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NOISE IMPACT ASSESSMENT OF JAMESON GATE: PROPOSED MIXED USE REDEVELOPMENT OF PARK SHOPPING CENTRE

Technical Report Prepared For

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New St South,
Dublin 8

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Our Reference

SS/15/8768NR02a

Date Of Issue

9 February 2021

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Document History

Document Reference		Original Issue Date	
SS/15/8768NR02		27 January 2021	
Revision Level	Revision Date	Description	Sections Affected
a	9 February 2021	Various comments	various

Record of Approval

Details	Written by	Approved by
Signature		
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Date	9 February 2021	9 February 2021

EXECUTIVE SUMMARY

Planning Permission is currently being sought for the construction of a new mixed use District Centre, Student Residential Housing and Build-to-rent (BTR) apartment accomodation development in 2 buildings, a South Building and a North Building, separated by a new pedestrian and bicycle street connecting Prussia Street to the Grangegorman SDZ campus and urban quarter. The buildings will range in height from 3-5 storeys on Prussia Street to 7-storeys (South building) and 8-storeys (North Building) towards to GDA campus. This report, prepared by AWN Consulting Limited (AWN), assesses the likely noise and vibration impact of the proposed development in the context of current relevant standards and guidance, and identifies requirements or possibilities for mitigation.

The existing noise climate has been surveyed during both daytime and night-time periods and have been found to be dominated by local and distant road traffic.

The assessment has considered the impact of noise during the operational phase of the proposed development. A review has been undertaken of the most appropriate guidance and standards relating to both phases and appropriate criteria set for each.

The primary sources of outward noise in the operational context are building services and mechanical plant, entertainment noise breakout, car parking activity, podium activity, traffic on the public road and deliveries to and from the building. Noise levels associated with each of these sources has been calculated at the nearest noise sensitive locations taking into account the distance and screening between the source and the residential properties. The assessment has concluded that noise emissions due to the operation of the sources under consideration are all below the range of recommended daytime and night-time noise limits appropriate for the development.

In addition, the inward noise impact on the student accommodation element of the development has been assessed and it has been found that once the glazing elements are selected to achieve an acoustic rating of 32 dB R_w the internal noise environment will meet best practice guidelines.

In summary, the noise impact associated with the new development is considered to be within acceptable noise levels and will not injure the residential amenity of the surrounding area.

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1.0 INTRODUCTION

Planning Permission is currently being sought for the construction of a new mixed use District Centre, Student Residential Housing and Build-to-rent (BTR) apartment accomodation development in 2 buildings, a South Building and a North Building, separated by a new pedestrian and bicycle street connecting Prussia Street to the Grangegorman SDZ campus and urban quarter. The buildings will range in height from 3-5 storeys on Prussia Street to 7-storeys (South building) and 8-storeys (North Building) towards to GDA campus. This report, prepared by AWN Consulting Limited (AWN), assesses the likely noise and vibration impact of the proposed development in the context of current relevant standards and guidance, and identifies requirements or possibilities for mitigation.

The subject site is located on the site of the existing Park Shopping Centre, Prussia Street, Dublin 7. The site is bounded to the north by residential properties, to the east by the Grangegorman campus, to the south by residential properties and to the west by Prussia Street.

2.0 RECEIVING ENVIRONMENT

2.1 Environmental Noise Survey

An environmental noise survey was conducted in order to quantify the existing noise environment. The survey was conducted in general accordance with ISO 1996-2: 2007: *Acoustics – Description and measurement and assessment of environmental noise. Part 2 – Determination of sound pressure levels*. Specific details are set out below.

2.2 Choice of Measurement Locations

Three measurement locations were selected as shown on Figure 1.

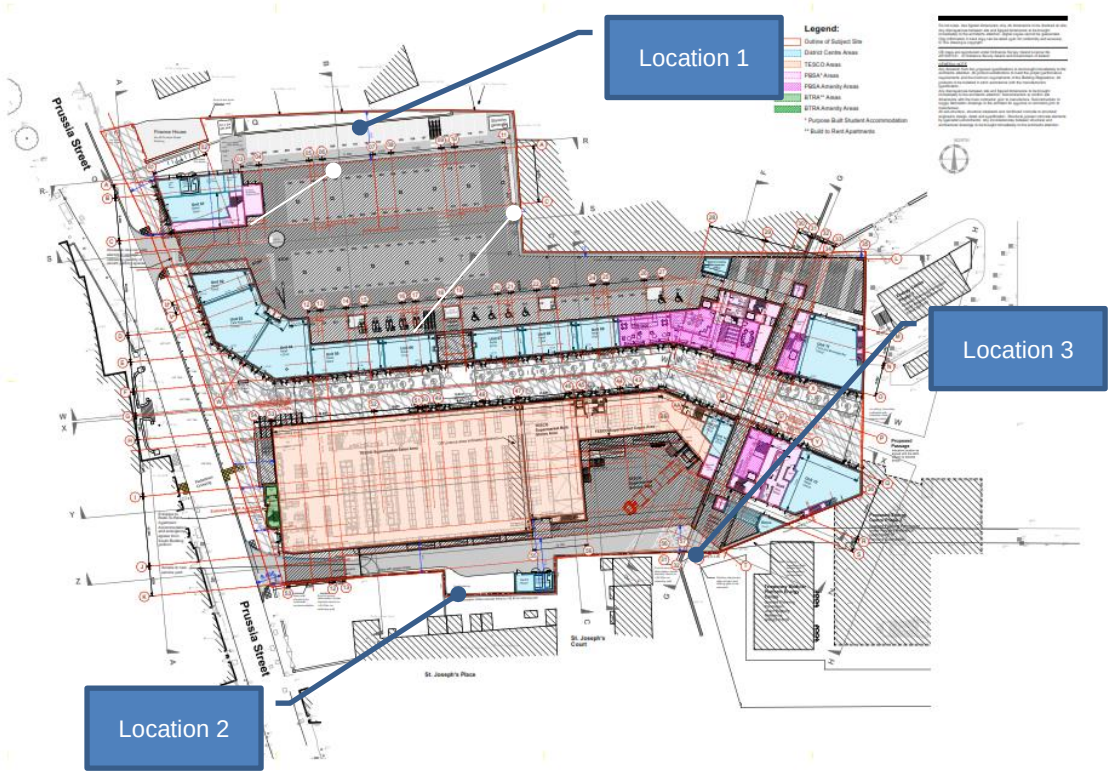

Figure 1 Noise Survey Locations

2.3 Survey Periods

Attended noise measurements were conducted at Locations 1 and 3 over the course of the following survey period:

- Daytime 12:00hrs to 13:30hrs 8 January 2016

The daytime measurements represent a typical period that was selected in order to provide a snapshot of the existing noise climate, with the primary purpose being to ensure that the proposed noise criteria associated with the development are commensurate with the prevailing environment.

