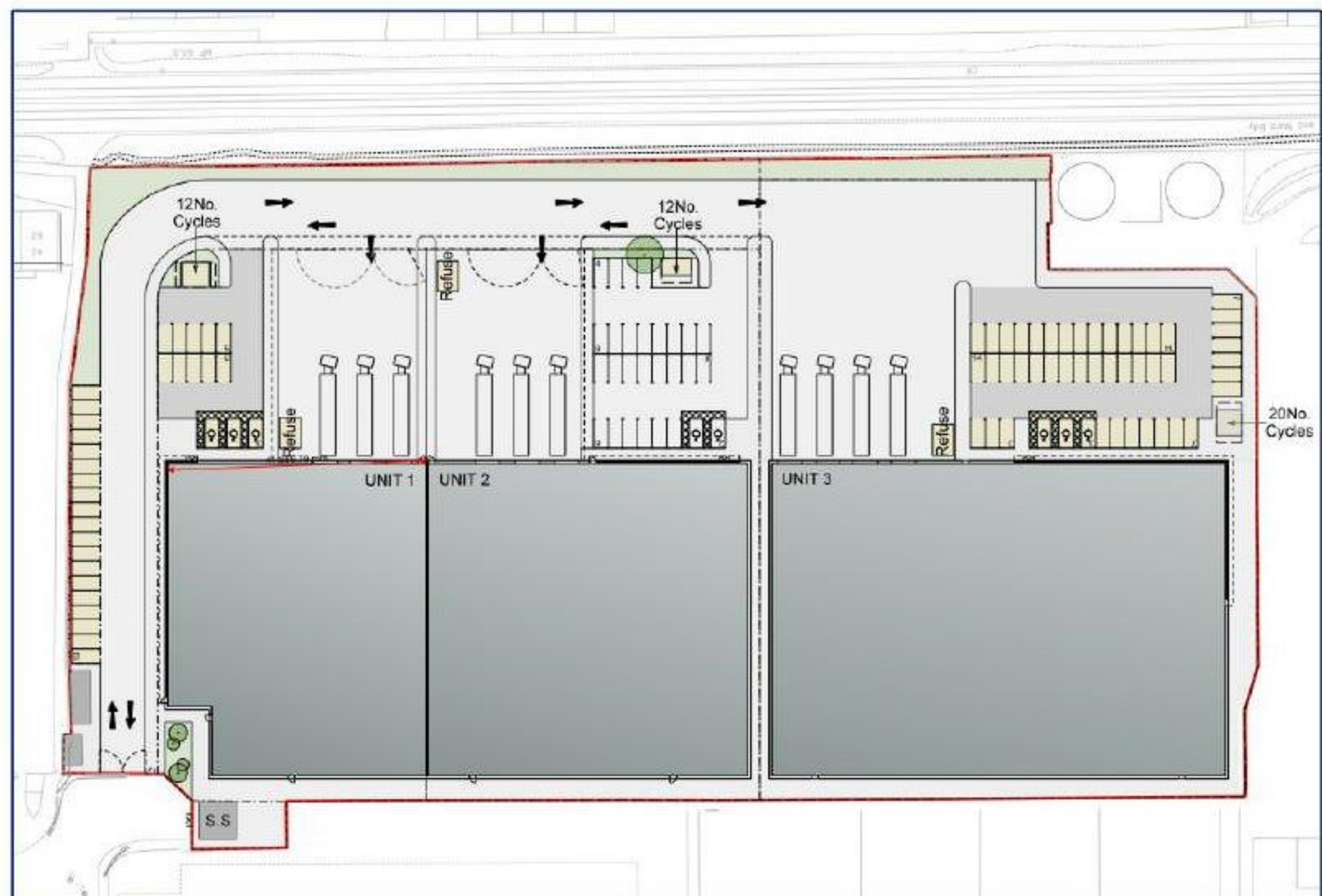


REPORT REF: 20757R02aPKmdw

NOISE IMPACT ASSESSMENT – 3NO. UNIT SCHEME

PROJECT VELOCITY, STANBRIDGE ROAD, HAVANT, HAMPSHIRE, PO9 2NS



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Date of issue:

Friday, 29 July 2016

Revision Schedule:

Report	Date	Comment
20757R02PKmdw	15.07.2016	First Issue
20757R02aPKmdw	29.07.2016	Second Issue - Section 6 reassessed using predicted HGV trip data.

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Executive Summary

Environoise Consulting Limited has been commissioned by BCP (Havant) LLP to prepare a noise impact assessment for a proposed 3No. Units scheme on land to the west of Stanbridge Road, Havant.

The purpose of the report is to provide sufficient information regarding noise to support a Reserved Matters planning application and discharge planning condition 10 in regards to an approved Outline Planning application (ref: APP/15/00284). In addition, to inform the design so that Building Research Establishment Environmental Assessment Method (BREEAM) credits under Hea 05 and Pol 05 within the Industrial 2014 technical manual can be achieved.

The report presents the results of a noise survey done to establish the existing ambient ($L_{Aeq, T}$) and background noise levels ($L_{A90, T}$). It also presents the results of measurements and assessments of the level of noise ingress into office areas, the impact of HGV deliveries and car park vehicle movements, and the impact of internal warehouse activities on nearby residential properties.

The assessment has concluded that HGV delivery noise will be of 'low impact' in accordance with BS4142:2014 and car park noise impact will be 'negligible' in accordance with DMRB guidance at the nearest receptors with mitigation in the form of a 3m and 2.4m barrier installed at the eastern and south eastern boundary of the site. Furthermore, noise from internal warehouse activity will be of 'low impact' in accordance with BS4142:2014 based on the proposed building envelope constructions. Therefore, Planning Condition 10 is satisfied.

Noise ingress into offices will be suitably controlled with the proposed glazing and ventilation strategies so that the credit sought under BREEAM Hea 05 can be awarded. Furthermore, as no fixed external services plant is proposed, the credit sought under BREEAM Pol 05 can be awarded by default.

1 Introduction

1.1 Overview

- 1.1.1 Environoise Consulting Limited has been commissioned by BCP (Havant) LLP to assess the level of noise impact on existing nearby noise sensitive receptors as a result of the proposed Project Velocity development comprising 3No. units at land adjacent to Stanbridge Road in Havant. The purpose of the report is to provide sufficient information regarding noise so that a condition relating to an approved Outline planning application (ref: APP/15/00284) can be discharged at the Reserve Matters application stage.
- 1.1.2 The report presents the results of the noise assessment undertaken and, where appropriate, recommends suitable mitigation measures.
- 1.1.3 The development will be assessed under the BREEAM Industrial 2014 scheme – Shell & Coreⁱ to achieve a ‘Very Good’ rating. Acoustic credits will be targeted, specifically Hea 05 and Pol 05.
- 1.1.4 The purpose of this assessment is twofold,
- Firstly, this report will evaluate existing noise impact at the site, and give recommendations for the construction of the building envelope so that the internal ambient noise level criteria given in BS 8233 ‘Sound insulation and noise reduction for buildings’, 2014ⁱⁱ can be achieved and the Hea 05 credit requirements can be met.
 - Secondly, to meet the planning requirements by assessing noise from HGV deliveries, car park movements and internal warehouse activity noise to see that operation of the development does not unduly disturb nearby residents.
- 1.1.5 Please note, fixed services plant is not proposed at the site and as such no plant noise impact assessment is required. As a result, the credit sought under BREEAM Pol 05 can be awarded by default.

1.2 Site Description

- 1.2.1 The application site is a 4.59 hectare plot in Havant accessed via Stanbridge Road, approximately 1 mile from Havant town centre. To the north are existing office buildings located on Downley Road, to the east of the site lies an adjoining railway linking London to Havant. To the south are existing adjoining industrial buildings, located on New Lane. To the west there are two industrial buildings adjoining the site on Stanbridge Road.
- 1.2.2 The proposals are for 3 units comprising of B1, B2 and B8 usage, see Figure 1.1. The site is proposed to be operational 24hrs a day, 7 days a week.
- 1.2.3 Unit 1 will contain approximately 2433 sq. m. (26 185 sq. ft.) of warehouse / industrial space and approximately 214 sq. m. (2 300 sq. ft.) of 1st floor office space together with associated parking and HGV docking bays.

- 1.2.4 Unit 2 will contain approximately 2585 sq. m. (27 820 sq. ft.) of warehouse / industrial space and approximately 232 sq. m. (2 500 sq. ft.) of 1st floor office space together with associated parking and HGV docking bays.
- 1.2.5 Unit 3 will contain approximately 4238 sq. m. (45 612 sq. ft.) of warehouse / industrial space and approximately 418 sq. m. (4 500 sq. ft.) of 1st floor office space together with associated parking and HGV docking bays.

Figure 1.1: Proposed development site



1.3 Noise Sensitive Receptors

- 1.3.1 The nearest noise sensitive receptors to the proposed development are residential houses on Nutwick Road approximately 28m to the west of the site, see Figure 1.2. These are situated behind a 3m (approx.) high bund upon which the railway line is situated.

Figure 1.2: Proposed development site and nearby noise sensitive receptors.



2 Planning Policy / Legislative Overview

2.1 Local Authority Requirements

- 2.1.1 Confirmation of the noise survey and assessment done has been provided to the relevant EHO of Havant Borough Council¹. Planning Condition 10 of the Outline Planning Permission (ref: APP/15/00284) from Havant Borough Council states the following:

10. The building shall not be occupied until detailed acoustic report has been submitted and approved at reserved matters stage. The detailed report must assess the final design of the building, operation of the service yard and noise impact of the proposed business activities and include any proposals relating to the installation of fixed noise making equipment e.g. refrigeration units, air conditioning, extract ventilation equipment, and so forth.

