amplifier	Rion NH-25	21609	
	Microphone	Rion UC-59	3789	
	Calibrator	Rion NC-74	34536109	22 September 2021
CRTN2 & ST1	Sound Level Meter	01dB Fusion	12798	24 November 2022
	Pre-amplifier	01dB PRE22	2004238	
	Microphone	GRAS 40CD	37007	
	Calibrator	01dB CAL-31	93438	08 October 2021

- 4.2.2 The measurement equipment was checked against the appropriate calibrator at the beginning and end of the measurements, in accordance with recommended practice, a drift of 0.2 dB was observed. Calibration certificates for which are available on request.

4.3 Weather Conditions

- 4.3.1 Weather conditions during the survey period were observed as being dry and sunny for the full duration of the survey with low wind speeds as shown in **Table 6** below.

Table 6 - Meteorological Conditions during the Survey

Survey Location	Date	Temperature (°C)	Wind Speed (m/s)	Wind Direction	Cloud Cover (Oktas)
CRTN1, CRTN2 & ST1	18 th May 2021 to 19 th May 2021	14	<5	NW	0

4.4 Noise Survey Results

4.4.1 For the attended locations CRTN1 and CRTN2, the presented measured data consists of the energetic 5-minute $L_{Aeq,T}$ samples over the stated survey period.

Table 7 - Results of attended Baseline Survey - CRTN1 & CRTN2

Location	Period	Duration (h)	Date	$L_{Aeq,T}$ dB	$L_{Amax,T}$ (min - max) dB	$L_{A10,T}$ (Arithmetic average) dB	$L_{A90,T}$ (Arithmetic average) dB
CRTN1 (Leeds Road)	Weekday Daytime (10:20 -13:20)	3	18 th May 2021 to 19 st May 2021	71.5	64.0 - 98.6	75.1	57.6
CRTN2 (Southgate Road)	Weekday Daytime (10:00 -13:00)			70.6	75.9 - 98.8	73.8	60.8

4.4.2 The results of the measurements conducted during the survey are summarised in the above table. The main dominating noise sources identified during the Site survey were Leeds Road and Southgate Road at locations CRTN1 and CRTN2 where it was observed that a frequent flow of vehicle movements occurred during the daytime period.

4.4.3 In short periods of no passing traffic, bird songs could be heard. No other major noise sources were depicted at the attended measurement locations.

4.4.4 For the attended location (ST1), the presented measured data consists of the energetic 5-minute $L_{Aeq,T}$ samples over the 30 minute measurement periods. The results of the short attended measurements are shown in **Table 8** below.

Table 8 - Results of Attended Survey - ST1

Period	Duration (m)	Monitoring Date	$L_{Aeq,T}$ dB	$L_{Amax,T}$ (min - max) dB	$L_{A10,T}$ (Arithmetic average) dB	$L_{A90,T}$ (Arithmetic average) dB
Weekday Daytime (13:54 -14:24)	30	18 th May 2021	62.1	62.7 - 84.2	64.3	51.0
Weekday night-time (23:04 -23:34)			57.4	56.3 - 87.0	51.0	41.4

4.4.5 The results of the measurements conducted during the short-term attended survey are summarised in the above table. The main dominating noise source identified during the attended measurement at location ST1 was observed to be the road traffic noise of intermittent vehicle movements along Old Leeds Road during the day and night periods.

4.4.6 No plant noise could be heard when listening at position ST1 attributable to any of the surrounding commercial premises during the day and premises do not operate during the night-time.

5.0 Noise Impact Assessment

5.1 Computer Noise Modelling

- 5.1.1 Computer noise modelling has been undertaken for the undeveloped Site using noise modelling software package CadnaA.
- 5.1.2 The dominant day and night noise levels of the existing noise environment are associated with road traffic movements along Leeds Road, Southgate Road, and Old Leeds Road, and therefore these sources have been modelled respectively.
- 5.1.3 The octave band spectral shape has been obtained from survey measurements for road traffic noise which is used to inform the indicative noise ingress calculations and model predictions.
- 5.1.4 **Table 9** below shows a summary of the noise modelling parameters.