An unattended noise survey was conducted at Location 2 over a 3 day period to obtain a measurement of noise levels over the day and night-time periods. This survey was conducted over the following survey period:

- 5 January to 8 January 2015

Survey periods for the attended and unattended measurements were 15 minutes in duration.

The weather during the daytime survey period was dry with wind speeds below 1m/s. Weather during the night-time survey period was cool, dry and calm with some precipitation.

2.4 Personnel and Instrumentation

Stephen Smyth (AWN) conducted the measurements during both survey periods.

Noise measurements were conducted using a Brüel & Kjær Type 2250 Sound Level Analyser. The measurement apparatus was check calibrated both before and after each survey using a Brüel & Kjær Type 4231 Sound Level Meter Calibrator.

2.5 Measurement Parameters

The survey results are presented in terms of the following three parameters:

L_{Aeq} is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period. It is typically used as a descriptor for ambient noise.

L_{AFMax} is the maximum sound level that is exceeded during the survey period measured using fast weighting.

L_{A90} is the sound level that is exceeded for 90% of the sample period. It is typically used as a descriptor for background noise.

The "A" suffix denotes the fact that the sound levels have been "A-weighted" in order to account for the non-linear nature of human hearing. All sound levels in this report are expressed in terms of decibels (dB) relative to $2x10^{-5}$ Pa.

2.6 Survey Results

2.6.1 Location 1

The survey results for Location 1 are given in Table 1.

Time (hrs)		Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
		$L_{Aeq,15min}$	L_{AFmax}	$L_{A90,15min}$
Daytime	12:00 – 12:15	58	79	50
	12:36 – 12:51	47	61	45

Table 1 Summary of Results for Location 1

Activity within the Park Shopping Centre carpark and traffic noise from Prussia Street were the dominant noise sources. During the first survey period a carwash within the carpark was also noted. Some intermittent noise from birdsong, pedestrian activity and noise from the glass bottle bank was also noted. The ambient noise level ranged from 47 to 58 dB $L_{Aeq,15min}$ and the background noise level ranged from 45 to 50 dB $L_{A90,15min}$.

2.6.2 Location 2

The unattended noise monitor was located at this position. The unattended baseline survey took place between 13:15hrs on 5 January and 14:30hrs on 8 January 2016. The measured noise levels for each time interval of fifteen minutes is plotted below (Figure 2).

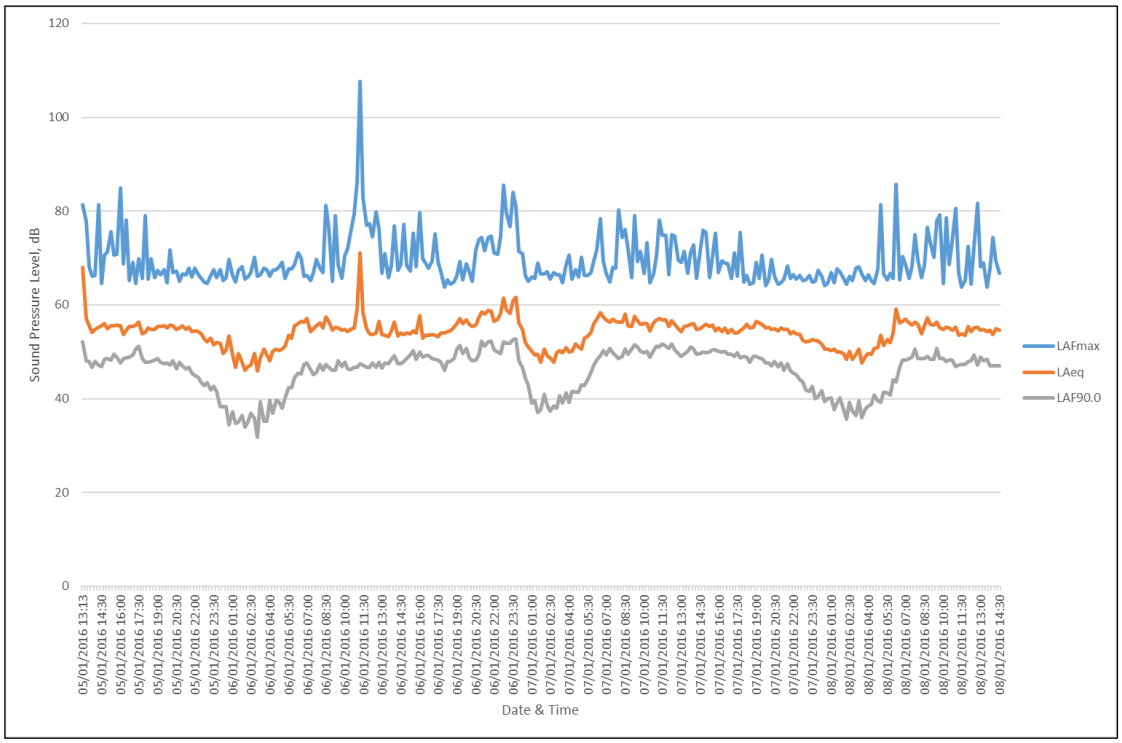

Figure 2 Unattended Noise Monitoring Results

Table 2 lists the measured noise levels for each time period of day, evening and night.

Period	Parameter	Min	Max	Average
Daytime (07:00hrs to 19:00hrs)	$L_{Aeq,15min}$	53	71	57
	L_{AFmax}	64	108	86
	$L_{A90,15min}$	45	52	49
Evening (19:00hrs to 23:00hrs)	$L_{Aeq,15min}$	52	61	56
	L_{AFmax}	64	86	72
	$L_{A90,15min}$	43	52	49
Night (23:00hrs to 07:00hrs)	$L_{Aeq,15min}$	46	62	53
	L_{AFmax}	64	86	72
	$L_{A90,15min}$	32	53	44

Table 2 Summary of unattended monitoring results for Location 2

Noise levels at this location were dominated by activity within the service areas of the Park Shopping Centre, pedestrian activity and building services plant.

2.6.3 Location 3

The survey results for Location 3 are given in Table 3 below.

Time		Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
		$L_{Aeq,15min}$	L_{AFmax}	$L_{A90,15min}$
Daytime	12:18 – 12:33	47	61	45
	12:51 – 13:06	49	71	45

Table 3 Summary of results for Location 3

Distant traffic noise and pedestrian activity were the dominant sources at this location. Other sources noted included birdsong and occasional aircraft movements. The ambient noise level ranged from 47 to 49 dB $L_{Aeq,15min}$ and the background noise level was of the order of 45 dB $L_{A90,15min}$.

3.0 CHARACTERISTICS OF THE PROPOSED DEVELOPMENT

The proposed development will involve the construction of new buildings, car parking facilities and service areas.

During the operational phase of the development, the primary sources of outward noise in the operational context are deemed long term and will involve:

- building services and mechanical plant;
- entertainment noise breakout;
- podium level activity;
- car parking activity;
- additional traffic on the public road, and;
- deliveries to and from the building.