Reason: *In the interest of protecting local residents from unreasonable noise levels which would be detrimental to the residential character of the area, and having due regard to Policy DM10 of the Havant Borough Core Strategy 2011 which forms part of the Local Development Framework and National Planning Policy Framework, March 2012.*

- 2.1.2 A noise report by others² was submitted to support the Outline planning application and considered noise from external activities (i.e. noise from services plant, service yard deliveries and car park movements). To correlate with the previous report, we have considered similar assessments and criteria used (where appropriate) as follows:

- HGV delivery & Internal activity noise impact - The noise level at the nearest noise sensitive receptor (NSR) should be equivalent to the representative background noise level (LA₉₀) when assessed in accordance with BS4142 'Method for rating and assessing industrial and commercial sound', 2014. In addition, night-time maximum noise levels from HGV deliveries to meet 45dB L_{Amax,fast} inside bedrooms as prescribed in the World Health Organisation (WHO) 'Guidelines for Community Noise', 1999.
- Car Park Vehicle Movements - The impact determined by considering the change in ambient noise levels that would result due to car park movements.

- 2.1.3 The predicted number of HGV movements for the scheme has been provided by Vectos (Transport Consultant)³.

2.2 National Planning Policy Framework

- 2.2.1 The National Planning Policy Framework (NPPF)ⁱⁱⁱ came into force in March 2012 and represents the government's commitment to promoting sustainable development.
- 2.2.2 Regarding acoustic design and noise control, the NPPF provides a set of overarching aims, broadly reflecting those already contained in the Noise Policy Statement for England (NPSE). They are directed towards the avoidance of significant adverse impacts and reduction of other

¹ Telephone conversation between Mark Moss, Havant Borough Council and Paul Kelly, Environoise Consulting on Monday 18th July 2016.

² Report ref: R1-16.3.15-Stanbridge Road Havant- 1515153-GJK dated 11th March 2015.

³ E-mail from Ian Dix, Vectos issued on Thursday 28th July 2016

adverse impacts on health and quality of life; set within the context of the Government's policy on sustainable development.

2.2.3 Now that the NPPF has been introduced, previous Planning Policy Guidance on Noise (PPG24) has been withdrawn; creating a gap between policy aims and any technical guidance available by which the realisation of those aims can be achieved.

2.2.4 There is an emphasis within the new framework on local planning authorities to create local policy and guidance which reflects both the NPPF and the NPSE, whilst at the same time reflecting the needs and priorities of their communities.

2.2.5 Further NPPF aims related to noise include:

Paragraph 109

2.2.6 *The planning system should contribute to and enhance the natural and local environment by: preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability;*

2.2.7 *Planning policies and decisions should encourage the effective use of land by re-using land that has been previously developed (brownfield land), provided that it is not of high environmental value. To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account.*

Noise Policy Statement for England

2.2.8 NPPF affirms that National Policy Statements form part of the overall framework of national planning policy, and should be a material consideration in decisions on planning applications. The Noise Policy Statement for England (NPSE)^{iv} came into force in 2010 and states:

- *The aim of this document is to provide clarity regarding current policies and practices to enable noise management decisions to be made within the wider context, at the most appropriate level, in a cost-effective manner and in a timely fashion.*
- *This Noise Policy Statement for England (NPSE) should apply to all forms of noise including environmental noise, neighbour noise and neighbourhood noise. The NPSE does not apply to noise in the workplace (occupational noise).*

Noise Policy Vision

2.2.9 Promote good health and a good quality of life through the effective management of noise within the context of Government policy on sustainable development.

Noise Policy Aims

- 2.2.10 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.

2.3 BS4142: 2014

- 2.3.1 The assessment of noise impact from proposed plant items and on-site HGV movements is typically carried out in accordance with BS4142 'Methods for rating and assessing industrial and commercial sound, 2014'.
- 2.3.2 BS4142:2014 provides a method of determining the 'impact of specific sound' on dwellings due to industrial and commercial noise sources. The basis of the BS4142 standard is a comparison between the representative background noise level (L_{A90}) in the vicinity of residential locations and the rating level of the industrial noise source under consideration. The Rating level ($L_{Aeq, T}$) is the specific noise level plus penalties of up to 18dB added for the subjective characteristic features such as the tonality and impulsivity of the noise.
- BS4142 suggests that a difference between rating level and background noise level at the receptor of +5dB(A) is likely to be an indicator of 'an adverse impact, depending on the context'.
 - A difference between rating level and background noise level at the receptor of +10dB(A) is likely to be an indicator of 'a significant impact, depending on the context'.
 - Where the rating level of the noise source does not exceed the background noise level it is an indicator of 'a low impact, depending on the context'.

Noise Character Corrections

- 2.3.3 A rating penalty can be applied to account for the character of the noise, namely tonality, impulsivity and intermittency.

Tonality

- 2.3.4 Tonality is rated using the Joint Nordic method as listed below:
- +2dB penalty: Just perceptible.
 - +4dB penalty: Clearly perceptible.
 - +6dB penalty: Highly perceptible.

Impulsivity

- 2.3.5 The impulsivity is the rapidity of the change in sound level as listed below:

- +3dB penalty: Just perceptible.
- +6dB penalty: Clearly perceptible.
- +9dB penalty: Highly perceptible.

Other sound characteristics

- 2.3.6 Where the specific sound feature characteristics are neither tonal nor impulsive but distinguishable against the residual noise then a 3dB penalty can be applied

Intermittency

- 2.3.7 The intermittency is when the specific noise has identifiable on/off conditions where a 3dB penalty can be applied.

2.4 BREEAM 2014

- 2.4.1 One credit is sought under Hea 05 'Acoustic Performance' and one credit is sought for Pol 5 'Reduction of Noise Pollution'.

2.5 Hea 05 Assessment Criteria

Credit - Internal ambient noise levels in offices

- Achieve indoor ambient noise levels that comply with the design ranges given in Section 7 of BS 8233:2014.
- A programme of acoustic measurements is carried out by a compliant test body in accordance with the acoustic testing and measurement procedures outlines in the Additional information section of this BREEAM issue.

Internal Noise Targets

- 2.5.1 A reasonable standard of internal ambient noise level is given in Table 2 of BS 8233 'Guidance on sound insulation and noise reduction for buildings', 2014 ambient noise levels in spaces when they are unoccupied and privacy is also important', see Table 2.1.

Table 2.1: Unoccupied target noise levels.

Criterion	Typical situation	Design [$L_{Aeq,T}$ (dB)]
Reasonable acoustic privacy in shared spaces.	Open-plan office	45 – 50
Reasonable conditions for study and work requiring communication	Cellular office, Staff room, Meeting room, executive office	40

2.6 Pol 05 Assessment Criteria

- 2.6.1 The following is required to demonstrate compliance for one credit:

- Where a noise impact assessment in compliance with BS 7445 has been carried out and the following noise levels measured/determined:
 - Existing background noise levels at the nearest or most exposed noise-sensitive development to the proposed development or at a location where background conditions can be argued to be similar.
 - The rating noise level resulting from the new noise source (see CN4)
 - The noise impact assessment must be carried out by a suitably qualified acoustic consultant holding a recognised acoustic qualification and membership of an appropriate professional body (see Relevant definitions in the Additional information section).
 - The noise level from the proposed site/building, as measured in the locality of the nearest or most exposed noise-sensitive development, is a difference no greater than +5dB during the day (07.00 to 23.00hrs) and +3dB at night (23.00 to 07.00hrs) compared to the background noise level.
 - Where the noise source(s) from the proposed site/building is greater than the levels described in criterion 4, measures have been installed to attenuate the noise at its source to a level where it will comply with criterion 4.
- 2.6.2 Externally fixed services plant is not proposed as part of the scheme and therefore a plant noise impact assessment is not required. As such the credit sought under BREEAM Pol 05 can be awarded by default.

2.7 Maximum Internal Noise Levels Criteria

- 2.7.1 The guidelines suggest that excesses over 45dB L_{Amax} inside bedrooms more than 10 -15 times can give rise to sleep disturbance.

2.8 Design Manual for Roads and Bridges (DMRB) 2008

- 2.8.1 Design Manual for Roads and Bridges (DMRB) 2008 Volume 11^{vi} describes how to assess noise and vibration effects from roads. The approach is to compare the 'with and without' scheme scenarios referred to as the 'do something' and 'do minimum' scenarios respectively.
- 2.8.2 A scale that is widely used to assess the significance of changes in road traffic noise has been developed from the DMRB to assess the noise effects caused by changes due to new developments, see Table 2.2.
- 2.8.3 The scale has been used to assess the noise impact as a result of changes in existing ambient noise levels due to car park vehicle movements.

Table 2.2: Significance of changes in road traffic noise levels.

Change in Noise Level (dB)	Impact Category	Initial Indicator of Significance
≥ 5	Major Adverse	Potentially significant increase
≥ 3 to ≤ 5	Moderate Adverse	Potentially significant increase
≥ 1 to < 3	Minor Adverse	Unlikely to be significant
< 1 to > -1	Negligible	Unlikely to be significant
≤ -1 to > -3	Minor Beneficial	Unlikely to be significant
≤ -3 to > -5	Moderate Beneficial	Potentially significant decrease
≤ -5	Major Beneficial	Potentially significant decrease

3 Noise Survey

3.1 Survey Procedure

- 3.1.1 Partially attended noise level measurements were made between 12.29hrs on Tuesday 28th and 12.29hrs on Thursday 30th June 2016 at a position considered representative of the proposed nearest residential dwellings, approximately 6m from the railway line see Figure 3.1.

Figure 3.1: Site, noise measurement and nearest noise sensitive receptor locations.



- 3.1.2 Noise levels were measured using a sound level meter with its corresponding microphone attached to an extension cable and mast. The microphone was fitted with a windshield and was situated approximately 3m above ground in free-field conditions. All noise level measurements were made over contiguous 15 minute periods. Overall A-weighted maximum ($L_{Amax, fast}$), ambient ($L_{Aeq, 15minutes}$) and background ($L_{A90, 15minutes}$) noise levels were measured as well as associated linear octave band frequencies.
- 3.1.3 Noise levels and measurement times are shown in section 4.0 of this report. All noise surveys were compliant with BS7445-1:2003 'Description and measurement of environmental noise. Guide to quantities and procedures'.