Table 9 - Noise model Input

Parameter	Setting
Façade Corrections	A 3 dB (A) correction has been applied to convert a free-field noise prediction to a façade level.
Ground Absorption	Acoustically hard (assumed 0.1 coefficient) – asphalt and paved areas
Met Conditions	10 degrees Celsius 70% humidity Wind from source to the receiver
Source Modelling	The noise sources considered for this exercise are Leeds Road (CRTN1) and Southgate Road (CRTN2) Day and evening traffic (main noise sources affecting the Site) and Old Leeds Road which are modelled as line sources respectively. Please note measured 3-hour CRTN measurement data has been converted to 18-hour data for both measurement positions CRTN1 and CRTN2: $L_{10} (18\text{-hour}) = L_{10} (3\text{-hour}) - 1 \text{ dB(A)}$ This is then converted using the following equations to derive 16-hour daytime and 4-hour evening $L_{Aeq,t}$ noise levels: Daytime $L_{Aeq, 16h} = 10 \log_{10} [1/16] (12 \times 10^{L_{day}/10} + 4 \times 10^{L_{evening}/10})$ Evening $L_{evening} = 0.97 \times L_{A10, 18h} - 2.87 \text{ dB}$
Receptor Height	Ground Floor 1.5m above ground First Floor 4.0 m above ground
Building Height	Indicative building heights are set to 14m and commercial buildings are set to 8m.
Terrain	Site has assumed flat land from source to receiver.
Site Layout	The indicative Site layout is provided by IB Planning.

Parameter	Setting
Validation of noise model:	
A noise level receptor point was positioned into the noise model at the unattended noise survey measurement locations (CRTN1, CRTN2, ST1) to calibrate the model using the measured octave band L_{eq} noise levels. The modelled results correlated with the measured results having 0dB difference.	

5.2 Habitable Rooms

- 5.2.1 At this stage, it is unclear to the exact internal arrangements of the proposed development. Most of the proposed internal rooms would likely be used for learning purposes, and as a worst case, it is assumed that these rooms would be located on the noisiest façade facing the dominant noises sources. It is also assumed that these rooms could facilitate large glazing areas.
- 5.2.2 To assess the potential glazing and ventilation requirements for the proposed development, noise ingress calculations were undertaken following the assumptions made regarding internal rooms, based on a nominal room dimension = (4×2.5×4m), with a typical façade and roof constructions:
- ▲ Rooms with an internal volume of 40m³;
 - ▲ 'Normal' internal surface finishes e.g. carpets etc;
 - ▲ Room glazed areas = 5m²; (large glazing area assumed)
 - ▲ Solid façade with brick/block cavity wall; and
 - ▲ Roof 100mm concrete.

5.3 Noise Model Scenarios

- 5.3.1 The proposed development will likely be operational during the day and evening hours over the week.
- 5.3.2 To ensure that the internal ambient noise level criteria for the proposed development are achieved worst case internal ambient noise levels are assessed to the guidance given in BS8233 and BB93 assuming the following internal noise limit criteria:
- ▲ BB93 - *Secondary school*: 35dB $L_{Aeq,30mins}$
 - ▲ BS8233 – Living room: 35dB $L_{Aeq,16hour}$
- 5.3.3 In order to assess the likely noise impact upon the proposed development two scenarios were modelled across the un-developed Site:
- ▲ $L_{Aeq,16h}$ daytime noise levels affecting the site; and
 - ▲ $L_{Aeq,4h}$ evening time noise levels.
- 5.3.4 Noise Modelling graphical outputs are provided in **Figures 3 - 4**.

5.4 Predicted Noise levels

- 5.4.1 **Table 10** below summarises the predictions of internal noise levels at the worst-case boundaries across the development site and their significance against the BS8233 and BB93 criteria with the façade treatment elements in place.
- 5.4.2 Noise ingress calculations are provided in **Appendix D** with a summary of the results in **Table 10**, below.

Table 10 – Noise Predicted Results.