In addition, the inward noise impact on the proposed residential units within the development must also be considered.

4.0 RELEVANT CRITERIA

There is no Irish Standard containing appropriate noise limit guidance that is applicable in this instance. In the absence of such standards, best practice dictates that the potential noise impact of the proposed development is assessed against appropriate British and/or International Standards.

4.1 Plant Items

The most appropriate standard used to assess the impact of a new continuous source (i.e. plant items) to a residential environment is BS 4142+A1:2019 *Methods for rating and assessing industrial and commercial sound*. This standard describes a method for assessing the impact of a specific noise source at a specific location with respect to the increase in "background" noise level that the specific noise source generates. The standard provides the following definitions that are pertinent to this application:

"*Specific sound level,* $L_{Aeq,\ Tr}$"	is equivalent continuous A-weighted sound pressure level produced by the specific sound source at the assessment location over a given reference time interval, *T*. This level has been determined with reference to manufacturers information for specific plant items.
"*Rating level*" $L_{Ar,Tr}$	is the specific noise level plus adjustments for the character features of the sound (if any), and;
"Background noise level"	is the sound A-weighted sound pressure level that is exceeded by the residual sound at the assessment location for 90% of a given time interval, *T.* This level is expressed using the L_{A90} parameter. These levels were measured as part of the baseline survey.

The assessment procedure in BS4142: 2014 is outlined as follows:

1. determine the specific noise level;
2. determine the rating level as appropriate;
3. determine the background noise level, and;
4. subtract the background noise level from the specific noise level in order to calculate the assessment level.

The lower the rating level is relative to the measured background sound level, the less likely it is that the specific source will have an adverse impact or a significant adverse impact. A difference of +10 dB or more is a likely to be an indication of a significant adverse impact, a difference of around +5 dB is likely to be an indication of an adverse impact, dependent on the context.

4.2 Entertainment Noise

Entertainment sound shall be so controlled that its level at any adjacent noise sensitive location shall not cause the ambient (measured in the absence of said entertainment sound) to increase, when assessed over 5 minute back to back periods. Similar criteria shall apply to the 63Hz & 125Hz octave band levels.

4.3 Vehicular Traffic Noise

In order to assist with interpretation of vehicle related noise, Table 4 offers guidance as to the likely impact associated with any particular change in traffic noise level.

Change in Traffic Noise Level (dB L_{A10})	Subjective Reaction	Impact
< 3	Negligible	Imperceptible
3 – 5	Perceptible	Slight
6 – 10	Up to a doubling of loudness	Moderate
11 – 15	Over a doubling of loudness	Significant
> 15		Profound

Table 4 Likely impact associated with change in traffic noise level

4.4 Other Noise Sources

For operational activities associated with the development that are not continuous in nature or entertainment noise, it is considered more appropriate to set noise limits at the nearest noise sensitive locations using guidance contained within British Standard BS 8233 (2014): *Guidance on Sound Insulation and Noise Reduction for Buildings*. This Standard sets out recommended noise limits for indoor ambient noise levels in dwellings as follows.

Typical situations	Design Range, $L_{Aeq,T}$ dB	
	Daytime $L_{Aeq,16hr}$ (07:00 to 23:00hrs)	Night-time $L_{Aeq,\ 8hr}$ (23:00 to 07:00hrs)
Livings rooms	35 – 40	n/a
Bedrooms	35	30

Table 5 Recommended indoor ambient noise levels from BS 8233: 2014

For the purposes of this study, it is appropriate to derive external limits based on the internal criteria noted in the paragraph above. This is done by factoring in the degree of noise reduction afforded by a partially open window. This is typically taken to be 15 dB(A).

As short periods of noise have the potential to cause a greater disturbance at night-time, a shorter assessment time period (T) is adopted. Appropriate periods are 1 hour for daytime (07:00 to 23:00 hours) and typically 5 minutes for night-time (23:00 to 07:00 hours).

In summary, the following criteria for non-plant items apply at the façades of those residential properties closest to the proposed development:

- Daytime (07:00 to 23:00 hours) 50 dB $L_{Aeq,1hr}$
- Night-time (23:00 to 07:00 hours) 45 dB $L_{Aeq,5min}$

4.5 Inward Noise Impact

The *Dublin Agglomeration Environmental Noise Action Plan December 2018 – November 2023 Volume 1: Dublin City Council* states the following with respect to assessing the noise impact on new residential development:

"Acoustic privacy is a measure of sound insulation between dwellings and between external and internal spaces. Development should have regard to the guidance on sound insulation and noise reduction for buildings contained in BS 8233:2014. The

following principles are recommended for minimising disruption from noise in dwellings:

- *Utilise the site and building layout to maximise acoustic privacy by providing good building separation within the development and from neighbouring buildings and noise sources.*
- *Arrange units within the development and the internal layout to minimise noise transmission by locating busy, noisy areas next to each other and quieter areas next to quiet areas*
- *Keep stairs, lifts, and service and circulation areas away from noise-sensitive rooms like bedrooms. Particular attention should be paid to the siting and acoustic isolation of the lift motor room. Proposals close to noisy places, such as busy streets may need a noise impact assessment and mitigation plan."*

In summary, the Dublin Noise Action Plan and relevant guidance referenced therein call for developments to have a good level of sound insulation in accordance with best Irish practice. There is no Irish standard guidance that is directly applicable to this scenario, hence it is proposed to make reference to BS 8233 for the purposes of arriving at appropriate design goals.

It is proposed to adopt the following standards for common rooms during the daytime and bedrooms during the night-time as follows:

- Living rooms in the daytime (07:00 to 23:00hrs): 40 dB $L_{Aeq,T}$
- Bedrooms in the night-time (23:00 to 07:00hrs): 30 dB $L_{Aeq,T}$

5.0 POTENTIAL OUTWARD IMPACT OF THE PROPOSED DEVELOPMENT

As previously stated there are five primary sources of noise considered for the operational context as follows:

- building services and mechanical plant;
- entertainment noise breakout;
- podium level activity;
- car parking activity;
- additional traffic on the public road, and;
- deliveries to and from the building.

The closest neighbouring noise sensitive properties to the proposed development are the residential properties to the north and south, the HSE facility to the north-east and the Grangegorman campus to the east. Figure 3 details the nearest noise sensitive locations (NSL) considered in this assessment.

The impact of each of these primary noise sources on the nearest noise sensitive locations, as displayed in Figure 3, are addressed in turn.