3.2 Weather Conditions

Tuesday 28th June 2016

- Daytime – 25% Cloud. Temperature 18 °C. Dry. Wind speed <5m/s.
- Night-time – 75% cloud. Temperature 7 °C. Intermittent Light Precipitation. Wind speed <5m/s.

Wednesday 29th June 2016

- Daytime – 50% cloud. Temperature 17 °C. Intermittent light precipitation. Wind speed ≤5m/s.
- Night-time – 75% cloud. Temperature 13 °C. Light precipitation. Wind speed ≤5m/s.

Thursday 30th June 2016

- Daytime - 50% cloud. Temperature 19 °C. Intermittent light precipitation. Wind speed ≤5m/s.

3.2.1 The above weather conditions were suitable for environmental noise measurements.

3.3 Instrumentation

3.3.1 The instrumentation used for the noise survey is shown in Table 3.1.

Table 3.1: Instrumentation details for attended survey and NSR measurements

Manufacturer	Equipment type	Serial number	Date of Calibration
Rion	NC-74 calibrator with ½" adaptor	34904967	3 rd August 2015
	NA-28 sound level meter	00501401	
	NH-23 preamplifier	01440	23 rd September 2015
	UC-59 Microphone	03881	

Calibration

3.3.2 The sound level meter was calibrated at the start and end of the noise surveys, there was no recorded drift greater than 0.3dB at 1 kHz and therefore measurements are acceptable. The calibration chain is traceable via National Standards held at the National Physical Laboratory (NPL).

4 Results

4.1 Ambient Noise Levels

- 4.1.1 The daytime and night-time overall A-weighted ($L_{Aeq,T}$) and octave band (L_{eq}) ambient noise levels obtained from measurement Position 1 are presented in Tables 4.1 and 4.2. Other ambient noise data is available on request.

Table 4.1: Highest daytime and night-time ambient noise levels.

Position	Period	Leq (15mins) at octave band centre frequency (Hz)							LAeq (15mins) (dB)
		63	125	250	500	1k	2k	4k	
1	Daytime								
	12.29 – 23.00 (28 th)	65	65	64	66	65	59	53	68
	07.00 – 23.00 (29 th)								
	07.00 – 12.29 (30 th)								
	Night-time								
	23.00 – 07.00 (28 th & 29 th)	57	60	61	59	60	54	48	63

- 4.1.2 We have used the values in Table 4.1 when assessing the level of noise ingress into proposed offices areas.

Table 4.2: Minimum daytime and night-time ambient noise levels.

Position	Period	Leq (15mins) at octave band centre frequency (Hz)							LAeq (15mins) (dB)
		63	125	250	500	1k	2k	4k	
1	Daytime								
	12.29 – 23.00 (28 th)	50	44	44	41	42	38	33	48
	07.00 – 23.00 (29 th)								
	07.00 – 12.29 (30 th)								
	Night-time								
	23.00 – 07.00 (28 th & 29 th)	44	41	37	34	33	28	23	37

- 4.1.3 We have used the values in Table 4.2 when assessing the noise impact of on-site car park vehicles movements on nearby residential dwellings.

4.2 Background Noise Levels

- 4.2.1 BS4142:2014 requires that assessment using a 'representative' background noise level should be done and suggests that this is found by determining the modal value of the noise data set. However, for a robust assessment we have used the lowest value.
- 4.2.2 Through analysis of the results, the 'representative' (lowest) daytime background noise level is 39dB $L_{A90, (15mins)}$ and the night-time 'representative' (lowest) background noise level is 35dB $L_{A90 (15mins)}$. We have used these values when assessing the noise impact from proposed services plant and HGV movements at the site.

- 4.2.3 The representative daytime and night-time A-weighted (L_{A90}) and corresponding octave band (L_{90}) background noise levels obtained from Position 1 are presented in Table 4.2. A time history of noise results is shown in Appendix B.

Table 4.3: Representative daytime and night-time background noise levels.

Position	Period	L_{90} (15mins) at octave band centre frequency (Hz)							L_{A90} (15mins) (dB)
		63	125	250	500	1k	2k	4k	
1	Daytime								
	12.29 – 23.00 (28 th)	50	43	38	34	35	30	21	39
	07.00 – 23.00 (29 th)								
	07.00 – 12.29 (30 th)								
	Night-time								
	23.00 – 07.00 (28 th & 29 th)	41	37	34	31	31	28	23	35

- 4.2.4 We have used the values in Table 4.3 for assessing the noise impact from proposed services plant and for the purposes of meeting BREEAM Pol 05 requirements.

4.3 Discussion

- 4.3.1 Daytime and night-time ambient noise levels in Table 4.2 indicate that the site is subject to noise levels akin to an industrial / urban environment. The noise climate during the daytime and the beginning and the end of the night-time period is dominated by passenger and freight train noise along the railway line to the east. This is the cause of the relatively high ambient noise levels obtained as shown in Table 4.1. The noise climate is also affected by industrial noise sources associated with industrial / commercial units along local Stanbridge Road to the west and Downley Road to the north, as well as road traffic (cars and HGV's) along Stanbridge and Downley Road.

5 Noise Ingress Assessment (Hea 05)

5.1 Noise Ingress Calculations

- 5.1.1 Calculations have been carried out to assess the attenuation requirements of the external building fabric of the proposed development, based upon achieving internal noise levels in offices as prescribed in Table 2, Section 7 of BS 8233:2014 for compliance with BREEAM Hea 05.

External Walls

- 5.1.2 The office element of the buildings will be cladded with a 90mm thick composite insulated steel cladding e.g. TATA Trimapanel. Product literature⁴ states that this system achieves a sound insulation performance of 29dB R_w . Where this is lined internally with 2No. layers of 12.5mm standard plasterboard as proposed, this is predicted⁵ to achieve a sound insulation performance of 47dB R_w (see Appendix C, Figure C1).

Glazing & Ventilation

- 5.1.3 Windows to offices are proposed to be double glazed and likely to be of the following specification:
- 6mm Pilkington Optifloat
 - 16mm argon cavity
 - 6mm Pilkington K glass.
- 5.1.4 Pilkington Glass rate this system as achieving a sound insulation performance of 31dB R_w .
- 5.1.5 It is generally accepted that glazing and ventilation openings within external façades will be the weakest elements acoustically. Therefore, designing the glazing and ventilation to be sufficiently robust to attenuate the highest levels of noise should provide a good acoustic environment.
- 5.1.6 Using the measured highest daytime ambient noise levels presented in Table 4.1 (corrected for distance from the train line to the Unit 1 offices i.e. 70m, Unit 2 and 3 offices i.e. 56m), the required minimum sound insulation performance (R_w) of the proposed façade elements to achieve the minimum required minimum internal noise level for offices (i.e. 40dB $L_{Aeq,T}$, see Table 2.1) and to satisfy BREEAM Hea 05 has been calculated using the 'simple method' calculation given in BS8233. BS8233 notes that 'simple method' can under estimate the R_w requirement by up to 5dB, therefore a 5dB has been included within the calculations (see Table 5.1).
- 5.1.7 It is anticipated that if the recommended glazing and ventilation specification are installed as set out herein, internal average noise levels should be within acceptable limits, as per BS 8233.

⁴

https://www.tatasteelconstruction.com/static_files/Tata%20Steel/content/Brands/Building%20Systems/Trimapanel%C2%AE%20System.pdf

⁵ Calculated using Marshall Day Acoustics Insul v8.09 sound insulation prediction software.

Table 5.1: Noise ingress assessment

Facade	External level $L_{Aeq,T}$, (dB) (A) [#]	Minimum Internal Noise Level Criterion $L_{Aeq,T}$ (dB) (B)	Required Sound Insulation Performance dB R_w (= A – B + 5) [*]
Unit 1 Office	57	40	22
Unit 2 & 3 Office	58	40	23

[#]Corrected for distance attenuation using $10 \times \log(r_2/r_1)$

^{*}Includes a +5dB allowance in accordance with BS8233

Glazing

- 5.1.8 It can be seen from results in Table 5.1 that a level of sound attenuation of ≥ 23 dB R_w is required. The currently proposed glazing system achieves 31dB R_w and is therefore suitable.
- 5.1.9 BREEAM Hea 05 internal noise level criteria will be met in all cases with the proposed internally lined external wall, proposed glazing and the below ventilation strategy.

Ventilation

- 5.1.10 If trickle vents are to be installed to meet background ventilation requirements, it is necessary for the ventilation attenuation performance of each proposed trickle vent to match or exceed that of the required glazing performance. In accordance with Table 5.1, an appropriate product would be standard (i.e. non-acoustic) trickle vent set within window heads.
- 5.1.11 Suitable background ventilation units should meet the minimum requirements under Part F of the Building Regulations.

