

NoiseAssess

Acoustics, Noise and Vibration Consultants

Project:	Proposed Lidl Food Store Bodhfryd, Wrexham
Scope of Report	Assessment of noise from proposed external plant, deliveries and customer vehicle movements in the car park
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1.0 INTRODUCTION

- 1.1 This noise assessment has been commissioned by Lidl UK GmbH to assist with a planning application for a new Lidl foodstore off Bodhfryd, Wrexham.
- 1.2 The site of the proposed store is currently occupied by a police station which has buildings along the south side of the site and car parking to the north and west as shown on Figure 1.
- 1.3 The site is bordered by the A5152 to the north and east and Wrexham Memorial Hall and County Court to the south. There is a large supermarket with a fuel filling station to the east on the far side of the A5152. The closest residential properties are to the northwest of the site.
- 1.4 Plans show a new store building in the southwest corner of the site with car parking to the north and east. Vehicle access to the site will be off the A5152 to the northeast as currently used as an entrance by the police station. There is to be a delivery bay with a loading dock at the west end of the new store building. External plant will be in a compound to the west of the store building and south west of the delivery bay. The proposed site layout is shown in Figure 2.
- 1.5 For the purposes of this assessment consideration has been given to the store being open for any period between 07:00-23:00 hrs. The proposed delivery hours have not yet been decided and are to be informed by the outcome of this noise assessment.
- 1.6 This report relates to the potential impact of the operational noise arising from external plant, deliveries and customer vehicle movements in the car park.

2.0 CRITERIA

BS4142

2.1 The noise impact of commercial/industrial noise sources on existing residential properties is normally assessed in accordance with BS4142¹.

2.2 The scope of BS4142 is given in the extract below.

"1.1 This standard describes methods for rating and assessing sound of an industrial and/or commercial nature, which includes:

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

The methods described in this British Standard use outdoor sound levels to assess the likely effects of sound on people who might be inside or outside a dwelling or premises used for residential purposes upon which sound is incident."

2.3 The standard compares sound from industrial / commercial sources with the background sound level. The standard states in Clause 9.1 that "Certain acoustic features can increase the significance of impact over that expected from a basic comparison between the specific sound level and the background sound level". Such features are taken into account by adding a correction to the specific sound level depending on the extent to which the distinguishing acoustic characteristics will attract attention. The standard states the following in Clause 9.2:

"Tonality: For sound ranging from not tonal to prominently tonal the Joint Nordic Method gives a correction of between 0 dB and +6dB for tonality. Subjectively, this can be converted to a penalty of 2 dB for a tone that is just perceptible at the noise receptor, 4 dB where it is clearly perceptible, and 6 dB where it is highly perceptible".

- "Impulsivity: A correction of up to 9 dB can be applied for sound that is highly impulsive, considering both the rapidity of the change in sound level and the overall change in sound level. Subjectively, this can be converted to a penalty of 3dB for impulsivity which is just perceptible at the noise receptor, 6 dB where it is clearly perceptible, and 9 dB where it is highly perceptible."
- "Other sound characteristics: Where the specific sound features characteristics that are neither tonal nor impulsive, though otherwise are readily distinctive against the residual acoustic environment, a penalty of 3dB can be applied."
- "Where tonal and impulsive characteristics are present in the specific sound within the same reference period then these two corrections can both be taken into account. If one feature is dominant then it may be appropriate to apply a single correction. Where both features are likely to affect perception of response, the correction ought normally to be applied in a linear fashion."
- "Intermittency: When the specific sound has identifiable on/off conditions, the specific sound level ought to be representative of the time period of length equal to the reference time interval which contains the greatest total amount of on time. This can necessitate measuring the specific sound over a number of shorter sampling periods that are in combination less than the reference time interval in total, and then calculating the specific sound level for the reference time interval allowing for time when the specific sound is not present. If the intermittency is readily distinctive against the residual acoustic environment, a penalty of 3 dB can be applied".

Note: Although not clear in the standard it appears from the examples given that the intermittency penalty is for use when the specific sound source is intermittent but not particularly impulsive. Therefore, it has been assumed that impulsive and intermittency penalties would not generally be both applied in a linear fashion.

2.4 BS4142 provides guidance on the assessment of impacts in Clause 11.

"11 Assessment of the impacts

COMMENTARY ON CLAUSE 11.

The significance of sound of an industrial / commercial nature depends upon both the margin by which the rating 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.

Obtain an initial estimate of the impact of the specific sound by subtracting the measured background sound level from the rating level, and consider the following:

- a) Typically, the greater this difference, the greater the magnitude of the impact.
- b) A difference of around +10dB or more is likely to be an indication of a significant adverse impact, depending on the context.
- c) A difference of around +5dB is likely to be an indication of an adverse impact, depending on the context.
- d) The lower the rating level is relative to the measured background sound level, the less likely it is that the specific sound source will have an adverse impact or a significant adverse impact. Where the rating level does not exceed the background sound level, this is an indication of the specific sound source having a low impact, depending on the context".

- 2.5 BS4142 recommends that the specific sound level during daytime periods 07:00 - 23:00 hrs should be determined over a reference time interval of 1 hour and during night-time periods 23:00 - 07:00 hrs over a reference time interval of 15 minutes.

Assessment in Context

- 2.6 BS4142 recommends that the industrial sound should also be assessed in context. Therefore, the sound levels have been assessed in the context of the character of the area; the existing ambient noise levels and the criteria given in BS8233².

- 2.7 The BS8233 recommendations for indoor ambient noise levels are given below.

Table 1: BS8233 recommendations for indoor ambient noise levels

Activity	Location	07:00 to 23:00 hrs	23:00 to 07:00 hrs
Resting	Living room	35 dBL _{Aeq,16hour}	-
Dining	Dining room/area	40 dBL _{Aeq,16hour}	-
Sleeping (daytime resting)	Bedroom	35 dBL _{Aeq,16hour}	30 dBL _{Aeq,8hour}

- 2.8 Paragraph 7.7.3.2 of BS8233 recommends that for traditional external amenity areas such as gardens and patios, it is desirable that during the daytime the external noise level does not exceed 50 dBL_{Aeq,T} with an upper guideline value of 55 dBL_{Aeq,T} which would be acceptable in noisier environments. The time period is not stated but is assumed to be 16 hours (07:00 hours to 23:00 hrs) as in the previous version of BS8233.