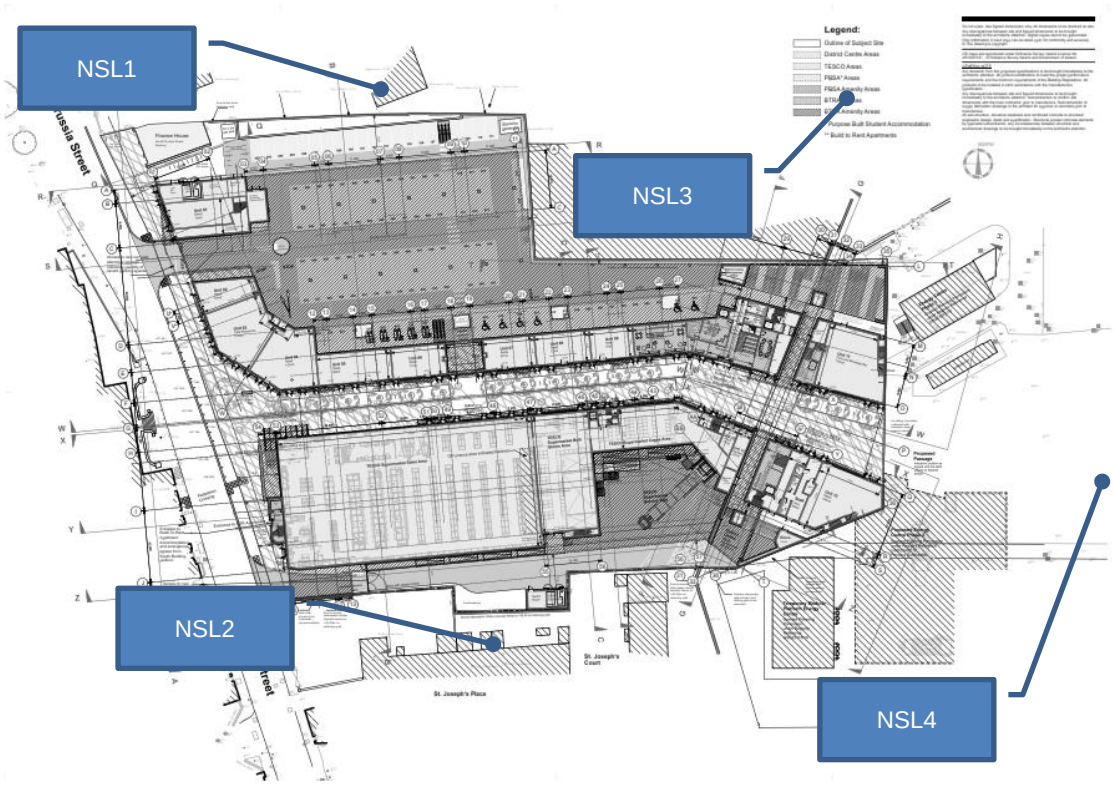

Figure 3 Noise Assessment Locations

5.1 Mechanical and Electrical Plant

The development will be served by mechanical and electrical plant once operational. It is assumed for the purposes of this assessment all plant will operate on a continual basis over day and night-time periods.

At this stage the specific details of the mechanical plant are unknown. Notwithstanding this, it is possible to specify an appropriate noise limit to be achieved from plant noise sources once the development is operational.

Making reference to the measured background noise levels on site for the most sensitive night-time period it can be seen that the existing background noise level is of the order of 40 dB L_{A90}.

Following the methodology outlined in BS4142 the cumulative plant noise emissions from the development should be no greater than the existing background noise in order to ensure that any new mechanical plant serving the development does not generate a significant noise impact. Therefore, the cumulative plant noise level at the NSL's should be less than or equal to 40 dB $L_{Ar,T}$.

The majority of building services plant serving the development is located at ground floor level within the carpark and service yard areas. Both of these areas are located below the buildings above and are therefore benefiting from significant noise shielding from the proposed buildings. Figure 4 illustrates the location of the internal plant areas serving the supermarket at ground level.

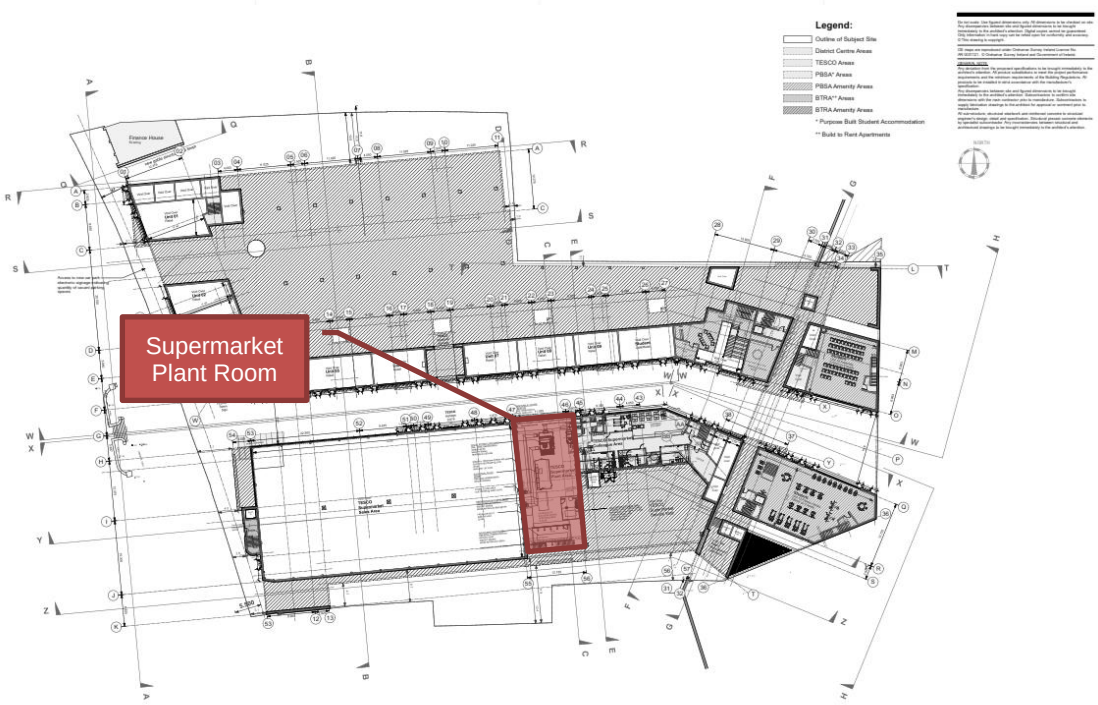

Figure 4 Supermarket Plant Room Location on Mezzanine Level

Some plant will be located externally on the first floor level as indicated in Figure 5.

