Acoustic Designs

4 Turlough Gardens, Fairview, Dublin 3
Phone : +353 (0)1 8376693
www.acoustic-designs.com

Noise Impact Assessment

Lucan Shopping Centre

Proposed Extension

Author : Dr. Peter Hill

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v1.1

Summary

Acoustic Designs were engaged to undertake a noise impact assessment for the proposed extension at Lucan Shopping Centre, Co Dublin. The assessment considers the impact of possible noise emissions from the proposed development on noise sensitive locations in the surrounding environment.

The proposed development consists of construction of a new extension to the existing shopping centre located to the north west of the existing shopping centre buildings. Noise sources considered include external heating, ventilation and air conditioning systems (HVAC) to support the commercial fit-out of the proposed building and noise emissions from delivery vehicles.

A noise survey was carried out at the site to establish the daytime, evening and night time background sound levels on the existing site. This was compared with the modelled noise emissions from the proposed development HVAC and vehicle noise sources to predict it's likely noise impact. The estimated noise emissions from the proposed development are unlikely to result in disturbance at noise sensitive locations close to the development site.

1. Introduction

Acoustic Designs were engaged to undertake a noise impact assessment for the proposed extension of Lucan Shopping Centre, Co Dublin. The assessment considers the impact of possible noise emissions from the proposed development on the surrounding environment including noise sensitive locations.

The proposed development consists of construction of a new building to the north west of the existing shopping centre building. This will be a stand alone retail unit. Noise emissions from the proposed development include noise from heating, ventilation and air conditioning systems (HVAC) and other equipment to support the fit-out of the retail unit. Noise from deliveries is also taken into consideration. There will be no significant increase in vehicle traffic on the site.

The proposed development, which is shown on the plan in the appendix, consists of a single stand alone two story building at the north western end of the site. The block will contain retail and storage space with HVAC and other equipment located on the roof of the building.

Lucan Shopping centre is accessed from the R120 which forms the eastern boundary of the site. The other side of the R120 has a number of educational buildings and there are housing estates on the other three sides of the shopping centre site.

Significant noise sources in the area include the M4 which runs to the north at a distance of approximately 250m and Weston Airport which is approximately 2km to the west. There are no other significant industrial or commercial sites close to the shopping centre.

The closest noise sensitive locations to the proposed development are housing in Hillcrest estate to the north west. The closest house will be approximately 40m from the rear façade of the proposed building.

2.0 Noise Sources

British Standard BS4142:2014 *Methods for rating and assessing industrial and commercial sound* details an assessment methodology which is based on a comparison of the specific noise from a proposed development against the background noise level at exposed noise sensitive receptors (NSR). It is the most appropriate methodology for assessing the likely impact of noise from the proposed development on the nearby noise sensitive locations (NSL). To implement the standard it is necessary to determine both the specific noise level and the background noise level at the closest noise sensitive location.

2.1 Background Noise Level

The primary source of noise in this area (residual noise) was observed to be road traffic noise. The site of the proposed development is bounded by the R120 to the east of the site and the M4 motorway approximately 250m to the north of the site. Weston Airport is approximately 2km to the west.

The primary ambient noise sources were observed to be road traffic noise from both the local R120 and the more distant M4. Both of these were present during the daytime, evening and night time periods. Some noise was observed from chillers and other equipment associated with the existing shopping centre and vehicles delivering to the site but this was mostly masked by the ambient road traffic noise at the northern end of the site. Intermittent light aircraft were observed during the daytime, evening and at night.