3.0 BASELINE SURVEY

- 3.1 A survey of the current noise levels at the site was carried out from 11:00 hrs on Friday 1 June to 10:00 hrs on Monday 4 June 2018.
- 3.2 Noise levels were measured on the west boundary of the police station site on a fence post approximately 60m south of the A5152. The microphone was in freefield conditions and at a height of approximately 2.5m above ground level. The survey location is marked A on Figure 1.
- 3.3 Noise levels were measured using an unattended auto-logging Rion NL-31 sound level meter (s/n 583274). The sound level meter was calibrated using a portable Norsonic 1251 calibrator (s/n 30901) at the start and finish of the survey periods with no variation in the calibration level.
- Noise levels were measured using 5-minute sample periods.
 - The noise survey measured broad band noise levels only.
- 3.4 Weather conditions when the site was visited to install and then retrieve the sound level meter were dry with low wind speeds (<5m/s). From the weather forecast it is understood that the weather conditions were similar during the survey period.
- 3.5 The results of the noise survey are presented in full in Appendix A2 and summarised below. The $dBL_{Aeq,5min}$ ambient noise levels have been logarithmically averaged and the $dBL_{A90,5min}$ background values have been arithmetically averaged. Where sufficient data is available the mode of the 1-hour daytime and 15-minute night-time dBL_{A90} values has also been given.

Table 2. Location A: Summary of free field daytime noise levels.

Day	Period	Ambient noise level dBL_{Aeq}		Background noise level dBL_{A90}	
		Average	Range	Average	Mode
Fri	11:00-23:00 hrs	49	45 - 52	45	46
Sat	07:00-23:00 hrs	50	48 - 53	46	47
Sun	07:00-23:00 hrs	50	43 - 55	45	45
Mon	07:00-10:00 hrs	52	49 - 55	45	-

Table 3. Location A: Summary of free field night-time noise levels.

Night	Period	Ambient noise level dBL _{Aeq}		Background noise level dBL _{A90}	
		Average	Range	Average	Mode
Fri - Sat	23:00-07:00 hrs	45	33 - 51	35	37
Sat - Sun	23:00-07:00 hrs	44	38 - 49	37	38
Sun - Mon	23:00-07:00 hrs	45	35 - 51	36	32

- 3.6 During the two site visits to install and retrieve the auto-logging sound level meter the main noise source was road traffic.

4.0 NOISE IMPACT ASSESSMENT

Criteria and Methodology

- 4.1 The potential noise impact of external mechanical services plant and deliveries has been assessed in accordance with BS4142¹ and assessed in the context of the existing ambient noise levels and BS8233².
- 4.2 Noise from customer vehicle movements in the car park has been assessed in terms of the potential increase in the existing ambient noise levels. For the purposes of this assessment any increase in ambient noise level greater than 3 dB(A) has been considered significant.
- 4.3 The BS4142 assessment of noise from external plant and deliveries have been carried out using the lowest average or lowest mode of the 1-hour daytime or 15-minute night-time background noise levels (dBL_{A90,T}). Consideration of noise from external plant and deliveries in context and of noise from the use of the car park has been carried out using the lowest 1-hour daytime and 15-minute night-time ambient noise levels.

Closest noise sensitive properties

- 4.4 The impact of noise has been assessed for the closest dwelling which is the house fronting onto the A5152 to the west of the site as marked 'R1' on Figure 1. The impact of daytime noise has been assessed for ground floor level at the property and the impact of night-time noise has been assessed for the first-floor level at the property.

External plant***Proposed external plant***

- 4.5 External plant is to be located in a compound to the west of the store and southwest of the delivery ramp as shown on Figure 2.
- 4.6 Calculations of mechanical services noise have been based on the manufacturer's noise data for the proposed plant as provided by the client and summarised below.

Table 4. Manufacturer's noise data for external plant

Item	No. Units.	Noise level
Guntner GFW 090.1/3-E(J)-F4/04/6P	2	37 dB(A) at 10m
Dimplex heat pump	2	45 dB(A) at 10m Night-mode: 41 dB(A) at 10m
Mitsubishi FDC280KXRE6	1	59 dB(A) at 1m

- 4.7 It is understood that:
- The Guntner GFW 090.1/3-E(J)-F4/04/6P dry coolers and Dimplex heat pumps will run intermittently 24 hours a day, 7 days a week.
 - The Mitsubishi FDC280KXERE6 VRF air conditioning unit will operate during store opening hours only.

Control of noise from external plant

- 4.8 It is recommended that the Dimplex heat pumps be set to run in night mode 23:00-07:00 hours.
- 4.9 2.6m high acoustic barriers should be installed around the plant compound as shown on Figure 3.

- 4.10 The acoustic barriers should have a minimum mass of 12 kg/m² and may comprise 20mm thick weather-treated, close-boarded timber fencing with cover strips to seal the gaps between panels and gravel boards to seal the gap at the base. A masonry wall with no gaps can also be used. Alternative constructions can be used if checked with an acoustic consultant.
- 4.11 Proprietary acoustics fences are available from the following:
- Jacksons Fencing
<https://www.jacksons-fencing.co.uk/acoustic-fencing>
 - Premier Acoustic Fencing
<http://www.premieracousticfencing.co.uk/>
 - Modular Walls
<http://www.modularwall.co.uk/products/acoustimax/>
 - Gramm Barriers
<http://www.grammbarriers.com/our-products/acoustic-barriers/>
- 4.12 To reduce the reflection of noise from hard finishes an absorbent lining should be used on the inside of the acoustic barriers. The absorbent lining could be formed with mineral wool covered with perforated metal sheeting with a minimum 30% open area. Alternatively, proprietary panels could be used such as:
- 'Tilon' noise absorptive panels (<https://tilontest.files.wordpress.com/2014/11/tenb45a2.pdf>)
or
 - 'Prosonic' external acoustic panels (<http://www.customaudiodesigns.co.uk/prosonic-external-acoustic-panels.htm>).
- 4.13 It is the Client's responsibility to check with the manufacturer that products chosen are suitable for the proposed use in other respects. The sound insulation performance of the proposed construction will be dependent upon correct installation and workmanship.
- 4.14 The recommendations are given for acoustic reasons only and advice on other matters should be obtained from other specialists. The safety implications of the installation of the recommended products / material should be checked by the Client before use and appropriate systems of work put in place.

Calculation of noise from external plant

- 4.15 The calculated noise levels due to external plant at the closest noise sensitive property at R1 are given below. The calculations include corrections for the number of plant items, attenuation due to distance and acoustic screening. The calculations assume that the measures to control noise from external plant as detailed above are in place.