6 Delivery Vehicle Noise Assessment

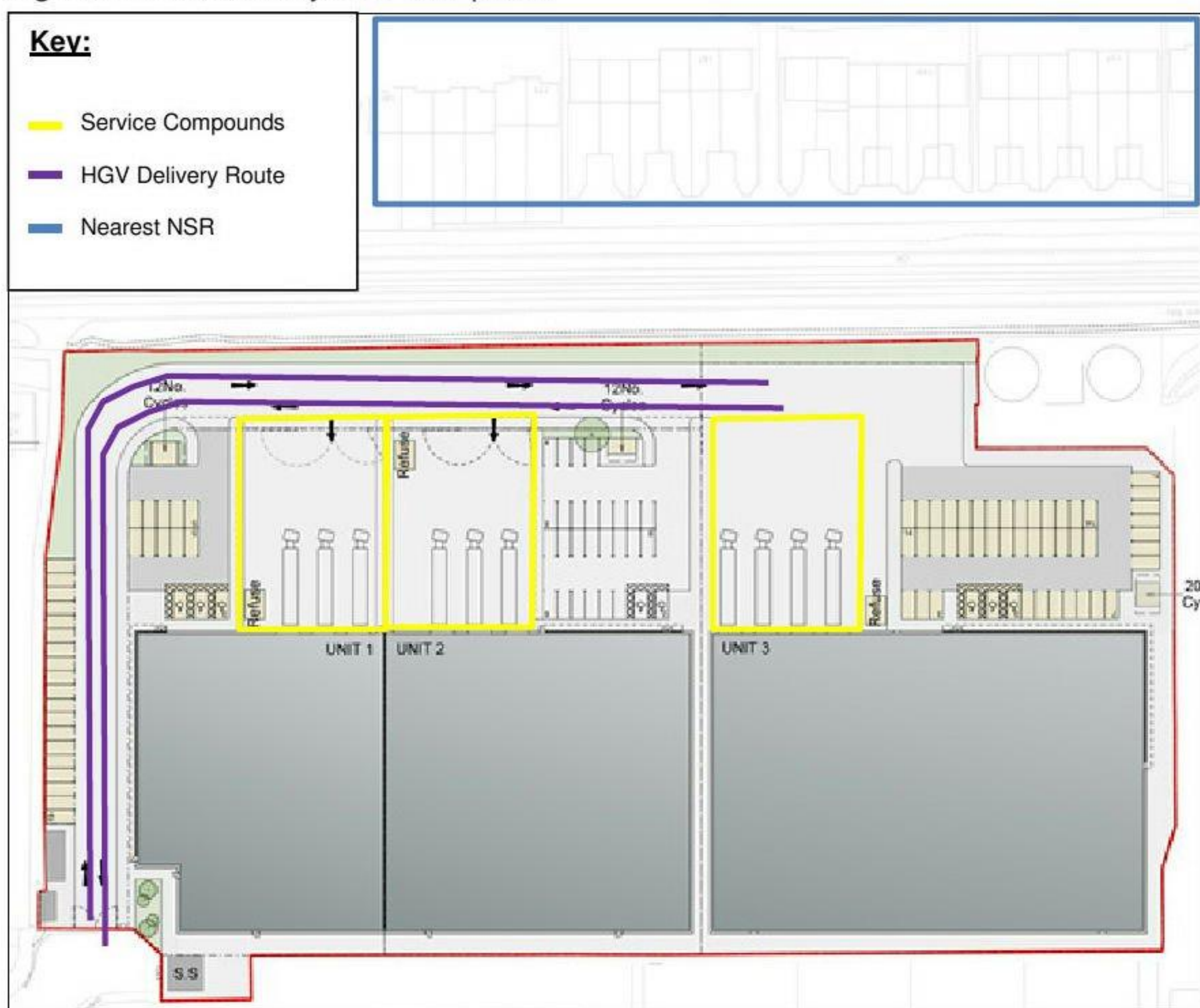
6.1.1 Currently, detailed information on the schedule of HGV deliveries and/or collections from unit is not available. However, predicted number of HGV movements have been provided by Vectos (Transport Consultant) ⁶ as follows:

- Daytime – 8 per hour.
- Night-time – 4 per hour.

6.1.2 Deliveries and collections will occur during both the daytime (07.00hrs – 23.00hrs) and night-time period (23.00hrs – 07.00hrs) within the service compounds as indicated (together with HGV route) in Figure 6.1.

6.1.3 The service areas are approximately 78m from the first floor window of the nearest NSR indicated in Figure 6.1.

Figure 6.1: Indicative layout of HGV paths.



⁶ E-mail from Ian Dix, Vectos to Martin Stutchbury, Stutchbury Associates issued on Thursday 28th July 2016 with Paul Kelly, Environoise Consulting copied.

- 6.1.4 Using details of the predicted deliveries numbers provided, we have considered in our noise assessment 8 two-way HGV trips during a reference period of 1-hour period for the daytime period as required by BS4142:2014 assessment methodology.
- 6.1.5 For the night-time period, 4 two-way trips in any 1-hour period are predicted. BS4142:2014 assessment methodology requires that a reference period of 15 minute is used for the night-time period. This would equate to 1 two-trip per hour. However, it is conceivable that there could be one coincident delivery / collection per any 15-minute period per Unit and therefore for a robust assessment we have considered 3 movements during this period.
- 6.1.6 Data from HGV movements measured at other sites has been used in the calculation as shown in Table 6.1.
- 6.1.7 We would expect fork lift truck (FLT) traffic on site within the delivery bays to support these vehicles.

Table 6.1: Delivery vehicle noise source data.

Activity	Source height	Single Event Noise Level L_{AX} (dB) at 10m.	Maximum Noise level $L_{Amax,fast}$ (dB) at 10m
Laden HGV arriving	1.0m	73	69
Laden HGV departing	1.0m	78	75
Fork Lift Truck Loading Operation	1.2m	67	65

- 6.1.8 The calculation for determining the impact of these individual events is:

$$L_{Aeq,T} = L_{AX} + 10 \times \log(R_2/R_1) + 10 \times \log(n/t)$$

Where:

L_{AX} = Single event noise level of event (dB)
 R_1 = Noise measurement distance from source (m)
 R_2 = Distance to 1m from nearest NSR (m)
 n = number of events occurring in t (seconds).

6.2 HGV Noise Levels at NSR

Daytime Delivery/Collection

- 6.2.1 For 8 HGV deliveries in 1-hour, using the higher of the two L_{AX} figures of 78dB in Table 6.1 results in an ambient noise level of $78 - 20 \times \log(78/10) + 10 \times \log(8/3600) = 34\text{dB } L_{Aeq,1\text{hour}}$, see Table 6.2 for full calculations.

Table 6.2: Calculated daytime noise from HGVs at NSRs.

Activity	Single Event Noise Level [L _{AX} (dB)] at 78m	Calculated L _{Aeq,1hour} for 8 vehicle movements	Maximum Noise level [L _{Amax,fast} (dB)] at 78m
Laden HGV arriving	55	29	51
Laden HGV departing	60	34	57
Fork Lift Truck Loading operation	49	23	47
Log Addition		35	-

Night-time Delivery/Collection

- 6.2.2 For 3 HGV deliveries in 15-minutes, using the higher of the two L_{AX} figures of 78dB in Table 6.1 results in an ambient noise level of $78 - 20 \times \log(78/10) + 10 \times \log(3/900) = 35\text{dB L}_{Aeq,15\text{minute}}$, see Table 6.3 for full calculations.

Table 6.3: Calculated night-time noise from HGVs at NSRs.

Activity	Single Event Noise Level [L _{AX} (dB)] at 78m	Calculated L _{Aeq,15minute} for 3 vehicle movements	Maximum Noise level [L _{Amax,fast} (dB)] at 78m
Laden HGV arriving	55	30	51
Laden HGV departing	60	35	57
Fork Lift Truck Loading operation	49	24	47
Log Addition		36	-

6.3 HGV Noise Impact at NSR

- 6.3.1 To meet planning requirements, noise attributable to on-site HGV deliveries should be equivalent to the existing background noise level when measured at 1m from the nearest noise sensitive receptor.
- 6.3.2 The overall HGV specific noise levels from Tables 6.2 and 6.3 have been compared to the representative daytime and night-time background noise levels given in Table 4.3. This is to determine compliance with planning requirements and the level of noise mitigation required, see Table 6.4.
- 6.3.3 HGV delivery noise can be considered to be impulsive. BS4142:2014 suggests an impulsivity feature correction of 0 to 9dB depending on how perceptible the noise is. For a robust assessment and considering the context of the site dominated by industrial and rail noise, a penalty of +3dB has been included.

Table 6.4: Daytime and night-time delivery noise impact assessment at NSRs

	At Nearest NSR	
	Daytime (07.00 – 23.00)	Night-time (23.00 – 07.00)
Specific Noise Level dB(A)	35	36
Acoustic Feature Correction (e.g. tonal, intermittent, impulsive noise) dB	3	3
Rating Level dB(A)	38	39
Background Noise Level dB(A)	39	35
Level of Excess dB	0	4
Conclusion	No Mitigation Required	Mitigation Required

- 6.3.4 As can be seen in Table 6.3, the predicted Rating level of HGV noise exceeds the representative night-time background noise level by 4dB. In accordance with BS4142:2014, this indicates an 'adverse impact' and as such, mitigation measures are necessary.

Night-time Maximum Noise Levels

- 6.3.5 As can be seen in Table 6.3, the highest maximum ($L_{Amax,fast}$) noise level at the NSR is calculated to be 57dB. If we assume 15 dB(A) attenuation for a first floor open window of the NSR, the internal noise level would be 42dB $L_{Amax, fast}$. This meets the WHO Guideline night-time noise criterion of ≤ 45 dB $L_{Amax, fast}$ as detailed in section 2.7 and therefore no further mitigation measures are necessary.

7 Car Park Noise Assessment

7.1 Overview

- 7.1.1 Car parking associated with each individual Unit will be located to the east of the Unit building, see Figure 7.1.

Figure 7.1: Car parking areas.



- 7.1.2 Each Unit has the following number of car parking spaces and mid-point distances to NSRs:

- Unit 1 – 13 (10 standard, 3 disabled) – 68m from NSR.
- Unit 2 – 26 (24 standard, 2 disabled) – 68m from NSR.
- Unit 3 – 45 (42 standard, 3 disabled) – 73m from NSR.

- 7.1.3 The level of daytime and night-time noise impact from vehicle movements within each proposed car park has been assessed at the nearest noise sensitive properties.

7.2 Noise from Car Park Vehicle Movements

Car Park Vehicle Noise

- 7.2.1 The noise values in Table 7.1 for Car Park vehicle movements have been used in our assessment. This is based on in-house noise data used in many other assessments.

Table 7.1: Car Park Noise Source Data.

Activity	Source height	Single Event Noise Level L_{AX} (dB) at 10m.
Door slam	1.0m	64
Car drive by	0.5m	67
Starting and pulling out	0.5m	72

- 7.2.2 The calculation for determining the impact of these individual events is:

$$L_{Aeq,T} = L_{AX} + 10\log_{10}(1/t) + 10\log(n)$$

Where n = number of events occurring in t (seconds).

e.g. 4 door slams: $L_{Aeq,T} = 64 + 10 \times \log_{10}(1/3600) + 10 \times \log(4) = 34\text{dBA}$
 $L_{Aeq,T} = 64 - 36 + 6 = 34\text{dBA}$

7.3 Car Parking Noise Impact

- 7.3.1 Car park noise levels have been predicted for each Unit, considering distance attenuation, over a 15-minute period at the residential dwellings (see Appendix D, Tables D1 to D3). For a robust assessment, we have considered the following number of cars parking spaces to be utilised for each Unit in any 15-minute period:

- Unit 1 – 3 spaces (3 arrivals / departures, 1 door slam per vehicle)
- Unit 2 – 7 spaces (7 arrivals / departures, 1 door slam per vehicle)
- Unit 3 - 11 spaces (11 arrivals / departures, 1 door slam per vehicle)

- 7.3.2 It is conceivable that the above usages will occur particularly where there is a change of shift both during the daytime and night-time periods. The values equate to all car parking spaces being utilised in a 1-hour period.