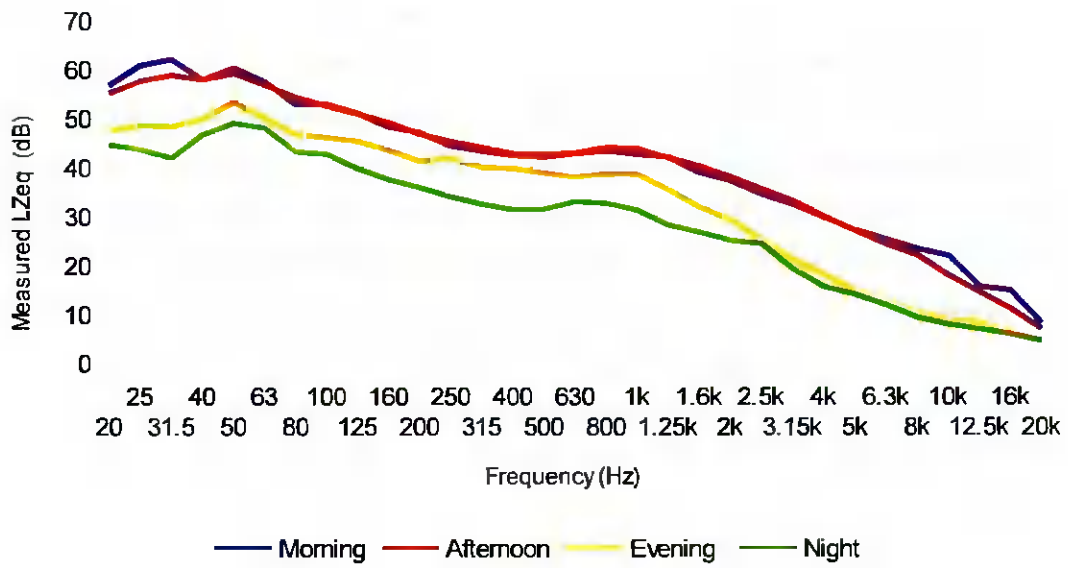
A noise survey was carried out to establish the current background noise levels for the site. Ideally this would have been carried out at a time when there was no activity on the existing site. The shopping centre operates 7-days with a supermarket and food takeaway businesses so there was no time when the site was closed. The site noise survey was therefore carried out as an attended survey to log the daytime, evening and night time noise levels and to observe activity on the site. The site noise survey

was carried out on the 12/13th October 2021. There were 4 measurements taken throughout the day commencing at approximately 11:10, 15:20, 21:50, 23:50. The daytime measurements were of approximately 1 hour 15 min duration and the night time measurement was effectively continuous from 21:50 until 02:00 with only a short gap around 23:40. The weather conditions were extremely good for environmental noise measurement, being dry, clear, and with no measurable wind. The measured sound levels are shown in Table 1 and Figure 1. The sound level meter was tripod mounted at 1.5m height following the methodology outlined in the EPA noise guidance document, NG4. The equipment used is detailed in the appendix.

Table 1 Measured sound levels

	L 10	L 90	LAFmin	LAFmax	LAeq
Morning	53	48	45	69	51
Afternoon	54	48	46	70	52
Evening	47	41	37	66	46
Night	42	34	30	61	40

Figure 1 1/3 octave spectrum of measured sound levels (L_{Zeq})



Additional ambient noise data was available for this site from the EPA noise maps. At the time of the site noise survey most of the travel and other restrictions in place to reduce the spread of the Covid-19 virus had been removed. However changes to commuting patterns and office working practices could have resulted in changes to traffic patterns and thus noise levels. The Institute of Acoustics has published guidance[1] in conjunction with the ANC which recommends caution where a site may experience deviation from typical noise conditions. The guidance recommends the use of additional sources with reference to the Environmental Noise Directive as a possible source of noise data.

The Environmental Noise Directive (END) requires local authorities to draw-up plans of action which will include measures to '*address priorities which may be identified by the exceeding of any relevant limit value or by other criteria chosen by the Member State and apply in particular to the most important areas as established by strategic noise mapping*'. Noise data from this work is available on the EPA website and can be accessed in map form. Extracts from these maps are shown below for the location of the proposed development.

The following EPA map[2] extracts show modelled noise levels due to road traffic along the M4 and the R120 roads in the area around the proposed development. The maps indicate that the noise levels on the proposed development site are likely to be in the range of 55-59dB L_{den}, falling below 45dB L_{night} at night. This can be converted[3] to a daytime $L_{Aeq,16hrs}$ and a night time $L_{Aeq,8hrs}$ giving the following.