Table 5. R1: Calculation of daytime noise from external plant

	Guntner GFW 090.1/3-E(J)-F4/04/6P dry coolers	Dimplex Heat Pumps	Mitsubishi FDC280KXRE6
Source noise level, dB(A)	37	45	59
Source noise measurement distance, m	10	10	1
Number of units	2	2	1
Correction for number of units, dB(A)	3	3	0
Distance, m	45	45	45
Distance correction, dB(A)	-13	-13	-33
Acoustic screening, dB(A)	-8	-7	-10
Noise level at house, dBL_{Aeq,1hr}	19	28	16
Total noise level at house, dBL_{Aeq,1hr}	29		

Table 6. R1: Calculation of night-time noise from external plant

	Guntner GFW 090.1/3-E(J)-F4/04/6P dry coolers	Dimplex Heat Pumps
Source noise level, dB(A)	37	41
Source noise measurement distance, m	10	10
Number of units	2	2
Correction for number of units, dB(A)	3	3
Distance, m	45	45
Distance correction, dB(A)	-13	-13
Acoustic screening, dB(A)	-7	-5
Noise level at receptor, dBL_{Aeq,15min}	20	26
Total noise level at receptor, dBL_{Aeq,15min}	27	

BS4142 Assessment of plant noise

- 4.16 The BS4142 assessment of plant noise at the nearest residential receivers is shown below.
- A 2dB tonal penalty and a 3dB impulsive/intermittency penalty have been added as a precaution.
 - The assessment has been carried out using the lowest average or modal background noise levels ($dB_{LA90,T}$).

Table 7. BS4142 assessment of plant noise.

Receiver	Day	Night
Specific noise level, dB_{LAeq}	29	27
Tonal Penalty, dB	2	2
Impulsive/Intermittency penalty, dB	3	3
Rating, dB	34	32
Background noise level, dB_{LA90}	45	32
Rating - background, dB	-11	0

- 4.17 The above assessment normally indicates a low impact depending on the context.

Plant noise considered in context

- 4.18 BS4142 recommends that the noise also be judged in context. The site is currently a police station and there are many other commercial operations nearby. The development of a foodstore is not out of context with the area and is unlikely to significantly change the character of the area for existing residents.
- 4.19 To assist with the consideration of noise from external plant in context the levels have been compared with the lowest ambient noise levels measured during the noise survey and the criteria given in BS8233. It is recognised that this standard is generally used for anonymous noise sources and it is used here only to provide additional information on the scale of the noise levels. The results of these comparisons are given below.

Table 8. Noise from external plant at closest dwellings assessed in context

	R1	
	Day	Night
Cumulative noise from development at receptor, $dB_{Aeq,T}$	29	27
Comparison with existing ambient		
Existing ambient noise level, $dB_{Aeq,T}$	43	33
Existing ambient + noise source, dB(A)	43	34
Increase, dB(A)	0	1
Difference, level at receptor-existing ambient, dB(A)	-14	-6
Comparison with BS8233 criteria for gardens		
BS8233 upper limit for private gardens	55	-
Difference between level at receptor & upper limit, dB(A)	-26	-
Comparison with BS8233 internal noise criterion		
Internal noise level, $dB_{Aeq,T}$	14-19	12-17
BS8233 internal noise criterion, $dB_{Aeq,T}$	≤ 35	≤ 30

†An increase in ambient noise level of up to 3dB(A) is not normally considered to be significant

††Attenuation due to partially open window is normally taken as 10-15dB(A)

- 4.20 The consideration of the noise in context supports the conclusion of the BS4142 assessment that the plant noise will have a low noise impact.

Delivery Noise***Delivery operations data***

- 4.21 Deliveries to the new store will be via the loading dock at the west end of the store building as shown on Figure 2.
- 4.22 The assessment of noise due to delivery vehicle movements and unloading has been based on noise measurements taken during deliveries to another Lidl store as summarised below.

Table 9. Noise source levels for delivery vehicle movements and unloading

Operation	Freefield noise level at 10m dB, SEL
1. HGV drive into site	79
2. HGV reverse, stop to open doors and reverse into loading bay	86
3. Unloading: each trip into / out of trailer	68
4. Drive forward and close rear doors	79
5. Drive away	79

- 4.23 The assessment has therefore been based on there being no more than 1 delivery within a 1-hour period. Delivery restrictions have not yet been determined and a decision on delivery times is to be informed by this noise assessment.

Control of noise from deliveries

- 4.24 It is recommended that a 2.0m high acoustic barrier should be installed along the west boundary of the store site as shown on Figure 3.
- 4.25 The acoustic barrier should have a minimum mass of 12 kg/m² and may comprise of one or a combination of the following:
- 20mm thick weather-treated, close-boarded timber fencing with cover strips to seal the gaps between panels and gravel boards to seal the gap at the base.
 - A masonry wall with no gaps or can also be used.

- An earthbund.

Alternative constructions can be used if checked with an acoustic consultant.

4.26 Proprietary acoustics fences are available from the following:

- Jacksons Fencing
<https://www.jacksons-fencing.co.uk/acoustic-fencing>
- Premier Acoustic Fencing
<http://www.premieracousticfencing.co.uk/>
- Modular Walls
<http://www.modularwall.co.uk/products/acoustimax/>
- Gramm Barriers
<http://www.grammbarriers.com/our-products/acoustic-barriers/>

4.27 It is the Client's responsibility to check with the manufacturer that products chosen are suitable for the proposed use in other respects. The sound insulation performance of the proposed construction will be dependent upon correct installation and workmanship.

4.28 The recommendations are given for acoustic reasons only and advice on other matters should be obtained from other specialists. The safety implications of the installation of the recommended products / material should be checked by the Client before use and appropriate systems of work put in place.

Calculation of noise from deliveries

- 4.29 The noise from the delivery vehicle movements and unloading has been calculated from SEL values using the following formula:

$$L_{Aeq}(T) = SEL + 10 \log N - 10 \log T$$

where $L_{Aeq}(T)$ = Equivalent continuous sound pressure level over time period T

SEL = 'Single Event Level', i.e. the 1 second L_{Aeq} which has the same total A-weighted energy as the entire event

N = Number of events in time period T

T = Time period in seconds

- 4.30 The calculated noise levels due to deliveries at the closest noise sensitive properties at R1 are given below. The calculations include corrections for the number of movements, attenuation due to distance and acoustic screening. The operation numbers refer to the operations detailed in Table 9. The daytime calculation has been based on one complete delivery within a 1-hour period including 24 cages. For the assessment of night-time deliveries, it has been assumed that the vehicle would arrive, reverse to the bay and partly unload within the 15-minute reference period. A higher SEL has been used for the reverse to cover the noise from typical reversing alarms.