- 7.3.3 A summary of the car park noise levels for each unit and the combined car park noise level are shown in Table 7.2.

Table 7.2: Predicted daytime and night-time Unit 1 to Unit 3 car park noise levels at NSRs.

Activity	Distance to NSR	Time (seconds)	Number of events	Calculated $L_{Aeq,15\text{minute}}$ (dB) at NSR
Unit 1 car park	68	900	3	32
Unit 2 car park	68	900	7	36
Unit 3 car park	73	900	11	38
Combined car park noise level $L_{Aeq,15\text{minute}}$ at NSRs				41

- 7.3.4 As can be seen in Table 7.2, the calculated combined car park noise level at the NSRs is 41dB $L_{Aeq,15\text{minute}}$. This is 7dB below the lowest 15-minute daytime ambient noise level and 4dB above the lowest 15-minute night-time ambient noise level presented in Table 4.2.

Change in Daytime Ambient Noise Levels

- 7.3.5 The change in ambient noise level as a result of car park vehicle movements during the daytime is predicted to be +0.8dB. With reference to DMRB guidance in Table 2.2, this change is of 'negligible' impact and 'unlikely to be significant'. Therefore, no further mitigation is required.

Change in Night-time Ambient Noise Levels

- 7.3.6 The change in ambient noise level as a result of car park vehicle movements during the night-time is predicted to be +5dB. With reference to DMRB guidance in Table 2.2, this change is of 'moderate adverse' impact and is a 'potentially significant increase'. To reduce noise levels so that the impact is 'negligible', further noise mitigation is required.

8 Noise from Internal Activities

8.1 Overview

- 8.1.1 The tenants of the 3 Units are currently not known and therefore proposed internal activities within the warehouse elements are unknown. To aid in the specification of plant items / noise generating equipment within the warehouse areas, we have assessed the allowable level of noise breakout from the warehouse considering an assumed internal noise level, the sound insulation performance of the façade construction and the measured background noise levels in accordance with BS4142:2014.

8.2 Building Envelope Constructions

External Wall

- 8.2.1 The proposed warehouse façades will comprise of a CA Twintherm metal composite panel system – 0.4mm internal steel liner, 180mm insulation panel, 0.7mm external profiled metal sheet (or similar). Based on product literature, the sound insulation performance of this is 42dB R_w .

Docking Bay Doors

- 8.2.2 We have considered standard roller shutters doors with a typical laboratory rated sound insulation performance of 18dB R_w .

Roof

- 8.2.3 The proposed warehouse roof constructions will comprise of CA Twintherm Griffon metal composite panel system - 0.4mm internal steel liner, 280mm insulation panel, 0.7mm external profiled metal sheet (or similar). Based on product literature, the sound insulation performance of this is 45dB R_w .
- 8.2.4 Rooflights will be installed covering 15% of the roof area. The proposed roof lights will comprise of triple glazed GRP. The typical airborne sound reduction for a triple skin rooflight is 30-35dB R_w . For a robust assessment we have considered this to be 30dB R_w .

8.3 Calculations

- 8.3.1 For a robust assessment, we have considered an internal reverberant noise level in each warehouse of 80dB(A) in accordance with the Noise at Work Regulations 2005.
- 8.3.2 The level of internal activity noise at the nearby NSR has been predicted by calculating the level of noise break-out from each building envelope (considering wall, roof and bay door surface areas determined from scale drawings); in addition, the composite sound reduction performances of each element and sound propagation from the building over a hard surface over a minimum distance of 85m to the nearest NSR's. The predicted noise level has then been compared to the

representative daytime and night-time background noise levels to determine the level of compliance with the proposed criteria.

8.3.3 The level of activity noise impact at the receptor has been calculated using the following formulae.

$$Lp_2 = Lp_1 - R + (10 \log S) - 20 \times \log(r) - 14$$

Where:

- Lp_1 = Reverberant ambient activity noise level in warehouse (i.e. 80dBA)
- Lp_2 = activity noise level at receptor (dBA)
- R = Composite Weighted Sound Reduction Index (dB R_w)
- S = Surface area of cladded facade (m^2)
- r = distance of facade to receptor (i.e. 85m).

8.4 Noise Impact Assessment

8.4.1 To meet planning requirements, noise attributable to internal activities in each warehouse should be equivalent to the existing background noise level when measured at 1m from the nearest noise sensitive receptor.

8.4.2 Activity noise level calculations for each unit are shown in Appendix D, Figure D1 to D3. The combined results of the assessment have been compared to the representative background noise levels in Table 4.3 in order to determine compliance with criteria, see Table 8.1.

8.4.3 Industrial noise can be considered to be impulsive. BS4142:2014 suggests an impulsivity feature correction of 0 to 9dB depending on how perceptible the noise is. For a robust assessment and considering the context of the site dominated by industrial and rail noise, a penalty of +3dB has been included.

Table 8.1: Daytime and night-time warehouse internal activity noise impact assessment at NSRs

	At Nearest NSR	
	Daytime (07.00 – 23.00)	Night-time (23.00 – 07.00)
Combined Specific Noise Level dB(A)	31	31
Acoustic Feature Correction	3	3
Rating Level dB(A)	34	34
Background Noise Level dB(A)	39	35
Level of Exceedance dB	-5	-1
Conclusion	No Mitigation Required	No Mitigation Required

Discussion

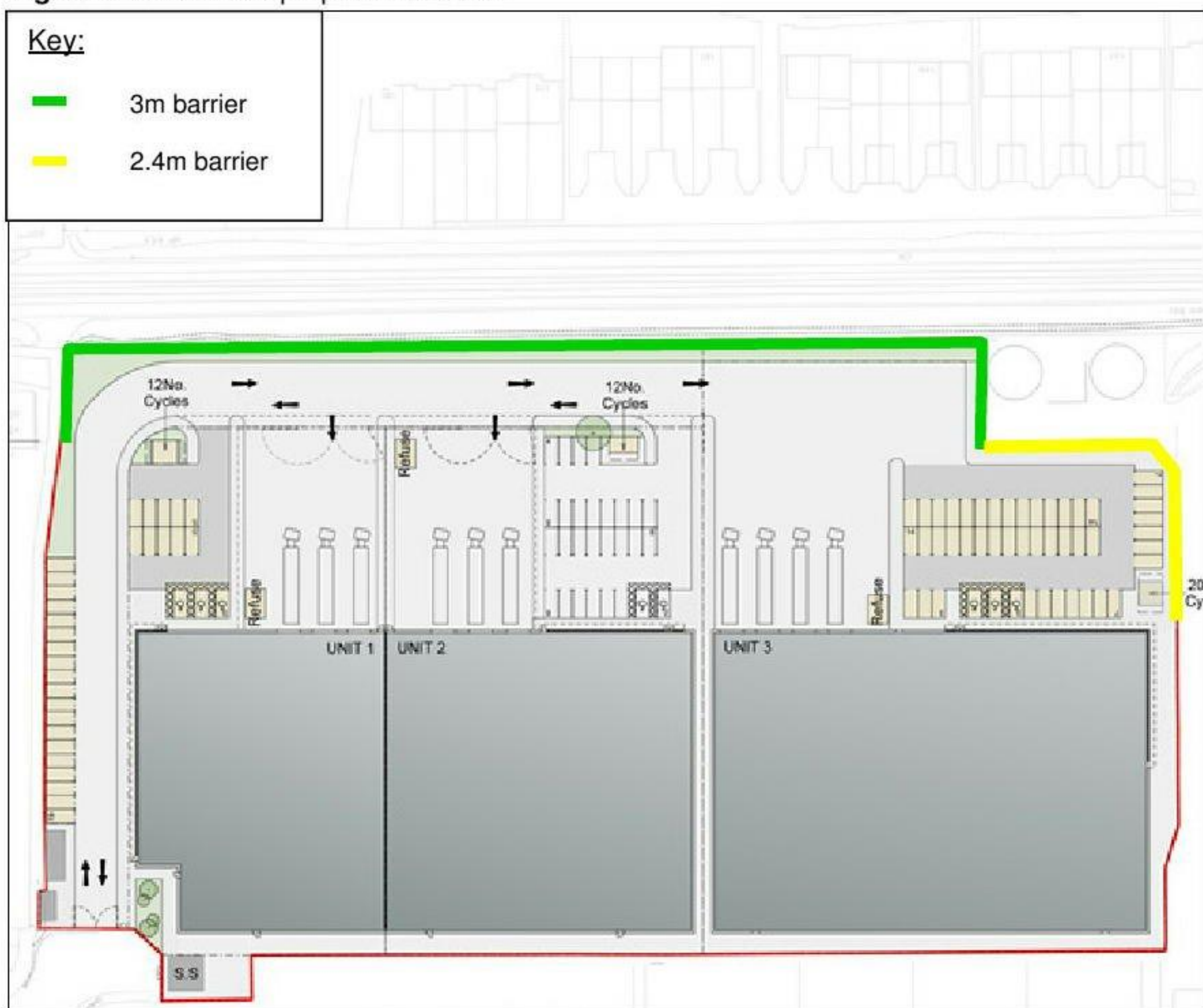
- 8.4.4 As can be seen in Table 8.1, internal activity noise levels meet the target requirements for the daytime period and night-time period. Therefore, no further mitigation measures are necessary and Planning Condition 10 is satisfied.