Location(s)	Period	BS8233 and BB93 Internal Ambient Noise Requirements / dB	Predicted Ambient Internal Noise Level / $L_{Aeq, T}$ dB	Difference / dB	Façade Mitigation Strategy
Worst case dwellings adjacent to Leeds Road and Southgate Road	Daytime	35	34	-1	Option 1
	Evening		35	0	
Remaining facades identified	Daytime		32	-3	Option 2
	Evening		35	0	

- 5.4.3 It can be seen in the above table the proposed façade mitigation strategy would achieve internal noise limit criteria for the day and evening periods respectively for worst-case proposed facades.
- 5.4.4 The worst-case proposed facades are adjacent to Leeds Road, Southgate Road, and Old Leeds Road where Option 1 mitigation strategy is provided. For less exposed facades Option 2 mitigation strategy is provided. The rest of the development will allow for openable windows as means for ventilation.

5.5 Façade Mitigation Strategy

- 5.5.1 To ensure worst-case proposed facades are adequately protected from the existing noise environment a façade specification Option 1 is provided.
- ▲ Option 1 – Double glazing with minimum 10/16/6 arrangement, with acoustic background ventilators, normalised sound level difference of minimum 47 dB $D_{ne,W} + C_{tr}$.
- 5.5.2 For less exposed areas façade specification Option 2 is provided.
- ▲ Option 2 – Double glazing with minimum 4/12/4 arrangement, with non-acoustic background ventilators normalised sound level difference of minimum 27 dB $D_{ne,W} + C_{tr}$.
- 5.5.3 Trickle ventilation has been used as a typical ventilation strategy where windows are required to be closed to meet indoor noise criteria or where it is deemed necessary to provide further enhancement for other sensitive proposed dwellings close to existing noise sources.
- 5.5.4 A façade mitigation strategy markup is given in **Appendix E**.

5.6 Plant Noise Limits - BS4142:2014+A1:2019 Assessment

- 5.6.1 The positioning and details of the proposed plant were not available at the time of this assessment. It is only possible at this time to consider an appropriate background noise level to assess for any proposed plant to not exceed when measured at the receptor locations. Therefore, it is considered that a background noise level of 50 $L_{A90,1hour}$ is appropriate for assessment purposes. When the exact details of the plant are known, further assessment should be undertaken to ensure that there is no exceedance at commercial receptor locations.

5.7 Construction Noise

- 5.7.1 In order to reduce and manage the noise and vibration impact during construction it is advised that a Construction Noise Vibration Management Plan (CNVMP) be implemented. The CNVMP should always address the Best Practicable Means (BPM) for reducing noise and vibration impacts to be adhered by the appointed contractor and workers during the construction phase.

6.0 Summary and Conclusions

- 6.1.1 Delta-Simons Environmental Consultants Limited (“Delta-Simons”) was instructed by IB Planning on behalf of Kirklees Council (the “Client”) to carry out a Noise Impact Assessment for Southgate - Leeds Road, Huddersfield HD1 1TW (the “Site”) to inform a planning application for a proposed development of a new flagship Health Innovation Campus for the University of Huddersfield.
- 6.1.2 This assessment has been undertaken to identify the key noise sources which may have the potential to impact upon the proposed development. Accordingly, this assessment has been completed with due regard to the National Planning Policy Framework (NPPF) and its associated National Planning Policy Guidance (NPPG), Building Bulletin 93 (BB93), BS8233:2014 ‘Guidance on sound insulation and noise reduction for buildings’, and ‘BS4142:2014+A1:2019 ‘Methods for rating and assessing industrial and commercial sound’. This assessment has been informed by an attended Noise Survey completed over a weekday period to quantify the existing noise environment that could adversely impact the proposed development.
- 6.1.3 A noise modelling software package (CadnaA) has been utilised to undertake noise model predictions across the un-developed Site supplemented by spreadsheet calculations.
- 6.1.4 The assessment has shown that the predicted level of noise at worst-case boundaries can be mitigated to not cause an adverse impact. However, a detailed Noise Impact Assessment should be undertaken at a later stage when information on the proposed internal layout is available to ensure all mitigation methods are appropriately specified as shown within this report.