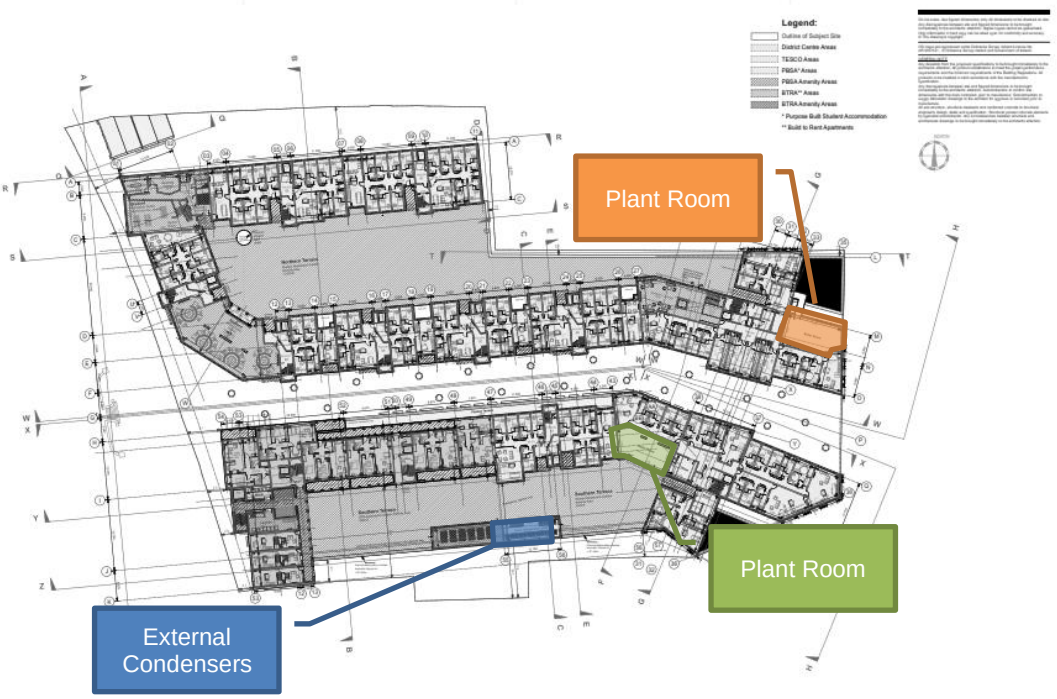

Figure 5 External Plant Locations

Taking into account the location of the plant, the distance to the NSL's and the attenuation provided by the acoustic screen around the external condenser plant area, it is necessary to ensure that plant is designed to achieve the following noise levels:

- First floor plant rooms – noise from each set of sound reducing louvres to be selected not to exceed a noise level of 65 dB at 1m from the louvre;
- Mezzanine level plant room – noise level from mezzanine plant, once it reaches the external condenser area, not to exceed 65 dB(A) at 1m from podium floor level, and;
- External condensers – each condenser to be selected not to exceed a noise level of 65 dB at 1m for each individual plant item.

Once plant is selected to comply with these noise limits during the detailed design stage the noise impact due to building services plant at the nearest off-site NSL's will be less than or equal to 40 dB(A).

5.2 Deliveries to the Development

The service yard serving the Tesco store is located at ground floor level on the southern side of the proposed development. The service yard is located below the mezzanine level and is therefore screened on three sides and above by the development buildings. On the southern side of the service yard there will be an opening that provides access to the yard area.

Deliveries to the store will be unloaded via a dock leveller within the service yard area. This will ensure that full and empty roll cages being loaded and unloaded from the trucks will be done so from within the store building and will not occur in the open service yard area.

The closest noise-sensitive properties are dwellings within St Joseph's Place beyond the southern boundary of the site. A solid site boundary will be provided between the development and the rear gardens of these properties. The boundary wall will be solid with no holes or gaps and have a surface mass of at least 10kg/m^2 and minimum insulation performance of B3 and a minimum absorption performance of A0 in accordance with the following British Standards for specifying noise barriers:

- BS EN 1793-1:1998: *Road traffic noise reducing devices – Test method for determining the acoustic performance – Part 1: Intrinsic characteristics of sound absorption*
- BS EN 1793-2:1998: *Road traffic noise reducing devices – Test method for determining the acoustic performance – Part 2: Intrinsic characteristics of airborne sound insulation*

This is typically achieved by a solid timber fence or block wall. The boundary wall will exceed 3m high when measured relative to the service yard ground level. Figure 6 illustrates the location of the boundary wall and the folding wall to the service yard.

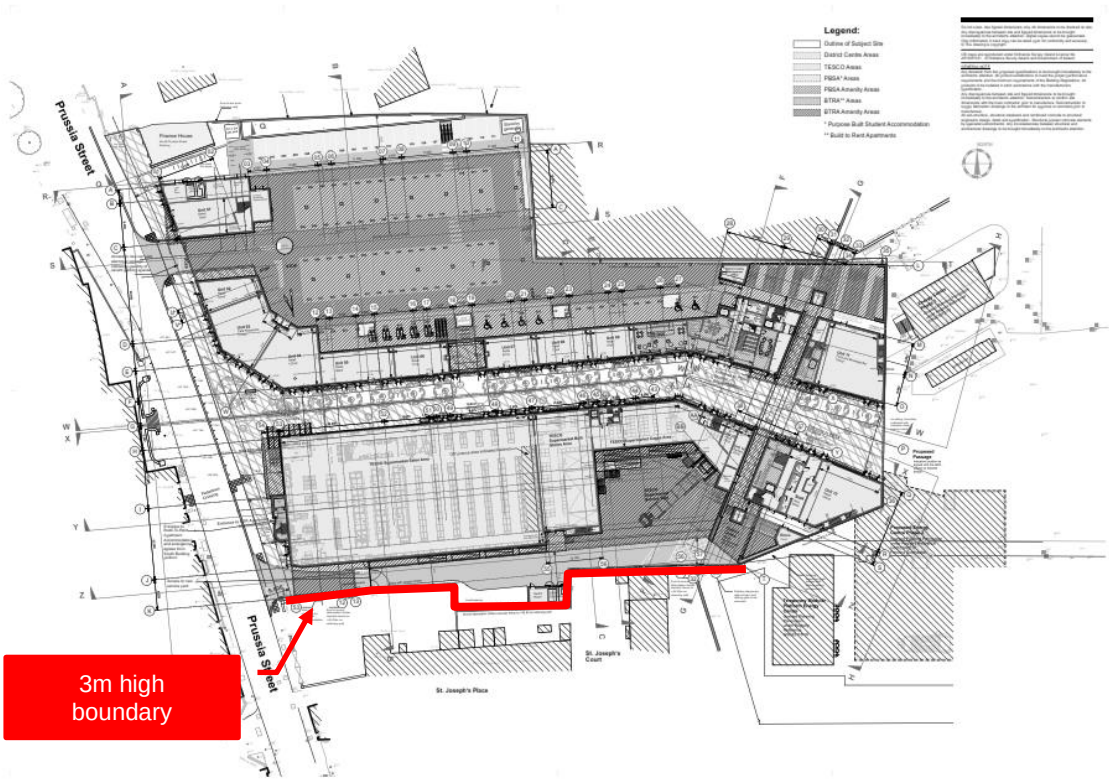

Figure 6 Position of Noise Attenuation to Southern Boundary

The noise level at a distance of 10m from a typical service yard using a dock leveller is of the order of 64 dB $L_{Aeq,1hr}$ during the daytime. This noise level includes the effects of reflections from building façades and service yard boundaries and contributions from all sources of noise, i.e. vehicles manoeuvring, reverse alarms, air brakes, refrigeration units and trolleys. This noise level does not include any screening from boundary treatments or noise barriers.