9 Recommendations

9.1 HGV & Car Park Noise

- 9.1.1 For HGV delivery noise to be of 'low impact' (in accordance with BS4142:2014) at the nearest NSR's during the daytime and night-time, a reduction of 4dB(A) is required. For the night-time car park noise impact to be 'negligible' (in accordance with DMRB) at the nearest NSR's, a ~5dB reduction is required. To achieve these reductions, we recommend 3m and 2.4 barriers (e.g. close boarded timber fences) as indicated in Figure 9.1.
- 9.1.2 Barrier attenuation calculations (see example in Appendix D, Figure D2) have been done considering distance of source to receptors, distance to source and barrier (determined from scale drawings), a source height of 1.5m for HGV's and 1m for cars and a receiver height (i.e. first floor windows) of 4m.

Figure 9.1: Extent of proposed barriers



Barrier Construction

- 9.1.3 The performance of the barrier is determined largely by the effective height as it is diffraction over the top which limits performance. The barrier material however must have attenuation properties significantly higher than that determined by the barrier geometry. An insertion loss of approximately 20dB is therefore needed for the barrier material.
- 9.1.4 Suitable barrier construction would be a close boarded timber fence with a surface mass of $\geq 15\text{kg/m}^2$. The fencing must be free from gaps in the fence itself and also between the fence and the ground. A suitable commercial product is provided by Jacksons: https://www.jacksons-fencing.co.uk/pages/catalogues/order_cat.aspx. Example specifications are shown in Appendix E, Figures E1 and E2.

9.2 HGV Best Practice

- 9.2.1 For the management of deliveries and noise, reference should be made to the Department of Transport's - Quiet Deliveries Good Practice Guidance – Key Principles and Processes for Community and Resident Groups, February 2015 document - <https://www.gov.uk/government/publications/quiet-deliveries-demonstration-scheme>
- 9.2.2 The following measures are recommended to reduce noise impacts:
- Low volume broadband white noise reversing alarms should be used.
 - Banksman should be used to guide HGVs into docking bays.
 - Reduce vehicle speed where appropriate to avoid excessive bumping and jolting particularly on more uneven surfaces around the site.
 - Effective preparation and maintenance of the vehicle area surfaces to minimise potholes and other defects.

9.3 Fork lift Trucks

- 9.3.1 The following measures are recommended to reduce noise impacts:
- Surfaces on which FLTs operate are free from bumps and steps so that shocks to the fork suspension do not cause impulsive noises.
 - Low volume broadband white noise reversing alarms should be used.
 - FLTs should be fitted with flashing lights to negate or reduce the need for the horn.
 - Where practicable (i.e. between trailers and delivery points) clearly mark work-site routes for the FLTs so that rough or uneven surfaces are avoided.
 - We recommend that 'white noise' reversing alarms are used and that flashing lights are employed to reduce needs for horns etc on FLTs.

9.4 Unit Management

- It is important to reduce noise impact that an open dialogue is kept with nearby residents and any concerns they have in relation to noise are dealt with and followed up.



-
- Management of all Units must introduce procedures within a Noise Management Plan to reduce the possibility of workers slamming doors, shouting and causing unnecessary noise. This requirement should be incorporated within any tenancy agreement.

10 Conclusions

10.1 Noise Ingress Levels

- 10.1.1 The assessment of ingress of rail traffic noise indicates that glazing achieving a sound reduction performance of $\geq 23\text{dB } R_w$ and background ventilation provided by standard trickle vents will be suitable to meet the internal noise level requirements of BREEAM Hea 05.

10.2 Noise from Deliveries

- 10.2.1 Predicted noise from HGV deliveries indicates that the level of noise generated will be of 'low impact' at nearby residential properties in accordance with BS 4142:2014 with the installation of a proposed $\geq 4\text{m}$ high barrier along the eastern boundary of the site. Therefore, Planning Condition 10 is satisfied.

10.3 Noise from Car Park Activities

- 10.3.1 Predicted noise from the use of car park indicates that the noise impact generated at nearby residential properties will be 'negligible' in accordance with DMRB guidance for the daytime period. For the night-time period, the noise impact from the car park will be 'negligible' with the installation of a proposed 4m barrier along the eastern boundary and a 3m high barrier at the south east of the site. Therefore, Planning Condition 10 is satisfied.

10.4 Noise from Internal Activities

- 10.4.1 Predicted noise from internal activities within the Units warehouses will be of 'low impact' during the daytime and night-time period at the nearby residential properties in accordance with BS1142:2014 without further mitigation measures. Therefore, Planning Condition 10 is satisfied.

Appendix A: Acoustic Terms

Between the quietest audible sound and the loudest tolerable sound there is a million to one ratio in sound pressure (measured in Pascal, Pa). Because of this wide range a noise level scale based on logarithms is used in noise measurement called the decibel (dB) scale. Audibility of sound covers a range of approximately 0 to 140 dB.

The human ear system does not respond uniformly to sound across the detectable frequency range and consequently instrumentation used to measure noise is weighted to represent the performance of the ear. This is known as the 'A weighting' and annotated as dB (A). Table 10.1 lists the sound pressure level in dB (A) for common situations.

Table A1: Noise levels for common situations.

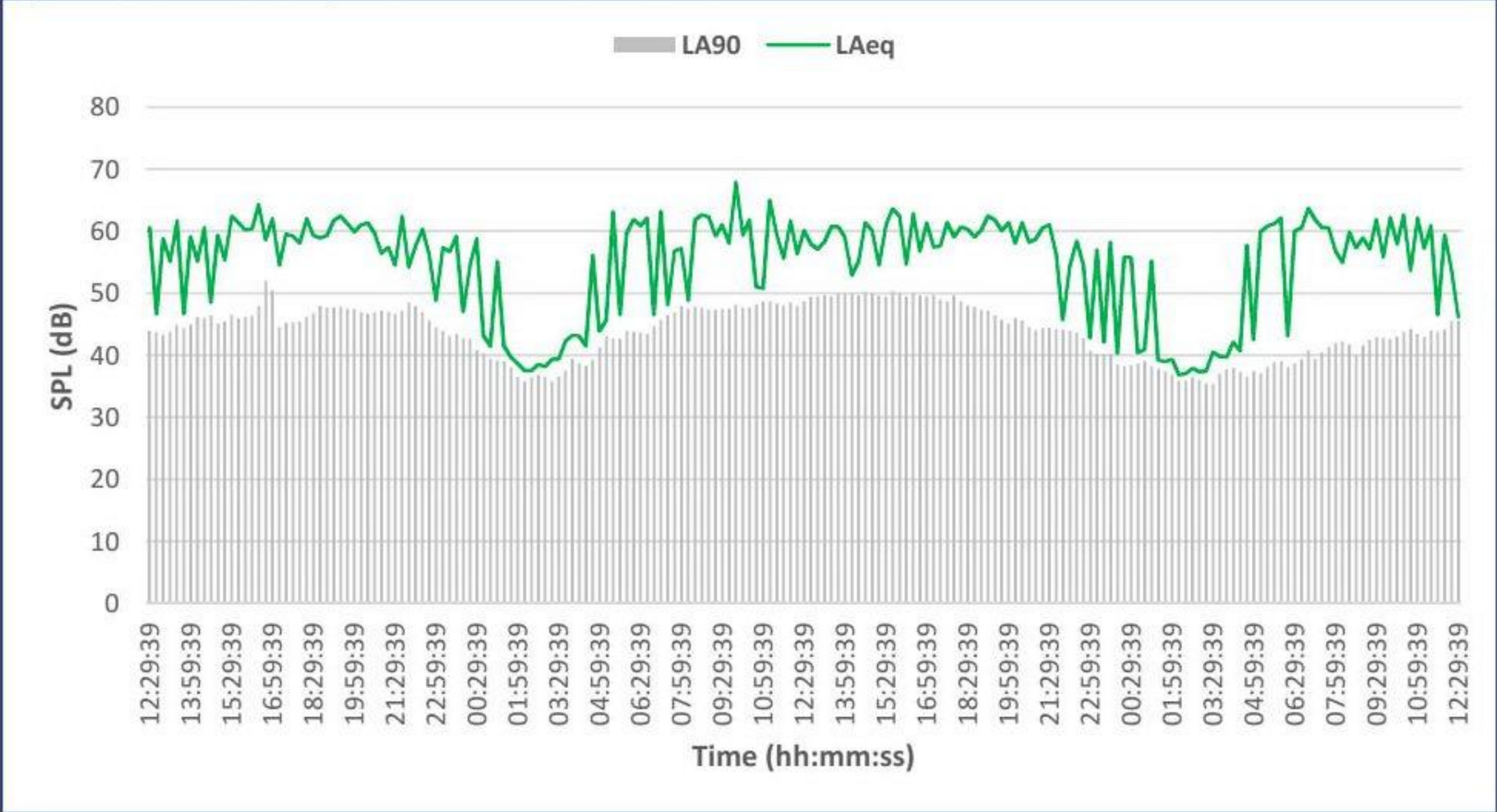
Typical noise level dB(A)	Example
0	Threshold of hearing
30	Rural area at night, still air
40	Public library, refrigerator humming at 2m
50	Quiet office, no machinery, Boiling kettle at 0.5m
60	Normal conversation
70	Telephone ringing at 2m, Vacuum cleaner at 3m
80	General factory noise level, heavy goods vehicle from pavement
90	Powered lawn motor, operators ear
100	Pneumatic drill at 5m
120	Discotheque – 1m in front of loudspeaker
140	Threshold of pain

The noise levels at a measurement point are rarely steady, even in rural areas, and vary over a range dependent upon the effects of local noise sources. Close to a busy motorway, the noise levels may vary over a range of 5 dB(A), whereas in a suburban area this may increase up to 40 dB(A) and more due to the multitude of noise sources in such areas (cars, dogs, aircraft etc.) and their variable operation. Furthermore, the range of night-time noise levels will often be smaller and the levels significantly reduced compared with daytime levels. When considering environmental noise, it is necessary to consider how to quantify the existing noise (the ambient noise) to account for these second to second variations.