Figure 1 – Proposed Site

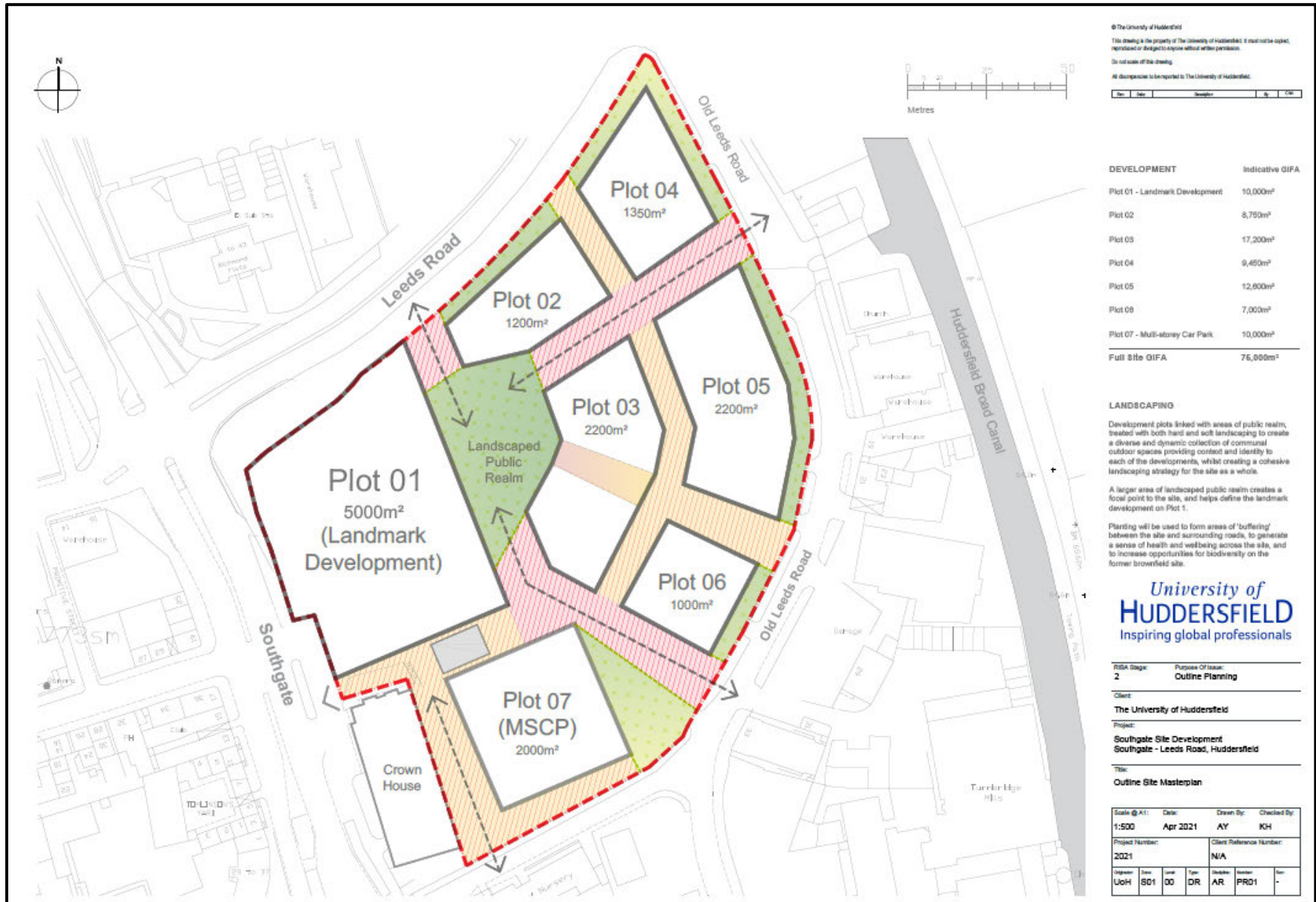