Taking into account attenuation due to distance and screening offered by the boundary wall and the folding service yard door, the predicted noise levels associated with deliveries are 48 dB $L_{Aeq,1hr}$ during the daytime at the closest NSL.

The expected noise level is within the daytime criteria of 50 dB $L_{Aeq,1hr}$ and is also below the measured existing ambient noise levels which are of the order of 57 dB $L_{Aeq,T}$.

It should be noted that night-time deliveries to the service yard are not possible within the noise limits.

5.3 Deliveries Vehicles Accessing the Development

The potential noise impact of delivery vehicles accessing the service yard is assessed through consideration of the cumulative noise level associated with a series of individual events. The noise level associated with an event of short duration, such as a vehicle drive-by, may be expressed in terms of its Sound Exposure Level[1] (L_{Ax}). The SEL can be used to calculate the contribution of an event or series of events to the overall noise level in a given period.

The appropriate formula is as follows.

$$L_{Aeq,\,T} = L_{Ax} + 10\log_{10}(N) - 10\log_{10}(T) - 20\log_{10}(r_2/r_1) - S \text{ dB}$$

Where:

$L_{Aeq,\,T}$	is the equivalent continuous sound level over the time period T (s);
L_{Ax}	is the "A-weighted" Sound Exposure Level of the event under consideration (dB);
N	is the number of events over the course of time period T.
r_2	is the distance from the edge of the entrance road to the facade of nearest property
r_1	is the distance from vehicle to the point of original measurement
S	is the attenuation due to screening

AWN had previously conducted a number of standardised noise measurements at an existing Tesco store. The measured SEL was of the order of 85 dB L_{AX} at 5m for HGV movements.

In this instance, the nearest noise sensitive locations to the service yard access road are the residential properties to the south of the site within St Joseph's Place at a distance of approximately 12m from the access road.

Based on delivery schedules for the existing store it is expected that there will be a peak visitation of 2 HGV's per hour during the morning and evening. For the purposes of calculations, a worst-case scenario of 6 HGV movements (i.e. 3 in and 3 out) to the development in any one-hour period during the daytime is used. The predicted daytime noise level at the properties to the south is calculated as follows:

$$L_{Aeq,\,1hr} = 85 + 10\log_{10}(6) - 10\log_{10}(3{,}600) - 20\log_{10}(12/5) - 5 = 45 \text{ dB}$$

The calculation above includes 5 dB screening from the boundary wall along the site access road as defined in Figure 6. It is understood that night-time deliveries will not be required.

The expected noise level is within the daytime criteria of 50 dB $L_{Aeq,1hr}$ and is also below the measured existing ambient noise levels (Ref. Section 2.6.2). It is concluded that the likely noise impact of HGV movements is not significant.

[1] Defined as being the "A-weighted" equivalent continuous sound level which, when maintained for one second, contains the same quantity of sound energy as the actual time varying level of one event.

5.4 Car Parking Activity

The development includes surface car parking on the ground level of the proposed store. The majority of the car park will be located under the development building, however, there are several spaces located external to the podium along the northern boundary. The closest noise-sensitive properties to the car park are those located within Rathdown Square beyond the northern boundary of the site and are represented by NSL 1 in Figure 2.

Typical noise levels 10m beyond the boundary of a busy car park during peak periods are of the order of 48 dB $L_{Aeq,1hr}$. Using this source level and allowing for the attenuation due to the existing boundary wall which will be retained, the predicted noise level from car parking at the properties to the north is 49 dB $L_{Aeq,1hr}$.

The predicted noise level is within the day criterion of 50 dB $L_{Aeq,1hr}$, but exceeds the night-time criterion of 45 dB $L_{Aeq,5min.}$ It should be noted that car parking activity is expected to be significantly lower during night-time hours and that the resultant noise impact will be lower than that assumed above.

It is concluded that the likely noise impact of car parking activity is not significant.

5.5 Podium Level Activity

Outdoor areas are being provided for residents of the scheme at podium level. The area on the southern side of the building is close to off-site noise sensitive locations within St Joseph's Place. The potential noise impact associated with this area is limited to voices from residents of the scheme. There are proposals to provide basketball courts, table tennis tables, grassed and seating areas on the podium.

In order to predict the impact of the proposed podium on the nearest noise sensitive locations, calculations have been carried out based on standardised noise source data for a typical human voice. Table 6 details the standardised sound power pressure level of a normal human voice at a distance of 1m from the speakers mouth. This level is taken from the American National Standards Institute document *ANSI 3.5:1997 – Methods for calculation of the speech intelligibility index.* This sound pressure level is an average of male and female voices and is a free-field level.

Description	Sound Pressure Level, dB re $2x10^{-5}$ Pa at Octave Band Centre Frequency (Hz)							dB(A)
	125	250	500	1000	2000	4000	8000	
Normal Voice Effort	51	57	60	54	49	44	39	60

Table 6 Sound Pressure Level of Normal Voice Effort

When calculating the potential noise impact of the podium it is important to consider the noise shielding that will be provided by the parapet wall to the podium. The proposal is to construct a solid parapet wall 2m high along the southern boundary as indicated in Figure 7. This wall will provide a good degree of noise shielding to the nearest noise sensitive locations. It has been calculated that a noise reduction of 15 dB will be provided for NSL1.