Table 2 Site ambient noise levels derived from noise modelling data

Day $L_{Aeq,16h}$	Night $L_{Aeq,8h}$
55	<45 dB

1 Joint Guidance on the Impact of COVID-19 on the Practicality and Reliability of Baseline Sound Level Surveying and the Provision of Sound & Noise Impact Assessments

2 Round 3 of the strategic noise mapping as presented on epa.ie/EPAMaps

3 The conversion between L_{den} and L_{Aeq} followed the methodology published in "*Conversion between noise exposure indicators L_{eq24h}, L_{Day}, $L_{Evening}$, L_{Night}, L_{dn} and L_{den}: Principles and practical guidance*" October 2017, International Journal of Hygiene and Environmental Health

Figure 2 L_{den} noise contour map (proposed development marked)

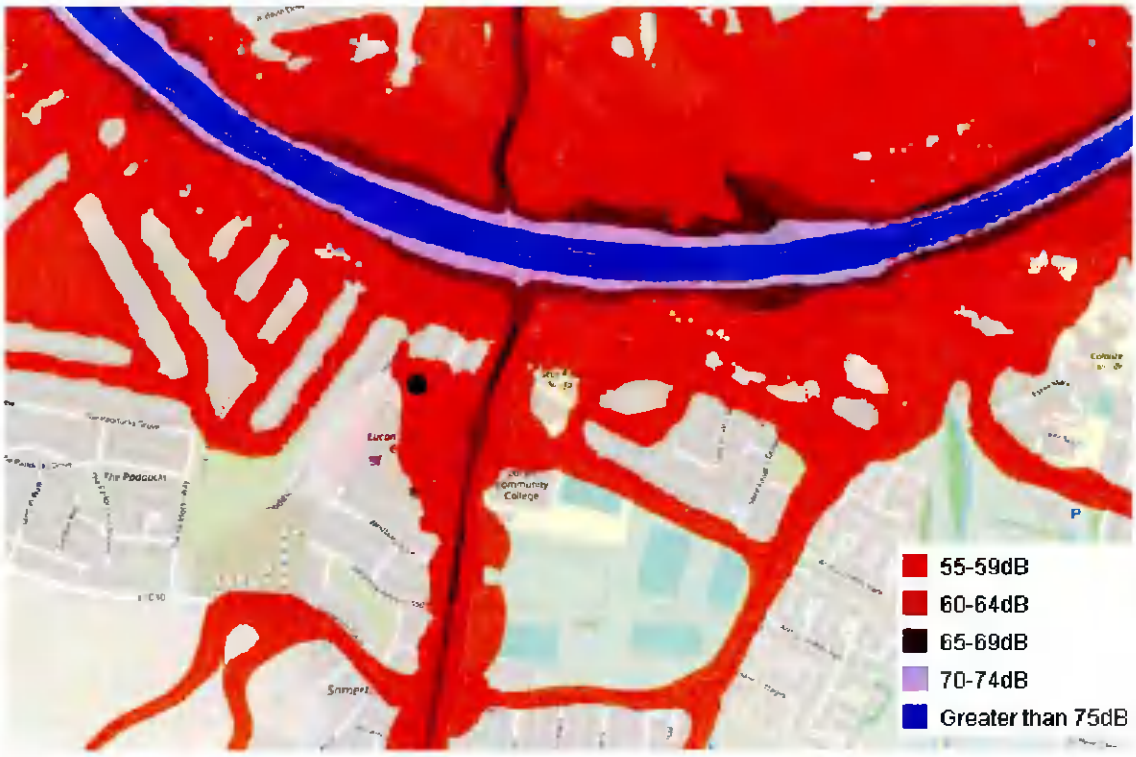
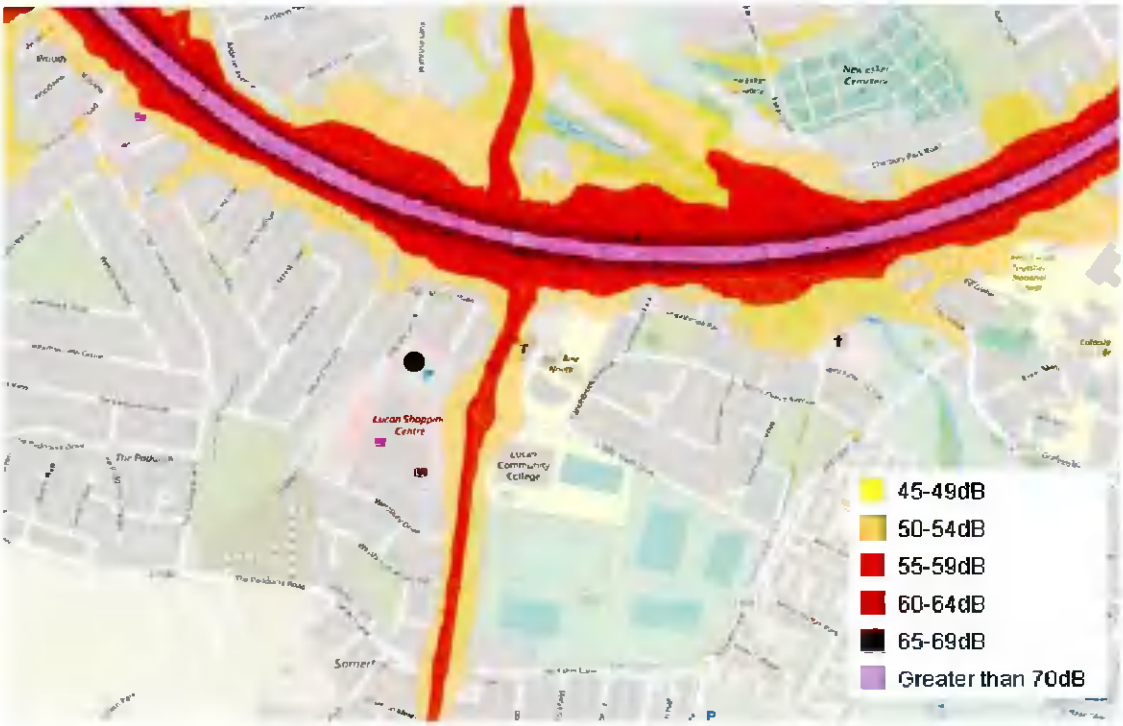