Figure 2 – Site Location and Noise Monitoring Locations

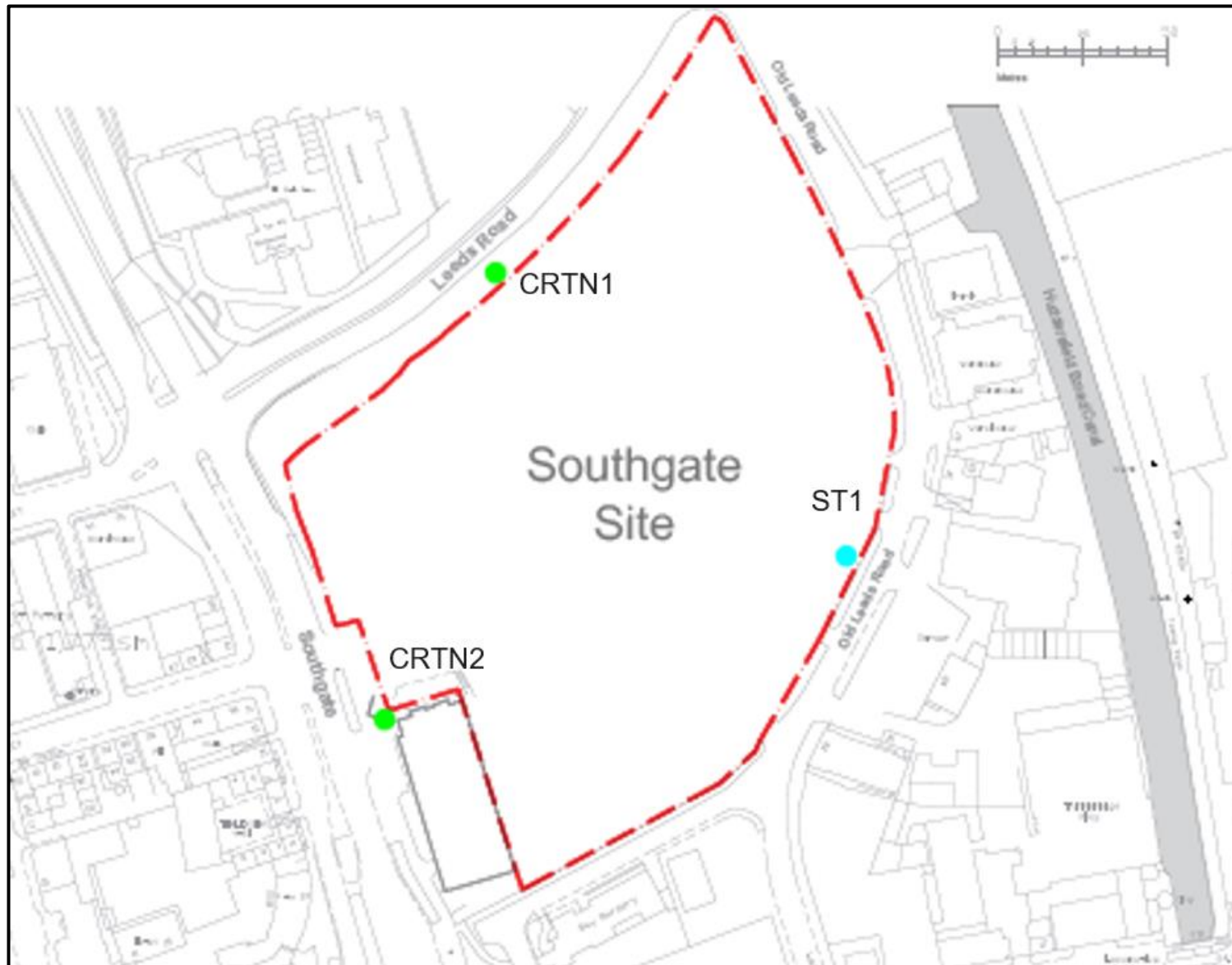
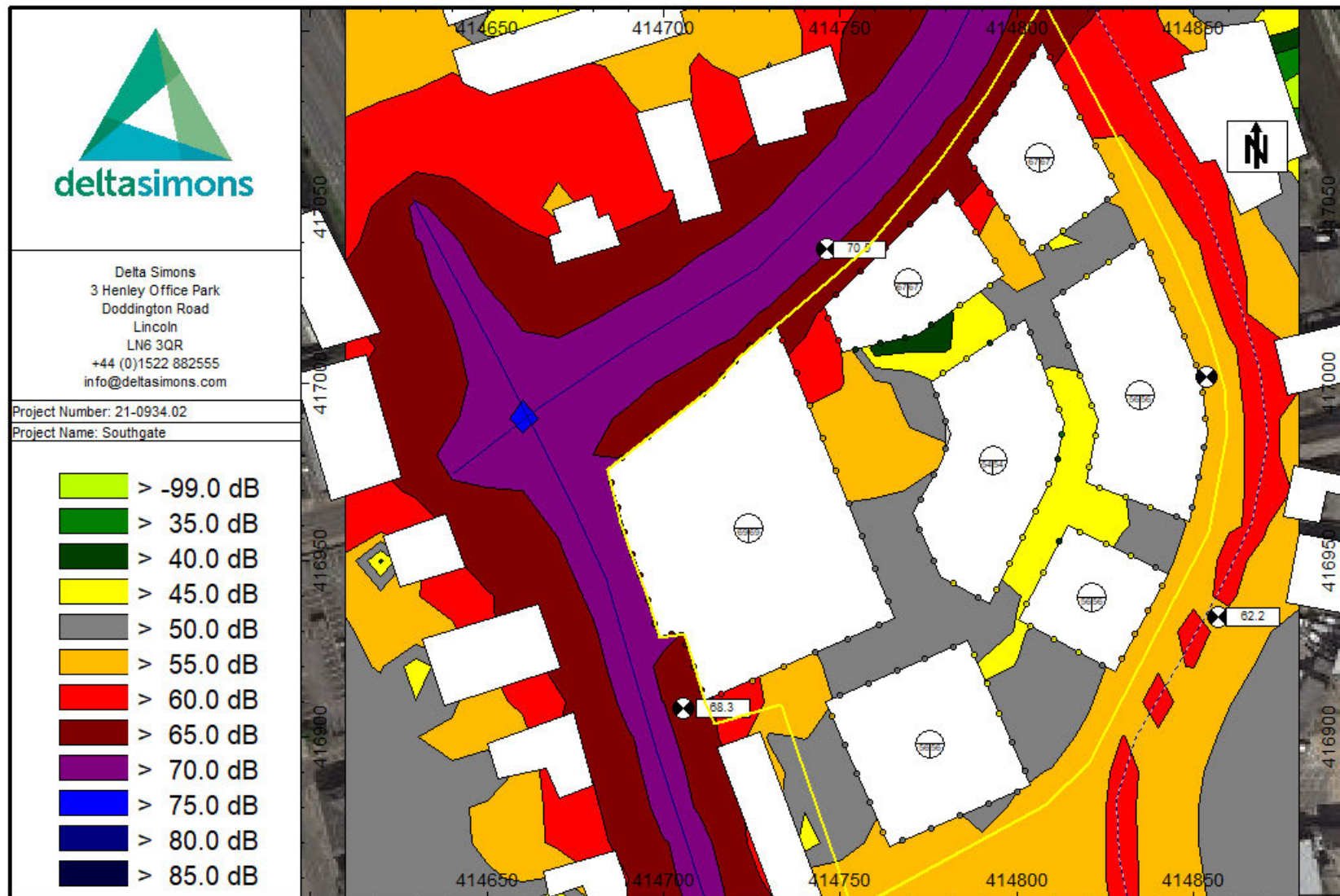