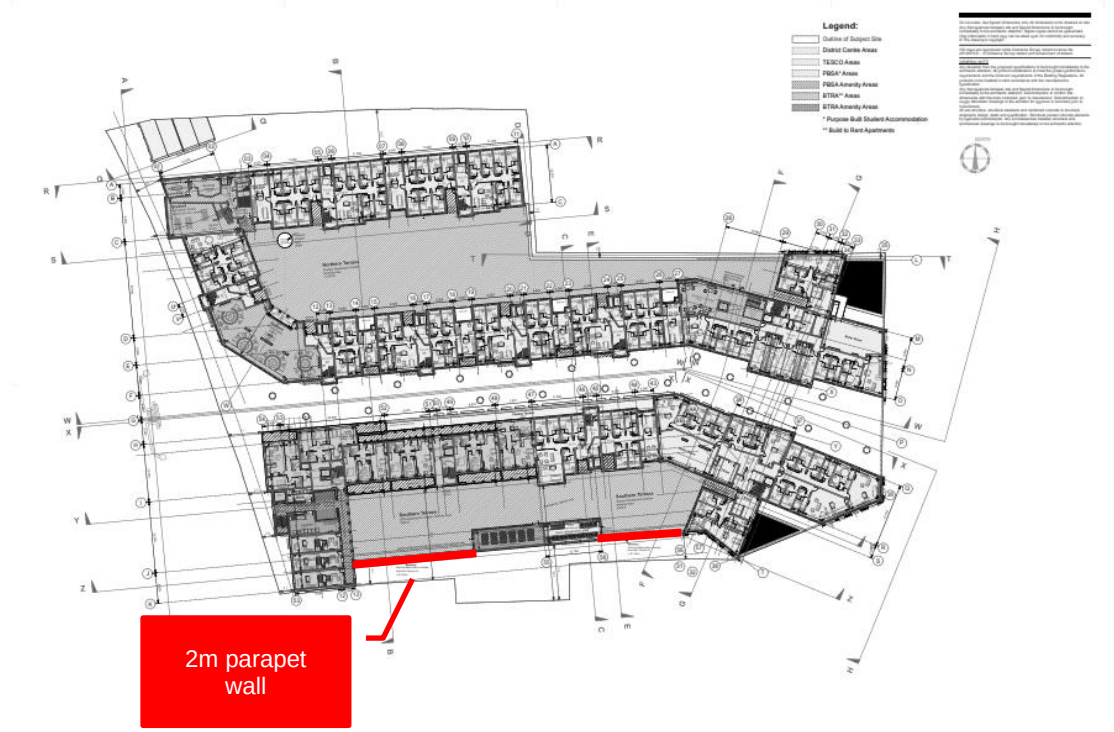

Figure 7 Parapet Wall Location on Podium Level

For the purposes of this assessment it is assumed that the podium will be busy with up to 30 people conversing simultaneously. We have also added a 5 dB penalty to account for raised voices. This represents a worst-case assessment as typically there will be less people using the podium.

Taking this into account and including the noise attenuation due to distance and the shielding discussed earlier the noise level at NSL2 is predicted to be of the order of 35 dB $L_{Aeq,T}$.

The predicted noise level is within the day criterion of 50 dB $L_{Aeq,1hr}$ and the night-time criterion of 45 dB $L_{Aeq,5min.}$ It should be noted that podium activity is expected to be significantly lower during night-time hours and that the resultant noise impact will be lower than that assumed above.

It is concluded that the likely noise impact of podium activity is not significant. Notwithstanding this, noise management policies are discussed in Section 7.0 of this report.

5.6 Entertainment Noise

At this stage it is not possible to predict the level of entertainment break-out from potential sources within the development. However, it is recommended that a comprehensive review of this issue should be undertaken prior to the development becoming operational. During this review the entertainment sound shall be so controlled that its level at any adjacent noise sensitive location shall not cause the ambient (measured in the absence of said entertainment sound) to increase, when assessed over 5 minute back to back periods. Similar criteria shall apply to the 63Hz & 125Hz octave band levels. Some possible mitigation measures that may be considered are discussed in Section 6.5 of this report.

5.7 Additional Vehicular Traffic on Public Roads

A detailed report on roads and traffic has been prepared by Pinnacle Consulting Engineers. Information from this report has been used to determine the predicted change in noise levels as a result of additional traffic serving the development.

For the purposes of assessing potential noise impact, it is appropriate to consider the relative change in traffic movements with and without the development using the provided peak hour figures, these are presented in Table 7.

Period	Two Way Trips Generated	
	Without Development	With Development
AM Peak (08:00 – 09:00)	78	18
PM Peak (17:00 – 18:00	239	37
Saturday (12:00 – 13:00)	328	80

Table 7 Noise Impact Associated with Development Traffic on Public Roads

Due to the reduction in the number of carpark spaces available there is a reduction in the number of trips to the development site with the proposed development. This will ultimately reduce the traffic movements to and from the site and therefore reduce the noise levels.

In summary, the likely noise impact of additional vehicular traffic on the local road scheme on the local environment is not significant.

6.0 POTENTIAL INWARD IMPACT OF NOISE ON THE PROPOSED DEVELOPMENT

As the development contains residential units for student and Build-to-rent (BTR) apartment accommodation the inward noise impact from existing noise in the environment and noise generated by the development itself should be considered. In compliance with BS 8233, internal noise levels should not exceed 40dB $L_{Aeq,T}$ during daytime periods within living spaces and 30dB $L_{Aeq,T}$ during night-time periods within bedrooms.

In order to assess compliance with these criteria, noise levels recorded during the baseline survey have been corrected to account for additional noise from the development and used to calculate internal noise levels within common rooms and bedrooms. The calculations take account of the surface area of the building elements (brick work, glazing etc.), their sound reduction indices and the internal room volumes of the spaces under consideration. As is the case in most buildings, the glazed elements of the building envelope and ventilation grilles are typically the weakest element from a sound insulation perspective.

In this instance the measured external noise levels in the vicinity of the site boundary are of the order of 57 dB $L_{Aeq,T}$ during the daytime and 53 dB $L_{Aeq,T}$ at night. However, taking into account the potential noise levels generated by the development itself the noise level at the façade of residential units is assumed to be up to 65 dB $L_{Aeq,T}$ during the daytime and 55 dB $L_{Aeq,T}$ at night-time for the purposes of this assessment. This is a worst-case assumption as it assumes the same noise level at all residential facades, regardless of the orientation or height of the building.

While the glazed elements will be selected as part of the detailed design of the buildings, for new residential units within the development it is assumed that a standard double glazed system will be installed. For the purposes of the noise assessment, the calculations assume a double glazed unit with a sound reduction index (SRI) of 35 dB R_w. Where natural ventilation vents are required, it is necessary that the wall vents are specified to achieve a sound insulation performance as follows,

- All elevations – 38dB $D_{n,e,w}$ (in the open position).

This specification and can be achieved by a range of proprietary vents in either through frame trickle vent or through wall vents.

Taking this into account and using the worst-case external noise levels discussed the predicted internal noise levels across the development are within the recommended daytime and night-time criteria.

7.0 MITIGATION MEASURES

7.1 Mechanical and Electrical Plant

The noise impact assessment outlined previously has demonstrated that once the mechanical plant is selected to have noise emissions lower than 65 dB(A) at 1m specific mitigation measures are not required in order to avoid a significant noise impact at the nearest noise sensitive locations.

Notwithstanding this, the following practices are recommended for all plant items in order to minimise potential noise disturbance for neighbours:

- all mechanical plant items shall be regularly maintained to ensure that excessive noise generated any worn or rattling components is minimised;
- any new or replacement mechanical plant items, including plant located inside new or existing buildings, shall be designed so that all noise emissions from site do not exceed the noise limits outlined in this document.
- Installed plant will have no tonal or impulsive characteristics when in operation.

7.2 Deliveries to the Development

The noise impact assessment outlined in Section 5.2 has demonstrated that ameliorative measures are not required. Notwithstanding this, the following *'good practice'* issues would be advised for the site.