Table 10. Daytime delivery noise at R1

Operation	1	2	3	4	5
SEL at 10m, dB(A)	79	86	68	79	79
No. of operations	1	1	24	1	1
Correction for no. of operations, dB(A)	0.0	0.0	13.8	0.0	0.0
Reference period, mins	60	60	60	60	60
Correction for reference period, dB(A)	-35.6	-35.6	-35.6	-35.6	-35.6
Distance, m	30	30	40	30	30
Distance correction, dB(A)	-9.5	-9.5	-12	-9.5	-9.5
Barrier correction, dB(A)	-9	-9	-10	-9	-9
Total: each item noise at house dBL_{Aeq}	24.9	31.9	24.2	24.9	24.9
Total noise at house dBL_{Aeq}	34.4				

1. Forward arrival; 2. Reverse, stop to open doors and reverse; 3. Unloading;

4. Move forward after delivery and stop to close doors; 5. Depart

Table 11. Night-time delivery noise at R1

Operation	1	2	3
SEL at 10m, dB(A)	79	86	68
No. of operations	1	1	10
Correction for no. of operations, dB(A)	0.0	0.0	10.0
Reference period, mins	15	15	15
Correction for reference period, dB(A)	-29.5	-29.5	-29.5
Distance, m	30	30	40
Distance correction, dB(A)	-9.5	-9.5	-12
Barrier correction, dB(A)	-6	-6	-7
Total: each item noise at house dBL_{Aeq}	34.0	41.0	29.5
Total noise at house dBL_{Aeq}	42.0		

1. Forward arrival; 2. Reverse, stop to open doors and reverse; 3. Unloading

BS4142 assessment of delivery noise

4.31 The BS4142 assessment of delivery noise at the nearest residential receptor is shown below.

- A 2dB tonal penalty and a 3dB impulsive/intermittency penalty have been added as a precaution.
- The assessment has been carried out using the lowest modal background noise levels (dBL_{A90,T}).

Table 12. BS4142 assessment delivery noise

Receiver	Day	Night
Specific noise level, dBL _{Aeq}	34	42
Tonal Penalty, dB	2	2
Impulsive/Intermittency penalty, dB	3	3
Rating, dB	39	47
Background noise level, dBL _{A90}	45	32
Rating - background, dB	-6	15

4.32 The BS4142 result for daytime deliveries normally indicates a very low impact depending on the context. The BS4142 result for night-time deliveries normally indicates a significant adverse impact depending on the context.

Assessment of delivery noise in context

- 4.33 BS4142 recommends that the noise also be judged in context. The site is currently a police station and there are many other commercial operations nearby. The development of a foodstore is not out of context with the area and is unlikely to significantly change the character of the area for existing residents. Deliveries to other commercial premises in the area and activities at the existing police station are likely to be unrestricted and are a feature of the area. The indication of adverse impact in the BS4142 assessment is due to the movement of the HGV which likely to be typical of the existing noise environment.
- 4.34 To assist with the consideration of delivery in context the levels have been compared with the lowest average ambient noise levels measured during the noise survey and the criteria given in BS8233. It is recognised that this standard is generally used for anonymous noise sources and it is used here only to provide additional information on the scale of the noise levels. The results of these comparisons are given below.

Table 13. Noise from deliveries at closest dwellings assessed in context

	R1	
	Day	Night
Cumulative noise from development at receptor, $dB_{L_{Aeq,T}}$	34	42
Comparison with existing ambient		
Existing ambient noise level, $dB_{L_{Aeq,T}}$	43	33
Existing ambient + noise source, dB(A)	44	43
Increase, dB(A)	1	10
Difference, level at receptor-existing ambient, dB(A)	-9	9
Comparison with BS8233 criteria for gardens		
BS8233 upper limit for private gardens	55	-
Difference between level at receptor & upper limit, dB(A)	-21	-
Comparison with BS8233 internal noise criterion		
Internal noise level, $dB_{L_{Aeq,T}}$	19-24	27-32
BS8233 internal noise criterion, $dB_{L_{Aeq,T}}$	≤ 35	≤ 30

†An increase in ambient noise level of up to 3dB(A) is not normally considered to be significant

††Attenuation due to partially open window is normally taken as 10-15dB(A)

- 4.35 The consideration of the noise in context supports the conclusion of the BS4142 assessment that the deliveries will have a very low noise impact during the daytime.
- 4.36 The consideration of noise due to deliveries during the night-time also supports the BS4142 assessment in that they are likely to have a significant adverse impact.

Summary of delivery noise assessment

- 4.37 The results of the assessment indicate that:
- Noise due to daytime deliveries will have a low impact and may be permitted between 07:00 hrs and 23:00 hrs, 7 days a week including bank holidays.
 - It may be necessary to restrict night-time deliveries (23:00 - 07:00 hrs).

Customer vehicle movements in the car park*Customer vehicle movement data*

- 4.38 Noise from the car park has been based on an SEL of 68 dB(A) at a distance of 10m for a car movement.
- 4.39 Data provided for another Lidl store indicates that the peak hour there may be 2.85 vehicle movements per parking bay (source data for Lidl, Wallasey). The calculated impact of noise from the use of the car park is based on the equal use of each parking space in the car park.
- 4.40 The plans show the store to have 120 external parking bays.

Calculation of noise from customer vehicle movements in the car park

- 4.41 Noise from customer vehicle movements in the car park has been calculated for R1.
- 4.42 The calculations are based on the assumption that the 2.0m high acoustic fence recommended in 4.24 to control delivery noise will be installed.
- 4.43 The calculated noise level due to customer vehicle movements in the car park is given below. The calculations include corrections for the number of movements and attenuation due to distance and screening.

Table 14. Calculation of daytime 1-hour noise levels at R1 due to peak customer vehicle movements in the car park.

	R1
Movement SEL at 10m, dB(A)	68
No. parking bays	120
No. movements per bay per hour	2.85
Total no. of movements per hour	342
Correction for no. of operations, dB(A)	25.3
Reference period, mins	60
Correction for reference period, dB(A)	-35.6
Distance, m	60
Distance correction, dB(A)	-15.6
Barrier correction	-6
Movement noise at dwelling dB L_{aeq,1hr}	36.1

4.44 The calculated car park noise is compared with the lowest 1-hour daytime ambient noise level below.

Table 15. Comparison of car park and current ambient noise levels.

	R1
Noise level from peak car park use, dB L _{aeq,1hr}	36
Current ambient noise level L _{Aeq}	43
Log sum of customer car & ambient noise	44
Increase in noise level dB(A)	1

4.45 The criterion adopted is that the increase in current noise levels caused by the car park noise should be less than 3 dB L_{Aeq}. The predicted increase is 1 dB L_{Aeq} at worst and therefore the criterion is expected to be met. The above calculation is conservative because it compares the car park noise level during the peak hour with the lowest current ambient noise levels in the 07:00-23:00 hours period.