Figure 3 – Noise Map – Daytime $L_{Aeq,16h}$ (1.5m height)



Figure 4 – Noise Map – Evening -time $L_{Aeq,4h}$ (4m height)



Appendix A – Limitations

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.

Appendix B – Glossary

Glossary

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 B1 - 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 B2 - 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 C – CRTN Measurement data

Table C1 - 3-hour CRTN measurement data

Position	Hourly summary					
	Date	Time	LAeq,1h	LAF.max	LA90	LA10
CRTN1 (Leeds Road)	18/05/2021	10:20-11:00	71.0	84.7	55.6	75.3
	18/05/2021	11:00-12:00	71.4	86.8	58.9	75.5
	18/05/2021	12:00-13:00	71.7	91.7	58.3	75.4
	18/05/2021	13:00-13:20	72.0	98.6	56.1	73.1
CRTN2 (South Gate Road)	18/05/2021	10:05-11:00	69.2	89.8	59.4	72.7
	18/05/2021	11:00-12:00	71.4	84.7	61.6	74.6
	18/05/2021	12:00-13:00	70.9	98.8	61.1	73.9
	18/05/2021	13:00-13:25	70.4	85.1	61.4	73.7

Appendix D – Noise Break In calculations

Figure D1 - Daytime $L_{Aeq,16h}$ Noise break in Calculation – Option 1

 deltasimons Environment - Health & Safety - Sustainability								
Façade Noise Break In		125	250	500	1000	2000	4000	dB(A)
		33.7	48.5	60.4	68.3	67.5	63.0	72.4
Safety Factor	0 dB	0.0	0.0	0.0	0.0	0.0	0.0	
L2 = L0 - R + 10*log(S/A) + 3dB								
Calculated A = 0.16V/RT								
Volume =	40 m3							
RT		0.5	0.5	0.5	0.5	0.5	0.5	
Absorption		13.0	13.0	13.0	13.0	13.0	13.0	
10*log(A/S)		-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	
FAÇADE Elements								
Façade Area	10.0 m2							
Glazing Area, S								
10/16/6 double glazing	5.0 m2	26	27	34	40	38	38	
Predicted noise level in building from glazing		-29	-30	-37	-43	-41	-41	32.8
		6.5	20.3	25.2	27.1	28.3	23.8	
Solid Façade 1								
Brick/block cavity wall	5 m2	41	45	45	54	58	58	
Predicted noise level through solid façade		-44	-48	-48	-57	-61	-61	16.6
		-8.5	2.3	14.2	13.1	8.3	3.8	
Trickle Vent								
Renson AK40		32.8	39.1	44.3	48.8	50	53	
Predicted noise level through trickle vent		-33	-39	-44	-49	-50	-53	24.8
	Lff-Dne+10log(A0/A)+K	2.7	11.2	17.9	21.3	19.3	11.8	
Combined Noise Levels (1+2+3)		8.1	20.9	26.3	28.3	28.9	24.1	33.5
Target dB(A) Level								35
								Pass

Figure D2 - Evening-time $L_{Aeq,4h}$ Noise break in Calculation – Option 1

 deltasimons Environment - Health & Safety - Sustainability										
Façade Noise Break In		125	250	500	1000	2000	4000	dB(A)		
		31.3	46.4	58.4	66.1	65.3	60.8	70.2		
Safety Factor	0 dB	0.0	0.0	0.0	0.0	0.0	0.0			
L2 = L0 - R + 10*log(S/A) + 3dB										
Calculated A = 0.16V/RT										
Volume =	18 m3									
RT		0.5	0.5	0.5	0.5	0.5	0.5			
Absorption		5.7	5.7	5.7	5.7	5.7	5.7			
10*log(A/S)		3.7	3.7	3.7	3.7	3.7	3.7			
FAÇADE Elements										
Façade Area	13.3 m2									
Glazing Area, S										
10/16/6 double glazing	5.0 m2	26	27	34	40	38	38			
Predicted noise level in building from glazing		-30	-31	-38	-44	-42	-42			
		7.7	21.8	26.8	28.5	29.7	25.2	34.2		
Solid Façade 1										
Brick/block cavity wall	1 m2	41	45	45	54	58	58			
Predicted noise level through solid façade		-51	-55	-55	-64	-68	-68			
		-13.3	-2.2	9.8	8.5	3.7	-0.8	12.0		
Solid Façade 2 / Ceiling										
100mm concrete solid	7 m2	37	39	45	52	55	55			
Predicted noise level through solid façade		-40	-42	-48	-55	-58	-58			
		-1.8	11.3	17.3	18.0	14.2	9.7	21.4		
Trickle Vent										
Renson AK40		32.8	39.1	44.3	48.8	50	53			
Predicted noise level through trickle vent		-34	-40	-46	-50	-51	-54			
Lff-Dne+10log(A0/A)+K		3.9	12.7	19.5	22.7	20.7	13.2	26.2		
Combined Noise Levels (1+2+3+4)		9.6	22.7	28.0	29.9	30.4	25.6	35.1		
Target dB(A) Level									35	
									Pass	