Figure 3 L_{night} noise contour map (proposed development marked)



The sound level data derived from the EPA noise maps gives results that are higher than the sound levels measured on-site. This may more accurately reflect traffic patterns prior to Covid-19, however, the EPA noise models may also be limited in their ability to accurately take into consideration local conditions and in particular the screening effects of local buildings or other features. The measured sound levels are lower than the EPA data and therefore present a greater degree of protection for the noise sensitive location. For these reasons the remainder of this assessment will use the measured sound level data.

2.2 Specific Noise Level

The proposed development will include the installation of external heating, ventilation and air conditioning systems (HVAC) on the roof of the proposed building. The equipment has not been specified and it's noise emissions are therefore not known at this stage.

External HVAC plant is usually made up of heat exchangers or chillers used for fridges or similar and larger air handling units (AHU's). The chiller units have one or more fans which generate noise and are characterised with a single sound power level value for the unit. These will typically be in the range of 50-60 dBA L_W. AHU's normally have three distinct noise sources for each unit. These are unusually characterised by the manufacturer in terms of their sound power levels which can be 50-100dBA L_W for the intake and exhaust sound power levels and 40-70dBA for the unit breakout noise levels. The specific sound power levels will depend on the design, size, power, fan speed and use of acoustic attenuation for each unit.

For the purposes of this assessment a typical external chiller unit[4] has been selected with a sound power level of 66dB L_{WA}. Similarly a typical AHU might have an inlet sound power level of 70dB L_W, an air exhaust sound power level of 90dBA L_W and a breakout sound power level of 65 dBA L_W.