Human subjects are generally only capable of noticing changes in steady levels of no less than 3 dB(A). It is generally accepted that a change of 10 dB(A) in an overall, steady noise level is perceived to the human ear as a doubling (or halving) of the noise level. (These findings do not necessarily apply to transient or non-steady noise sources such as changes in noise due to change in road traffic flow, or intermittent noise sources). The equivalent continuous A-weighted sound pressure level, L_{Aeq} , is the single number that represents the average sound energy measured over that period. The L_{Aeq} is the sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period. It is commonly used to express the energy value from individual sources that vary in level over their operational cycle.

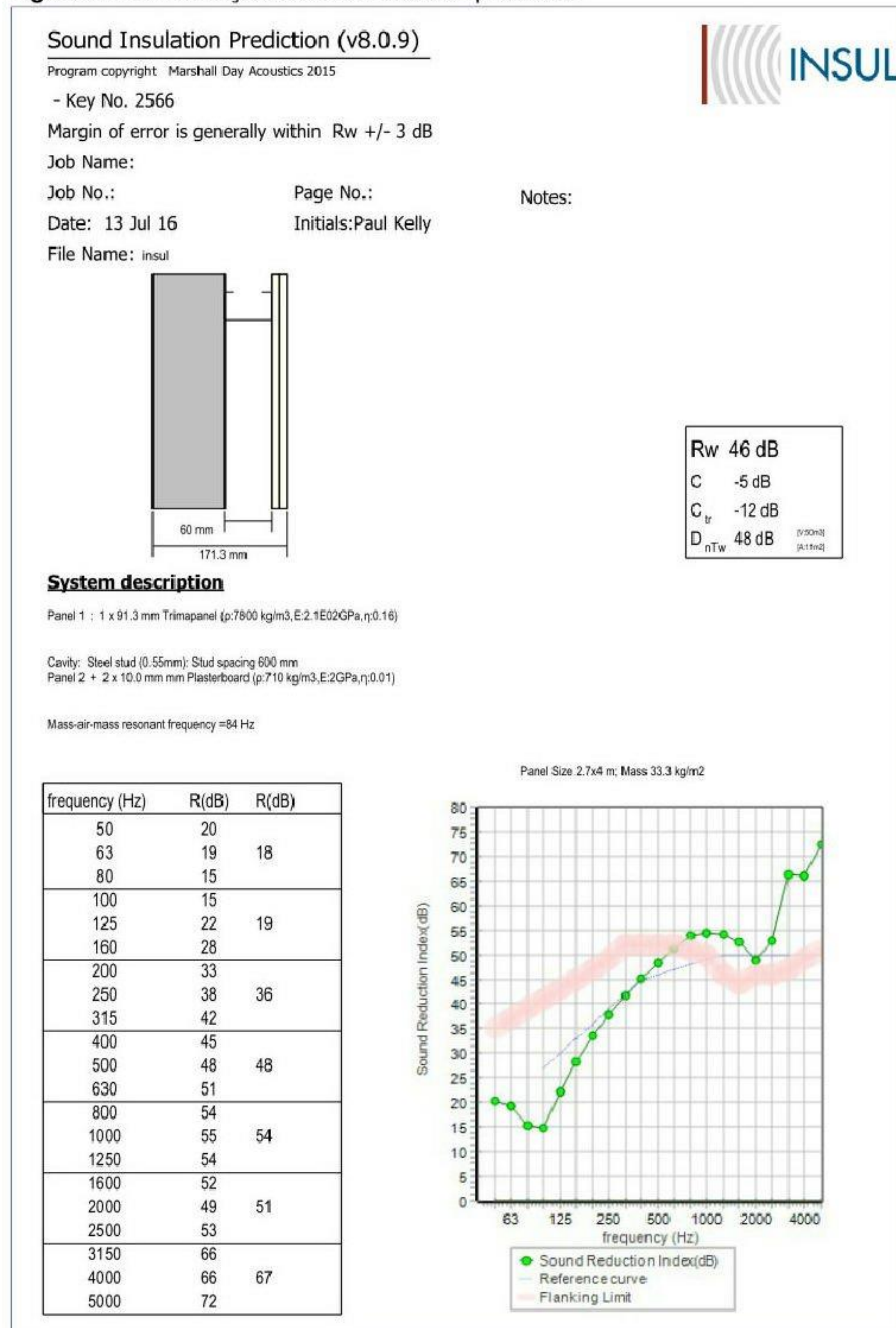
Appendix B: Noise Survey Results

Figure B1: Time history of noise level measurements at Position 1



Appendix C: Façade Sound Insulation

Figure C1: Office façade sound insulation prediction



Appendix D: Calculations

Table D1: Predicted daytime and night-time Unit 1 car park noise levels at NSRs.

Activity	Single Event Noise Level L_{AX} (dB) at 10m.	Time (seconds)	Number of events	Calculated $L_{Aeq,1hour}$ (dB) at 10m
Door slam	64	900	3	39
Car Drive By	67	900	3	42
Stopping / Starting and Pulling Out	72	900	3	47
Total car park noise level $L_{Aeq,15minute}$ at NSR (68m)				32

Table D2: Predicted daytime and night-time Unit 2 car park noise levels at NSRs.

Activity	Single Event Noise Level L_{AX} (dB) at 10m.	Time (seconds)	Number of events	Calculated $L_{Aeq,1hour}$ (dB) at 10m
Door slam	64	900	7	43
Car Drive By	67	900	7	46
Stopping / Starting and Pulling Out	72	900	7	51
Total car park noise level $L_{Aeq,15minute}$ at NSR (68m)				36

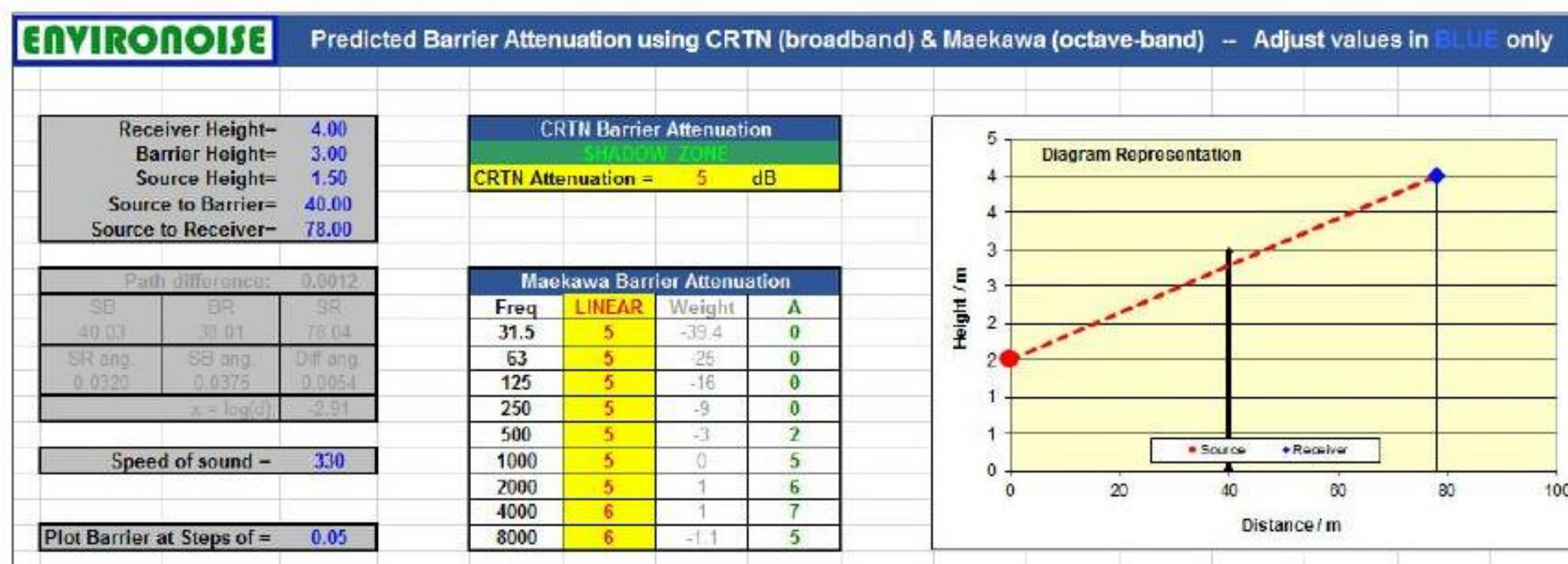
Table D3: Predicted daytime and night-time Unit 3 car park noise levels at NSRs.

Activity	Single Event Noise Level L_{AX} (dB) at 10m.	Time (seconds)	Number of events	Calculated $L_{Aeq,1hour}$ (dB) at 10m
Door slam	64	900	11	45
Car Drive By	67	900	11	48
Stopping / Starting and Pulling Out	72	900	11	53
Total car park noise level $L_{Aeq,15minute}$ at NSR (68m)				38