Figure D3 - Daytime $L_{Aeq,16h}$ Noise break in Calculation – Option 2

 deltasimons Environment - Health & Safety - Sustainability								
Façade Noise Break In		125	250	500	1000	2000	4000	dB(A)
		19.9	34.5	46.6	55.1	54.2	48.7	59.0
Safety Factor	0 dB	0.0	0.0	0.0	0.0	0.0	0.0	
L2 = L0 - R + 10*log(S/A) + 3dB								
Calculated A = 0.16V/RT								
Volume =	40 m3							
RT		0.5	0.5	0.5	0.5	0.5	0.5	
Absorption		13.0	13.0	13.0	13.0	13.0	13.0	
10*log(A/S)		-1.2	-1.2	-1.2	-1.2	-1.2	-1.2	
FAÇADE Elements								
Façade Area	10.0 m2							
Glazing Area, S								
4/12/4 sealed	5.0 m2	24	23	30	33	33	30	
Predicted noise level in building from glazing		-27	-26	-33	-36	-36	-33	25.4
		-5.3	10.3	15.4	20.9	20.0	17.5	
Solid Façade 1								
Brick/block cavity wall	5 m2	41	45	45	54	58	58	
Predicted noise level through solid façade		-44	-48	-48	-57	-61	-61	3.1
		-22.3	-11.7	0.4	-0.1	-5.0	-10.5	
Trickle Vent								
Titon Invent	Dne	31.4	30.4	30.4	33.7	27.7	30.4	
	Ao/A	-31	-30	-30	-34	-28	-30	
Predicted noise level through trickle vent	Lff-Dne+10log(A0/A)+K	-9.7	5.9	18.0	23.2	28.3	20.1	31.1
Combined Noise Levels (1+2+3)		-3.9	11.7	20.0	25.3	28.9	22.0	32.1
Target dB(A) Level								35
								Pass

Figure D4 - Evening-time $L_{Aeq,4h}$ Noise break in Calculation – Option 2

 deltasimons Environment - Health & Safety - Sustainability								
Façade Noise Break In		125	250	500	1000	2000	4000	dB(A)
		18.8	33.9	45.8	53.8	52.9	47.9	57.8
Safety Factor	0 dB	0.0	0.0	0.0	0.0	0.0	0.0	
L2 = L0 - R + 10*log(S/A) + 3dB								
Calculated A = 0.16V/RT								
Volume =	18 m3							
RT		0.5	0.5	0.5	0.5	0.5	0.5	
Absorption		5.7	5.7	5.7	5.7	5.7	5.7	
10*log(A/S)		3.7	3.7	3.7	3.7	3.7	3.7	
FAÇADE Elements								
Façade Area	13.3 m2							
Glazing Area, S								
4/12/4 sealed	5.0 m2	24	23	30	33	33	30	
Predicted noise level in building from glazing		-28	-27	-34	-37	-37	-34	27.9
		-2.8	13.3	18.2	23.2	22.3	20.3	
Solid Façade 1								
Brick/block cavity wall	1 m2	41	45	45	54	58	58	
Predicted noise level through solid façade		-51	-55	-55	-64	-68	-68	-0.4
		-25.8	-14.7	-2.8	-3.8	-8.7	-13.7	
Solid Façade 2 / Ceiling								
100mm concrete solid	7 m2	37	39	45	52	55	55	
Predicted noise level through solid façade		-40	-42	-48	-55	-58	-58	8.9
		-14.3	-1.2	4.7	5.7	1.8	-3.2	
Trickle Vent								
Titon Invent	Dne	31.4	30.4	30.4	33.7	27.7	30.4	
	Ao/A	-33	-32	-32	-35	-29	-32	
Predicted noise level through trickle vent	Lff-Dne+10log(A0/A)+K	-7.2	8.9	20.8	25.5	30.6	22.9	33.4
Combined Noise Levels (1+2+3+4)		-1.2	14.8	22.8	27.6	31.2	24.8	34.5
Target dB(A) Level								35
								Pass

Appendix E – Façade Mark up - Option 1 and Option 2