Noise modelling was carried out using iNoise v2021 Pro. This software implements

4 Daikin RXM/N series with a cooling capacity of 7kW.

the methodology described in ISO 9613 for calculating the propagation of noise in outdoor environments. The source inputs to the noise model are the typical data above where it is assumed that four of each chiller unit and two AHU's are installed on the roof of the proposed building. A 2.5m high solid barrier has been included around the roof mounted plant to reduce the noise impact on the surrounding environment. All equipment will run during the daytime and only the chiller units, which are normally associated with refrigeration, will run during the night time (23:00-07:00). The AHU's are in use only during opening hours in line with normal practice for commercial buildings. The results of the noise modelling are shown in Figure 4 and 5 below as sound pressure level (SPL) contours for daytime and night time. The numbers shown on these figures are the SPL at these noise sensitive locations and this data is tabulated in the appendix.

The results of the noise model show that during the daytime the highest sound level is calculated at Hillcrest Grove directly behind the proposed building where the SPL is 37.7dB L_{Aeq}. At night when the AHU's are not operating, the sound level from the plant is 10dB L_{Aeq} or less at all receivers.

In addition to the noise emissions from the fixed plant, the proposed retail unit will have deliveries at the rear of this building. It is understood that these are likely to consist of one HGV approximately 4 times per week. A delivery scenario using a typical goods vehicle[5] was also modelled in iNoise with the resulting noise contours shown in Figure 6. The NSL that will experience the highest sound level in this case is another of the houses on Hillcrest Grove which has a calculated sound pressure level of 58.1dB L_{Aeq}. It is important to note that this noise will only occur while the vehicle engine is operating. From observation, deliveries take approximately 30 minutes.

5 Heavy goods vehicle from CNOSSOS-EU noise project with an L_w of 102dBA.

Figure 4 Daytime noise contours from modelling of the roof mounted plant for the proposed development