5.0 CONCLUSIONS

5.1 Recommendations have been made for acoustic barriers to control noise from external plant and deliveries including:

- A 2.6m high acoustic barriers around the plant compound.
- A 2.0m high acoustic barrier along the west site boundary.

Specifications have been provided for the acoustic barriers.

The acoustic barriers are shown on Figure 3.

5.2 With the recommended acoustic barriers in place and the Dimplex heat pumps set to operate in night-mode during the night-time 23:00-07:00 hrs, noise from external plant will have a low noise impact.

5.3 With the recommended acoustic barriers in place noise from deliveries will have a low noise impact if they are restricted to the daytime periods (07:00-23:00 hrs, 7 days a week including Bank Holidays).

5.4 With the acoustic barrier recommended to control noise from daytime deliveries in place the potential noise from customer cars has been assessed and has been found to be low in comparison with current ambient noise levels.

6.0 REFERENCES

1. BS4142: British Standard 4142:2014, Methods for rating and assessing industrial and commercial sound.
2. BS8233: British Standard 8233, Guidance on sound insulation and noise reduction for buildings, BSI 2014.

FIGURE 1. LOCATION OF SITE, NOISE SURVEY & RECEPTOR

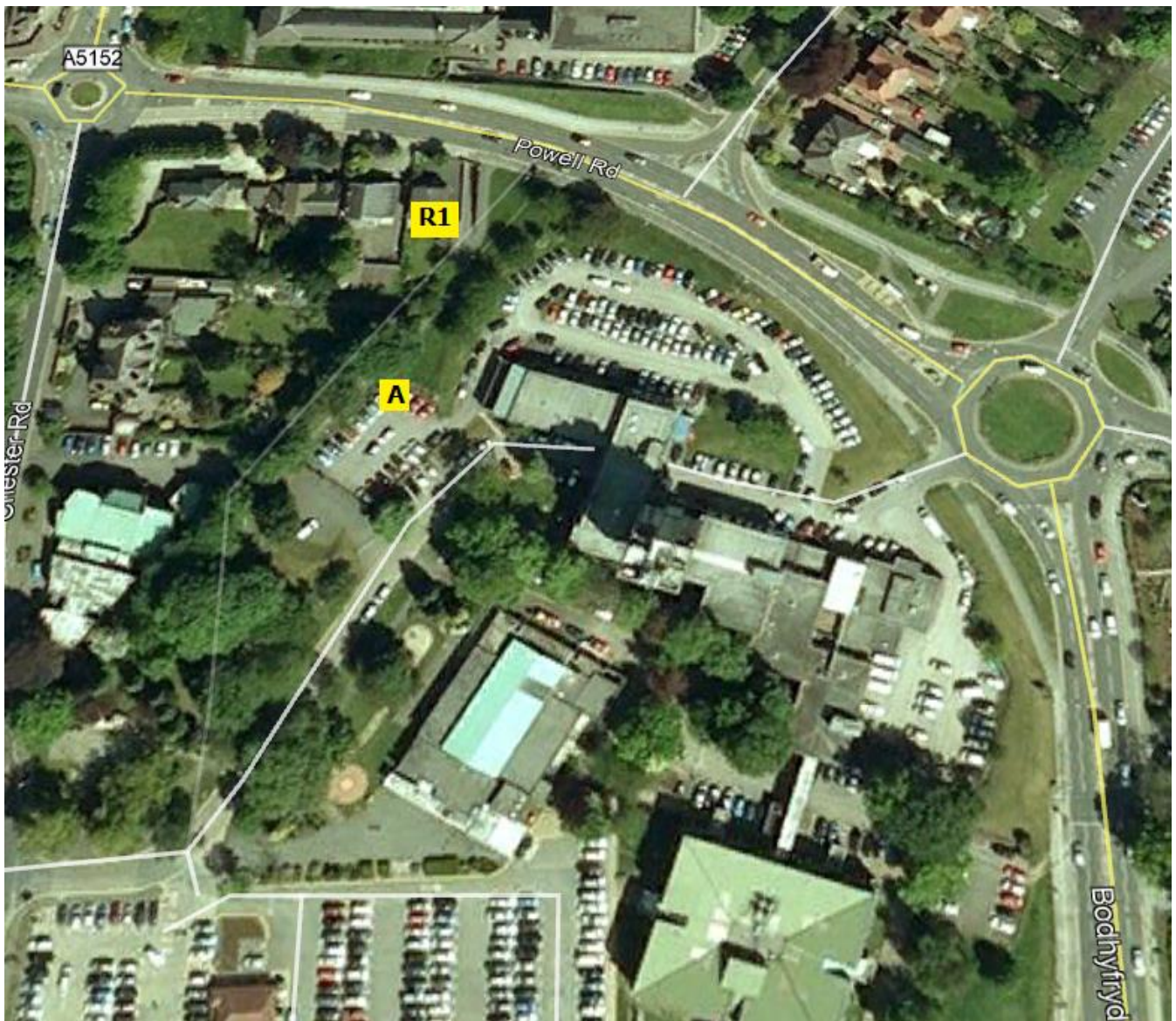
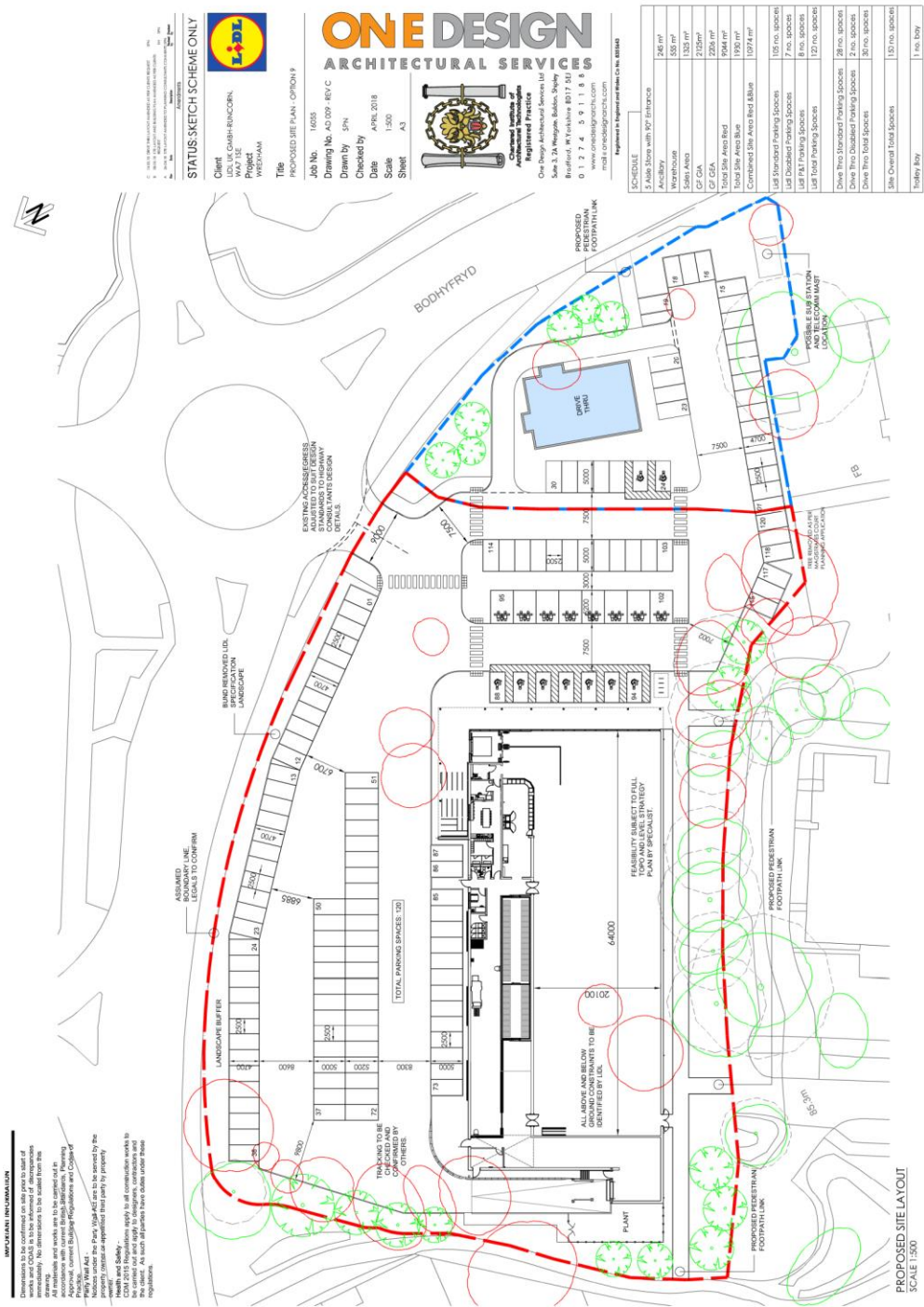