It is critical that drivers making regular deliveries to site behave in a way that noise disturbance is minimised.

- Vehicle engines shall not be left idling once on site. In addition, on-board refrigeration units (if any) shall also be turned off when on site.
- Drivers should minimise impact sounds whilst working about their vehicle. This includes dropping tailgates and moving cages and pallets.
- All radios and amplified music in the truck cab shall be turned off prior to the doors being opened.
- There should be no shouting or communicating in raised voices whilst on site.
- There should be no unnecessary sounding of horns whilst on site.

In addition to the above truck noise management practices, we propose that the following practices are adopted to minimise potential noise disturbance for neighbours.

- All mechanical plant items e.g. motors, pumps etc. shall be regularly maintained to ensure that excessive noise generated any worn or rattling components is minimised.
- Any new or replacement mechanical plant items, including plant located inside new or existing buildings, shall be designed so that all noise emissions from site do not exceed the noise limits outlined in this document.
- An appointed Noise Liaison Officer shall ensure that all truck drivers have been briefed and understand the requirements of the site practice. It will be the Noise Liaison Officer's responsibility to ensure that drivers are adhering to the requirements of site practice.
- Staff should not communicate with raised voices within the delivery yard.
- Appropriate signs should be erected requesting that staff should keep noise to a minimum within the service yard/shipping dock areas.
- Roll cages should be fitted with composite rubber and nylon wheels that reduce shock loads and consequent vibration and noise.

- Metal cages should be replaced with much quieter plastic dollies where practicable.
- The surface of the service yard should be smooth and continuous with no holes or ridges that would cause trolleys to vibrate unnecessarily.

7.3 Delivery Vehicles accessing the Service Yards

The noise impact assessment outlined in Section 5.3 has demonstrated that with the proposed 3.0m high boundary wall additional ameliorative measures are not required.

7.4 Car Parking Activity

The noise impact assessment outlined in Section 5.4 has demonstrated that ameliorative measures are not required.

7.5 Podium Level Activity

The developer will implement in full the following noise management polity throughout the operational phase of the development to minimise further any noise impact from the podium areas. The implementation of this policy will ensure that noise from the podium areas will be minimised. The noise management policy outlines the following measures:

- The podium areas will operate without music of any type.
- Members of staff will conduct regular checks of the external area at all times. The area will also be subject to CCTV coverage. Coverage will operate for 24 hours with images retained for 30 days.
- Signage will be erected in the external area and by all exits to the premises to remind students of the need to respect the rights of our neighbours to the quiet enjoyment of their homes, businesses and other activities.
- If on occasion students are found to be making excessive noise a member of staff will take immediate action to rectify the situation, e.g. ask the student to talk more quietly or if problems persist, ask them to return inside the premises.
- A telephone number will be circulated to residents to allow any complaints as to noise from the premises or as to any other elements of its operation to be communicated easily.
- If any complaints of noise disturbance are received immediate steps will be taken to prevent a recurrence of the situation.
- The premises management will ensure that all residents and staff are made aware of the need to respect the rights of our neighbours to the quiet enjoyment of their homes, businesses and other activities.
- Regular residents meetings will be convened unless it is apparent that attendance at such meetings means they may no longer be necessary. The meetings will allow any issues which arise from the operation of the premises to be discussed.

7.6 Entertainment Noise

At this stage it is not possible to definitively state what mitigation measures are required to ensure control of entertainment noise. However, the following issues, amongst others, may be considered during the detailed design stage:

Appropriate Linings Proposed constructions (e.g. external walls) should be reviewed in order to determine whether additional measures are required in order to control noise emissions from the highlighted areas. These measures would typically consist of independent wall linings where appropriate.

Glazing Where glazing is proposed in the design the installed elements should offer an appropriate sound insulation performance in order to minimise noise break out.

Doors Access to noisy areas from external locations should be via acoustic lobbies with double doors separated by an appropriate distance. Access to areas from other locations within the demise should be via doors offering good acoustic performance. All doors required to offer good acoustic performance should be a thick solid core timber construction and should have proprietary acoustic seals on head, jambs and meeting stiles. Furthermore, one doorset in each lobby should have a threshold seal.

Ventilation Ventilation should be supplied by suitably attenuated mechanical means. Once details of the proposed building services installation are known, consideration should be given to: the potential for entertainment noise breakout to atmosphere via ductwork; the potential for services noise transfer to both external and internal areas.

Audio System The audio systems should feature a distributed array of loudspeakers arranged such that the coverage zones are tightly controlled and all patrons are within the “near field” of one or more loudspeakers. This will limit the amount of sound energy incident upon the external walls and in turn help to control the amount of noise transfer and break-out

Noise Level Once the measures outlined above are implemented it would be recommended that a maximum permissible noise level be set for each venue (i.e. a noise level that should not be exceeded in order to ensure that noise emissions are kept to an acceptable level).

7.7 Additional Vehicular Traffic on Public Roads

The noise impact assessment outlined in Section 5.7 has demonstrated that ameliorative measures are not required.

7.8 Inward Impact on Proposed Student Accommodation

The noise impact assessment outlined previously has demonstrated that once appropriate glazing systems are selected to achieve 32 dB R_w, the internal noise environment within the student accommodation will meet best practice guidelines.

8.0 CONCLUSION

An environmental noise survey has been carried out to assess the existing noise environment.

Calculations have been carried out to predict the noise level associated with the development. Based on the results of the predictions it can be concluded that once suitable mitigation is implemented, the noise emissions from the operation of the development are unlikely to injure the residential amenity of the neighbouring properties and will be within best practice international noise guidelines.

In addition, the inward noise impact on the student accommodation element of the development has been assessed and it has been found that once the glazing elements are selected to achieve an acoustic rating of 32 dB R_w the internal noise environment will meet best practice guidelines.

In summary, the potential noise impact of the proposed development is not significant and will not injure the residential amenity of the area.

APPENDIX A

GLOSSARY OF ACOUSTIC TERMINOLOGY

ambient noise The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.

background noise The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).

broadband Sounds that contain energy distributed across a wide range of frequencies.

dB Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 µPa).

dB L_{pA} An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'–weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.

Hertz (Hz) The unit of sound frequency in cycles per second.

$L_{Aeq,T}$ This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T).The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.

L_{AFmax} is the instantaneous slow time weighted maximum sound level measured during the sample period (usually referred to in relation to construction noise levels).

L_{AF90} Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval; it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.

noise Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.

APPENDIX A
GLOSSARY OF ACOUSTIC TERMINOLOGY (Continued)

noise sensitive location NSL – Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.

octave band A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.

sound pressure level The sound pressure level at a point is defined as:

$$Lp = 20Log\frac{P}{P_0} \text{ dB}$$

specific noise level A component of the ambient noise which can be specifically identified by acoustical means and may be associated with a specific source. In BS 4142, there is a more precise definition as follows: 'the equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval ($L_{Aeq, T}$)'.