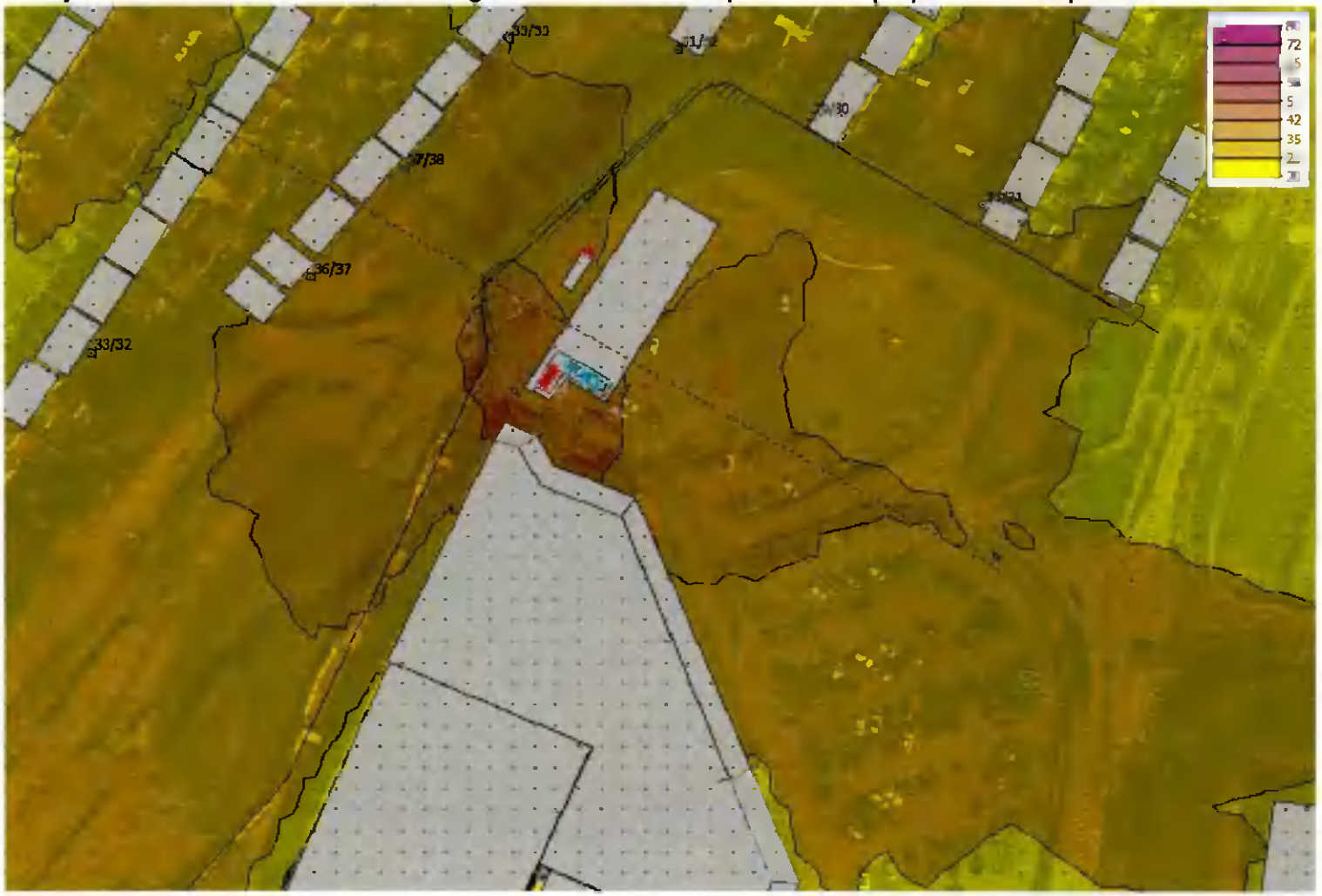
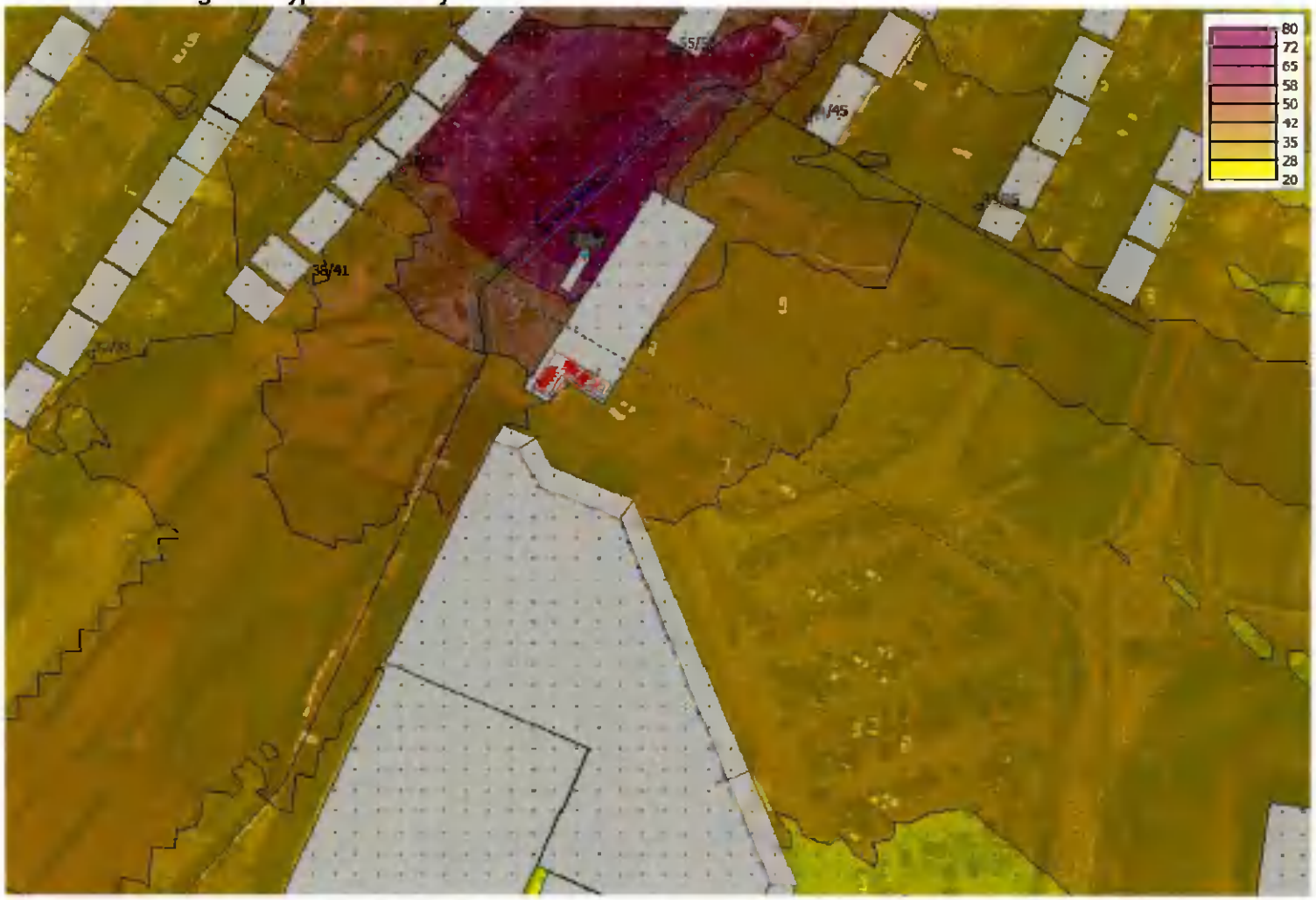