FIGURE 2. PROPOSED SITE PLAN



[illegible]

APPENDIX A1: ACOUSTIC TERMINOLOGY

Ambient noise	The sound pressure level at a given location (i.e. sound from all sources) usually measured using the L_{Aeq} parameter.
A-weighting	A weighting applied to the frequencies which make up a sound pressure level to mimic the response of the human ear which is less responsive to low frequency sounds as it is to high frequency sounds. The resultant level after application of the weighting is called the 'A-weighted sound pressure level' and is denoted by dB(A) or by using a subscript A (e.g. dB_{LAeq}).
Background noise	The noise measured in the absence of the noise under investigation usually using the statistical parameter L_{90} which represents the quietest parts of the measurement period.
Broadband sound	Sound which contains all the frequencies.
Decibel (dB)	A logarithmic measurement scale used for sound pressure levels. This scale is used because the simple use of sound pressures would be unwieldy as the range of pressures to which the human ear responds is very large. The normal threshold of hearing at 1kHz is 0dB. A level of $120dB_{LAeq}$ is very loud (L signifies level and the A and eq are explained under A-weighting and L_{eq}). Some night club dance floors can have sound levels of around $110 dB_{LAeq}$. In the workplace the wearing of hearing protection is compulsory for staff who experience a noise level of over $85dB_{LAeq}$ averaged over an 8-hour day and is normally used when the levels are over $80dB_{LAeq}$ averaged over the 8-hour day. Noise intrusion levels into bedrooms (e.g. from traffic noise) are often controlled to below $30dB_{LAeq}$ in the design of new properties (standards sometimes vary between authorities). Noise levels of below $20dB_{LAeq}$ are very quiet and would normally only be achieved in a well designed recording studio. Although noise calculations are normally carried out using figures to 1 decimal place the results are often presented to the nearest dB as changes of a fraction of a dB are not normally perceptible even in controlled conditions.
Facade noise level	Noise level including a contribution from the reflection from a building facade, usually measured at 1m from the facade.
Free field	Noise levels with no contribution from reflections from nearby structures.
Hertz	The units used for frequency denoted by Hz, i.e. the number of cycles of pressure fluctuation per second. K used in front of Hz represents 1000 (1kHz = 1000Hz). High frequency sounds (e.g. 8kHz) are high pitched and low frequency sounds (e.g. 63Hz) are the bass notes.

L _{eq}	A parameter used to denote the 'equivalent continuous sound pressure level'. This is the sound pressure level of a continuous sound that would contain the same energy as the varying sound being measured or investigated. L _{Aeq} is the parameter used to denote the 'A-weighted equivalent continuous sound pressure level' (see A-weighting).
L ₁₀	A statistical parameter often used for the measurement of road traffic noise. It is the level exceeded for 10% of the time period being considered. If A-weighted a subscript A is included and the time period can also be included in subscript, e.g. L _{A10, 1hour} .
L ₉₀	A statistical parameter often used for the measurement of background noise levels. It is the level exceeded for 90% of the time period being considered. If A-weighted a subscript A is included and the time period can also be included in subscript, e.g. L _{A90, 5min} .
L _{max}	The maximum noise level which occurred during the monitoring period. L _{Amax,f} denotes the maximum A-weighted sound pressure level using the fast time constant of 125ms.
Loudness	Although a 3dB increase is equivalent to a doubling of the sound power level of a sound source this increase is the minimum perceptible under normal conditions. It takes a 10dB change in noise level for it to sound roughly twice (or half) as loud subjectively.
Rating Level	A term used in BS4142. The 'Specific Noise Level' plus a 5dB weighting if the noise has certain characteristic features which may make it more disturbing.
Residual noise	The ambient noise remaining when the specific noise source being investigating is not contributing to the noise level at that location (normally measured using the L _{Aeq} parameter).
Specific Noise Level	A term used in BS4142. The L _{Aeq} noise level produced at the assessment position by the noise source being investigated over the reference time period (1-hour in the day and 5-mins at night).
SEL	Single Event Level. The total sound energy of a noise event (e.g. a train pass-by) compressed into 1 second. i.e. . the 1 second L _{Aeq} which has the same total A-weighted energy as the entire event.