Figure D1: Unit 1 to 3 Activity noise calculations at NSR

Unit 1 - Roof	Overall 'A' weighted level (dB)	Wall	Overall 'A' weighted level (dB)
Assumed Reverberant level dBA	80	Assumed Reverberant level dBA	80
Composite sound insulation R of roof cladding dB R _w	38	Sound insulation R of façade cladding dB R _w	27
cladding area m ²	2142	cladding area m ²	546
+10 x log (facade area)	33	+10 x log (facade area)	27
Distance of proposed building to NSR	85	Distance of proposed building to NSR	85
+20 x log (distance)	39	+20 x log (distance)	39
+14	14	+14	14
+10 x log (60/100)	-2	+10 x log (60/100)	-2
-6 for 90 degree angle correction	-6		
Resultant ambient level (L _{eq,T})	15	Resultant ambient level (L _{eq,T})	26
Unit 2 - Roof	Overall 'A' weighted level (dB)	Wall	Overall 'A' weighted level (dB)
Assumed Reverberant level dBA	80	Assumed Reverberant level dBA	80
Composite sound insulation R of roof cladding dB R _w	38	Sound insulation R of façade cladding dB R _w	28
cladding area m ²	2652	cladding area m ²	676
+10 x log (facade area)	34	+10 x log (facade area)	28
Distance of proposed building to NSR	85	Distance of proposed building to NSR	85
+20 x log (distance)	39	+20 x log (distance)	39
+14	14	+14	14
+10 x log (60/100)	-2	+10 x log (60/100)	-2
-6 for 90 degree angle correction	-6		
Resultant ambient level (L _{eq,T})	15	Resultant ambient level (L _{eq,T})	25
Unit 3 - Roof	Overall 'A' weighted level (dB)	Wall	Overall 'A' weighted level (dB)
Assumed Reverberant level dBA	80	Assumed Reverberant level dBA	80
Composite sound insulation R of roof cladding dB R _w	38	Sound insulation R of façade cladding dB R _w	29
cladding area m ²	3825	cladding area m ²	975
+10 x log (facade area)	36	+10 x log (facade area)	30
Distance of proposed building to NSR	85	Distance of proposed building to NSR	85
+20 x log (distance)	39	+20 x log (distance)	39
+14	14	+14	14
+10 x log (60/100)	-2	+10 x log (60/100)	-2
-6 for 90 degree angle correction	-6		
Resultant ambient level (L _{eq,T})	17	Resultant ambient level (L _{eq,T})	26
Units 1 - 3 Daytime		Units 1 - 3 Night-time	
Total ambient noise level (roof and wall)	31	Total ambient noise level (roof and wall)	31
Rating Level (+3dB)	34	Rating Level (+3dB)	34
Background levels [L ₉₀ (15mins)]	39	Background levels [L ₉₀ (15mins)]	35
Excess over criteria (L _{eq,T})	-5	Excess over criteria (L _{eq,T})	-1
Further attenuation required dB(A)	0	Further attenuation required dB(A)	4

Figure D2: Example barrier attenuation calculation



Appendix E: Example Barrier Specifications

Figure E1: Example 3m barrier specification

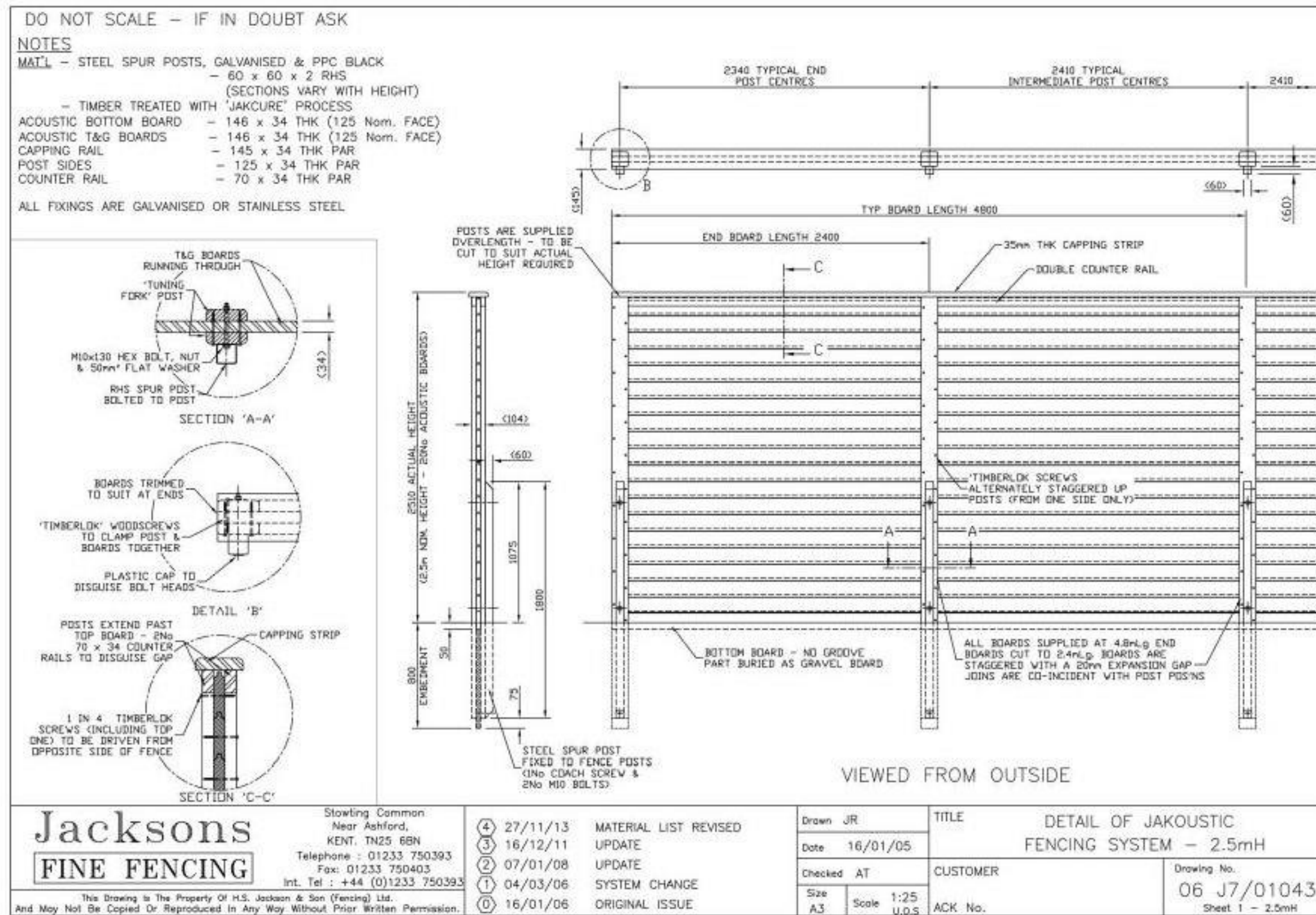
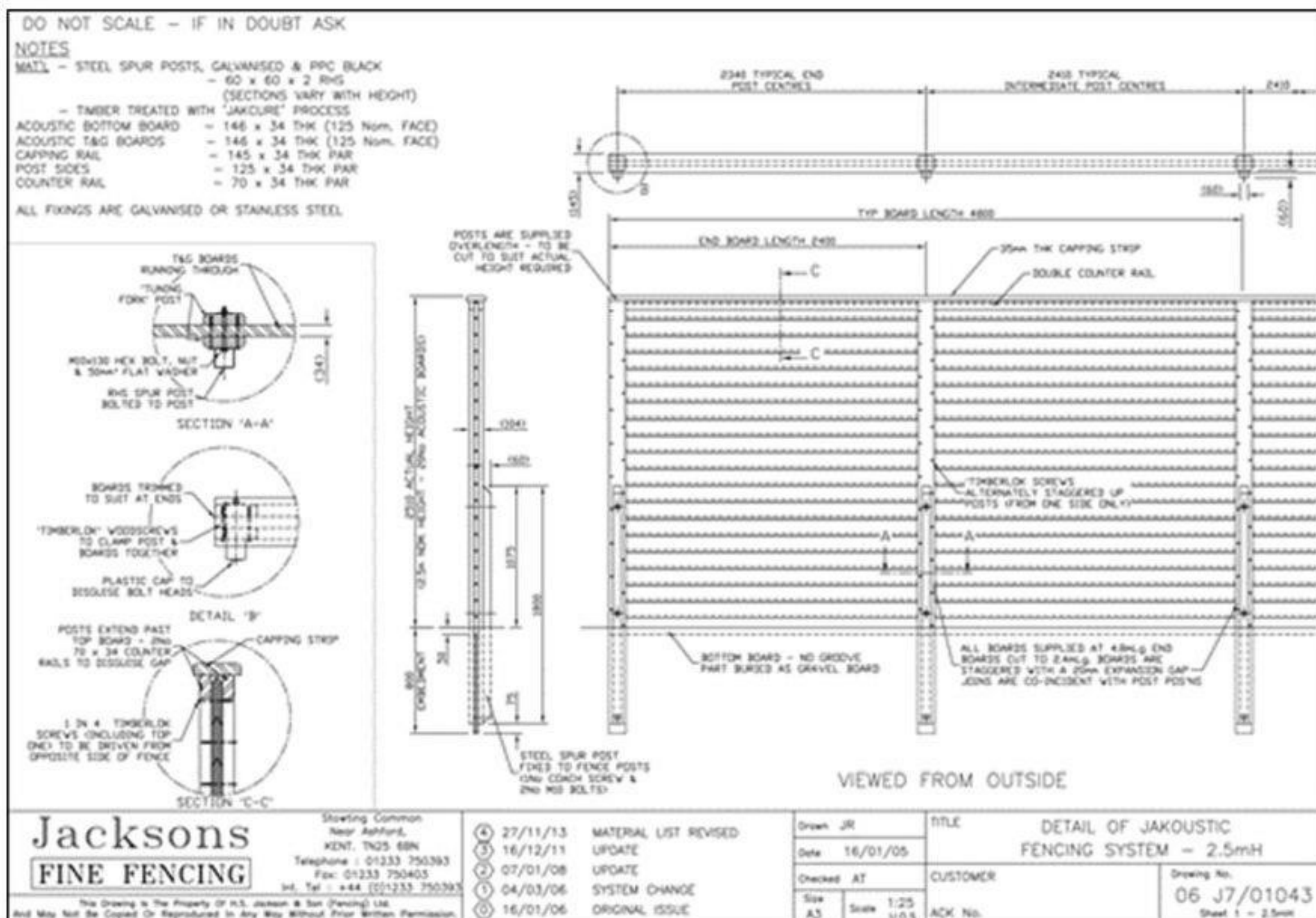


Figure E2: Example 2.5m barrier specification



References

- ⁱ BREEAM 2014 UK New Construction SD5076: 4.1
- ⁱⁱ BS 8233 'Sound insulation and noise reduction for buildings', 2014
- ⁱⁱⁱ National Planning Policy Framework Department for Communities and Local Government, March 2012.
- ^{iv} Noise Policy Statement for England, DEFRA March 2010.
- ^v BS4142 'Methods for rating and assessing industrial and commercial sound, 2014
- ^{vi} Design Manual for Roads and Bridges (DMRB) 2008 Volume 11.