Figure 5 Night time noise contours from modelling of the roof mounted plant for the proposed development

Figure 6 Noise modelling for a typical delivery vehicle



2.3 Vehicular Traffic

The road traffic analysis prepared by Transport Insights consultants predicts that the impact of the proposed expansion of the shopping centre (and medical centre) will be less than 2.5% of additional vehicle traffic accessing the site during peak times. This change will have a negligible impact on the overall vehicle noise emissions for the site.

In addition, the proposed building will provide an effective barrier to the transmission of noise from the carpark to some of the houses on Hillcrest Grove. In practice this will only have a small impact on the overall noise level at these houses as the dominant ambient noise source was observed to be external to the shopping centre site, namely road traffic noise on the M4 and R120.

The proposed extension includes rear access to the building for delivery vehicles. This brings heavy goods vehicles behind the proposed extension for deliveries. The impact of noise from a typical HGV delivery vehicle in this location is shown in the modelling above.

3.0 BS 4142 Noise Assessment

BS 4142:2014 *Methods for Rating and Assessing Industrial and Commercial Sound* provides a methodology for assessing the likely impact on noise sensitive receptors of sound from industrial or commercial sources. The assessment methodology compares the measured or predicted specific noise level from the source under assessment against the measured background noise level with appropriate corrections being applied for the character of the sound. BS 4142:2014 allows for a correction of between 0-6 dB for tonality, up to +9dB for impulsivity or +3 dB for other distinctive but non-tonal and non-impulsive noise sources.

Taking the background noise levels from Section 2.1 above and using modelled sound pressure levels from Section 2.2, an assessment in accordance with BS4142

can be carried out as follows. Impulsive noise is not normally associated with HVAC equipment and it should be a requirement that the installed equipment does not generated noise of a tonal character. On that basis both of these corrections are set to 0dB.

The calculated daytime noise levels include noise from the AHU and chiller units. During the night time only the chiller units will operate. There is a 2.5m high solid barrier on the roof enclosing the AHU's and the chillers reducing the noise emissions from this equipment.

Table 3 Calculation of the daytime and night time noise rating levels

	Day $L_{Aeq,16h}$	Night $L_{Aeq,8h}$
Specific noise level at NSL (LAeq)	37.7	8.9
Correction (Tonal / Impulsive)	0	0
Noise Rating Level (LAr)	38	9

Table 4 Noise assessment for the proposed new building.