APPENDIX A2: EXISTING NOISE LEVELS – SURVEY RESULTS

Daytime Noise Measurements

Table A2.1: Daytime Noise Survey Data
Friday 01 Jun 2018

Date	Start (h:m:s)	Period (h:m:s)	Free field noise levels (dB)		
			L _{Aeq}	L _{Amax(f)}	L _{A90}
01/06/2018	11:00:00	01:00:00	48.9	64.3	45.8
01/06/2018	12:00:00	01:00:00	49.2	69.7	46.0
01/06/2018	13:00:00	01:00:00	47.8	67.0	45.2
01/06/2018	14:00:00	01:00:00	48.1	67.0	45.1
01/06/2018	15:00:00	01:00:00	49.4	66.7	45.9
01/06/2018	16:00:00	01:00:00	51.1	68.3	46.6
01/06/2018	17:00:00	01:00:00	51.0	70.8	47.3
01/06/2018	18:00:00	01:00:00	52.3	69.8	48.7
01/06/2018	19:00:00	01:00:00	50.2	68.0	45.9
01/06/2018	20:00:00	01:00:00	48.5	71.1	44.3
01/06/2018	21:00:00	01:00:00	46.7	71.4	42.0
01/06/2018	22:00:00	01:00:00	44.7	67.5	39.7
AVERAGE			49.4	-	45.2
HIGHEST			52.3	71.4	48.7
LOWEST			44.7	64.3	39.7
MODE			-	-	46

Table A2.2: Daytime Noise Survey Data
Saturday 02 Jun 2018

Date	Start (h:m:s)	Period (h:m:s)	Free field noise levels (dB)		
			L _{Aeq}	L _{Amax(f)}	L _{A90}
02/06/2018	07:00:00	01:00:00	48.1	69.9	42.5
02/06/2018	08:00:00	01:00:00	48.5	72.4	43.8
02/06/2018	09:00:00	01:00:00	49.0	64.2	45.8
02/06/2018	10:00:00	01:00:00	51.5	77.0	46.7
02/06/2018	11:00:00	01:00:00	49.5	70.7	46.9
02/06/2018	12:00:00	01:00:00	50.3	65.1	47.2
02/06/2018	13:00:00	01:00:00	50.5	71.1	46.4
02/06/2018	14:00:00	01:00:00	50.2	68.0	47.1
02/06/2018	15:00:00	01:00:00	49.7	70.4	46.6
02/06/2018	16:00:00	01:00:00	53.2	83.7	46.4
02/06/2018	17:00:00	01:00:00	49.3	67.0	46.0
02/06/2018	18:00:00	01:00:00	50.2	68.8	46.1
02/06/2018	19:00:00	01:00:00	49.3	69.6	45.2
02/06/2018	20:00:00	01:00:00	51.5	64.6	47.6
02/06/2018	21:00:00	01:00:00	52.1	81.0	46.5
02/06/2018	22:00:00	01:00:00	49.8	76.4	42.6
AVERAGE			50.4	-	45.8
HIGHEST			53.2	83.7	47.6
LOWEST			48.1	64.2	42.5
MODE			-	-	47

Table A2.3: Daytime Noise Survey Data
Sunday 03 Jun 2018

Date	Start (h:m:s)	Period (h:m:s)	Free field noise levels (dB)		
			L _{Aeq}	L _{Amax(f)}	L _{A90}
03/06/2018	07:00:00	01:00:00	46.3	65.7	37.0
03/06/2018	08:00:00	01:00:00	46.2	68.3	39.4
03/06/2018	09:00:00	01:00:00	50.5	75.0	44.9
03/06/2018	10:00:00	01:00:00	50.2	71.1	46.9
03/06/2018	11:00:00	01:00:00	51.6	74.9	47.3
03/06/2018	12:00:00	01:00:00	52.3	71.0	48.1
03/06/2018	13:00:00	01:00:00	51.8	74.2	48.0
03/06/2018	14:00:00	01:00:00	52.3	76.4	47.9
03/06/2018	15:00:00	01:00:00	54.6	75.9	48.6
03/06/2018	16:00:00	01:00:00	51.4	73.4	46.6
03/06/2018	17:00:00	01:00:00	49.1	71.4	45.6
03/06/2018	18:00:00	01:00:00	48.8	70.5	45.1
03/06/2018	19:00:00	01:00:00	48.5	66.8	44.5
03/06/2018	20:00:00	01:00:00	48.4	68.7	43.2
03/06/2018	21:00:00	01:00:00	46.1	64.1	42.6
03/06/2018	22:00:00	01:00:00	42.8	63.8	38.8
AVERAGE			50.3	-	44.7
HIGHEST			54.6	76.4	48.6
LOWEST			42.8	63.8	37.0
MODE			-	-	45

Table A2.4: Daytime Noise Survey Data
Monday 04 Jun 2018

Date	Start (h:m:s)	Period (h:m:s)	Free field noise levels (dB)		
			L _{Aeq}	L _{Amax(f)}	L _{A90}
04/06/2018	07:00:00	01:00:00	48.7	68.3	43.5
04/06/2018	08:00:00	01:00:00	50.0	71.6	45.9
04/06/2018	09:00:00	01:00:00	54.5	78.8	46.7
AVERAGE			51.8	-	45.4
HIGHEST			54.5	78.8	46.7
LOWEST			48.7	68.3	43.5
MODE			-	-	-

Night-time noise measurements

Table A2.5: Night time Noise Survey Data

Friday 01 Jun 2018 to Saturday 02 Jun 2018

Date	Start (h:m:s)	Period (h:m:s)	Free field noise levels (dB)		
			L _{Aeq}	L _{Amax(f)}	L _{A90}
01/06/2018	23:00:00	0:15:00	43.7	58.7	39.2
01/06/2018	23:15:00	0:15:00	43.3	55.3	37.6
01/06/2018	23:30:00	0:15:00	48.3	57.5	44.9
01/06/2018	23:45:00	0:15:00	45.4	52.7	41.8
02/06/2018	00:00:00	0:15:00	41.5	49.6	36.4
02/06/2018	00:15:00	0:15:00	41.2	57.4	34.2
02/06/2018	00:30:00	0:15:00	38.8	54.2	32.8
02/06/2018	00:45:00	0:15:00	39.7	60.7	32.5
02/06/2018	01:00:00	0:15:00	39.5	50.2	31.9
02/06/2018	01:15:00	0:15:00	39.9	53.2	32.1
02/06/2018	01:30:00	0:15:00	39.1	57.9	28.4
02/06/2018	01:45:00	0:15:00	38.6	52.1	28.9
02/06/2018	02:00:00	0:15:00	37.0	52.5	28.7
02/06/2018	02:15:00	0:15:00	36.1	48.4	27.6
02/06/2018	02:30:00	0:15:00	33.3	45.9	27.1
02/06/2018	02:45:00	0:15:00	37.2	54.2	28.6
02/06/2018	03:00:00	0:15:00	38.7	51.2	30.0
02/06/2018	03:15:00	0:15:00	38.3	60.9	28.4
02/06/2018	03:30:00	0:15:00	41.8	67.6	30.9
02/06/2018	03:45:00	0:15:00	43.6	60.2	34.9
02/06/2018	04:00:00	0:15:00	50.7	66.9	36.7
02/06/2018	04:15:00	0:15:00	48.7	67.4	37.6
02/06/2018	04:30:00	0:15:00	46.2	63.1	37.3
02/06/2018	04:45:00	0:15:00	47.6	61.0	36.4
02/06/2018	05:00:00	0:15:00	45.2	60.8	36.8
02/06/2018	05:15:00	0:15:00	46.8	65.9	36.5
02/06/2018	05:30:00	0:15:00	43.0	54.6	37.2
02/06/2018	05:45:00	0:15:00	46.4	62.5	39.5
02/06/2018	06:00:00	0:15:00	48.6	62.1	40.8
02/06/2018	06:15:00	0:15:00	49.9	56.3	47.1
02/06/2018	06:30:00	0:15:00	48.8	65.7	44.6
02/06/2018	06:45:00	0:15:00	46.8	64.9	42.3
AVERAGE			45.0	-	35.3
HIGHEST			50.7	67.6	47.1
LOWEST			33.3	45.9	27.1
MODE			-	-	37