	Day	**Night**
Noise Rating Level (LAr)	38	9
Background noise level (LA90)	47	34
Difference (LA90 - LAr)	-9.1	-24.6

Table 4 shows that the calculated daytime noise rating level is 9dB below the daytime background noise level at the worst affected noise sensitive location. The noise impact will be lower at all other noise sensitive locations. This is highly unlikely to give rise to disturbance at these locations.

Similarly the night time noise emissions from the proposed development are more than 20dB below the night time measured background noise level and this is extremely unlikely to give rise to disturbance at these locations.

The noise level calculated at the closest houses during vehicle deliveries is 58.9dB L_{Aeq}. This is approximately 11dB above the measured daytime background noise level and 25dB above the night time measured background noise level. The short duration of deliveries and their infrequent occurrence (4 times per week) mean that it is not appropriate to assess the noise impact in the same way as the continuous noise from the HVAC plant. Deliveries are a practical necessity for a retail unit and although the noise levels are above the background sound level, they are not frequent and of short duration minimising the noise impact. In addition a row of trees has been proposed on the western site boundary to provide visual screening to the rear of the proposed building.

BS 4142:2014 places considerable emphasis on the context for the noise under assessment stating that: "*The significance of sound of an industrial and/or commercial nature depends upon both the margin by which the rating level of the specific sound source exceeds the background sound level and the context in which the sound occurs. An effective assessment cannot be conducted without an understanding of the reason(s) for the assessment and the context in which the sound occurs/will occur. When making assessments and arriving at decisions, therefore, it is essential to place the sound in context.*

The dominant ambient noise source in the area is road traffic noise from the M4 and local roads (R120). These roads together carry very large volumes of road traffic and while the M4 is approximately 250m from the site, noise from it is clearly audible day, evening and at night. Lucan Shopping Centre has been on this site for about 30 years and the level of activity and and noise from the existing shopping centre is not excessive. The proposed development will add a new retail unit to the existing shopping centre. The modelled noise emissions from the proposed development will have minimal daytime noise impact and no discernable night time noise impact on the surrounding environment. Noise may occur from delivery vehicles at the rear of the proposed development which should be mitigated by their infrequent nature and short duration.

Appendix I Glossary

A-weighting	Frequency weighting applied to sound measurements mimicking the frequency sensitivity of the human ear.
L_{Aeq}	Equivalent continuous A-weighted sound pressure level of a steady sound that has, over a given period, the same energy as the fluctuating sound being measured.
L_{A90}	A-weighted sound pressure level exceeded for 90% of the sample period
L_{A10}	A-weighted sound pressure level exceeded for 10% of the sample period
L_{Amax}	Highest A-weighted sound pressure level recorded during the sample period
L_{Amin}	Lowest A-weighted sound pressure level recorded during the sample period

Appendix II Instrumentation

The following equipment was used to take sound level measurements. The sound level meters conform to IEC 61672 Class 1.

	Manufacturer	Model	Serial No.	Calibration Date	Calibration Certificate
Sound Level Meter	NTi	XL2	A2A-10536-E0	14/07/20	SLM200106
Acoustic Calibrator	NTi	CAL200	16780	01/02/21	AC190071

Appendix III Table of Results from the Noise Model

Name	AHU	Chiller	Delivery
Rec 1_A	32.9	7.7	32.0
Rec 1_B	32.4	6.7	33.2
Rec 2_A	36.0	9.9	38.1
Rec 2_B	36.6	10.2	40.7
Rec 3_A	37.1	8.5	53.2
Rec 3_B	37.7	8.9	55.4
Rec 4_A	33.0	7.5	55.7
Rec 4_B	33.1	6.9	57.4
Rec 5_A	30.8	8.0	55.4
Rec 5_B	32.2	7.5	58.1
Rec 6_A	29.2	5.4	40.3
Rec 6_B	30.3	6.1	45.5
Rec 7_A	31.2	8.3	33.3
Rec 7_B	31.0	8.0	34.7

Appendix IV

Ariel view of the existing Lucan Shopping Centre showing the location of the site noise survey (yellow dot)