Table A2.6: Night time Noise Survey Data**Saturday 02 Jun 2018 to Sunday 03 Jun 2018**

Date	Start (h:m:s)	Period (h:m:s)	Free field noise levels (dB)		
			L _{Aeq}	L _{Amax(f)}	L _{A90}
02/06/2018	23:00:00	0:15:00	47.4	68.2	40.0
02/06/2018	23:15:00	0:15:00	43.7	63.3	39.7
02/06/2018	23:30:00	0:15:00	44.2	53.7	39.9
02/06/2018	23:45:00	0:15:00	44.3	70.8	38.3
03/06/2018	00:00:00	0:15:00	43.0	53.0	38.4
03/06/2018	00:15:00	0:15:00	42.9	63.7	37.8
03/06/2018	00:30:00	0:15:00	42.7	59.7	37.8
03/06/2018	00:45:00	0:15:00	41.3	50.8	37.2
03/06/2018	01:00:00	0:15:00	40.9	51.8	36.3
03/06/2018	01:15:00	0:15:00	40.7	61.5	35.6
03/06/2018	01:30:00	0:15:00	40.5	55.2	34.9
03/06/2018	01:45:00	0:15:00	40.2	62.2	34.1
03/06/2018	02:00:00	0:15:00	38.7	54.2	33.7
03/06/2018	02:15:00	0:15:00	39.0	50.9	33.7
03/06/2018	02:30:00	0:15:00	39.1	51.8	32.6
03/06/2018	02:45:00	0:15:00	39.4	62.1	31.3
03/06/2018	03:00:00	0:15:00	38.4	59.5	33.0
03/06/2018	03:15:00	0:15:00	39.6	59.7	32.7
03/06/2018	03:30:00	0:15:00	40.1	52.0	35.4
03/06/2018	03:45:00	0:15:00	47.5	65.8	37.1
03/06/2018	04:00:00	0:15:00	48.2	63.9	40.0
03/06/2018	04:15:00	0:15:00	48.6	65.5	37.9
03/06/2018	04:30:00	0:15:00	41.9	57.2	37.2
03/06/2018	04:45:00	0:15:00	44.8	64.3	39.3
03/06/2018	05:00:00	0:15:00	44.1	60.0	37.5
03/06/2018	05:15:00	0:15:00	42.1	61.4	36.4
03/06/2018	05:30:00	0:15:00	44.1	63.6	38.6
03/06/2018	05:45:00	0:15:00	43.6	56.5	37.5
03/06/2018	06:00:00	0:15:00	45.1	63.4	38.5
03/06/2018	06:15:00	0:15:00	44.9	66.5	36.9
03/06/2018	06:30:00	0:15:00	44.7	67.5	37.3
03/06/2018	06:45:00	0:15:00	44.1	61.0	37.7
AVERAGE			43.7	-	36.7
HIGHEST			48.6	70.8	40.0
LOWEST			38.4	50.8	31.3
MODE			-	-	38

Table A2.7: Night time Noise Survey Data**Sunday 03 Jun 2018 to Monday 04 Jun 2018**

Date	Start (h:m:s)	Period (h:m:s)	Free field noise levels (dB)		
			L _{Aeq}	L _{Amax(f)}	L _{A90}
03/06/2018	23:00:00	0:15:00	42.1	59.9	35.7
03/06/2018	23:15:00	0:15:00	41.0	61.6	36.8
03/06/2018	23:30:00	0:15:00	40.0	52.9	34.9
03/06/2018	23:45:00	0:15:00	40.6	59.6	35.5
04/06/2018	00:00:00	0:15:00	40.3	52.0	35.2
04/06/2018	00:15:00	0:15:00	40.5	50.9	35.4
04/06/2018	00:30:00	0:15:00	41.5	57.1	33.7
04/06/2018	00:45:00	0:15:00	37.6	48.3	32.1
04/06/2018	01:00:00	0:15:00	45.4	61.5	33.5
04/06/2018	01:15:00	0:15:00	41.3	58.6	32.1
04/06/2018	01:30:00	0:15:00	38.2	50.3	33.4
04/06/2018	01:45:00	0:15:00	35.7	46.6	31.4
04/06/2018	02:00:00	0:15:00	37.2	53.2	31.6
04/06/2018	02:15:00	0:15:00	34.6	43.1	32.1
04/06/2018	02:30:00	0:15:00	35.2	47.4	31.8
04/06/2018	02:45:00	0:15:00	38.9	53.5	31.8
04/06/2018	03:00:00	0:15:00	37.2	48.7	31.8
04/06/2018	03:15:00	0:15:00	37.4	48.3	32.8
04/06/2018	03:30:00	0:15:00	47.3	67.2	35.8
04/06/2018	03:45:00	0:15:00	49.6	66.0	37.8
04/06/2018	04:00:00	0:15:00	49.6	65.9	39.5
04/06/2018	04:15:00	0:15:00	46.2	63.9	37.2
04/06/2018	04:30:00	0:15:00	49.7	71.1	37.7
04/06/2018	04:45:00	0:15:00	50.2	66.7	37.6
04/06/2018	05:00:00	0:15:00	47.0	65.2	38.6
04/06/2018	05:15:00	0:15:00	44.6	55.8	40.3
04/06/2018	05:30:00	0:15:00	44.3	58.1	40.1
04/06/2018	05:45:00	0:15:00	50.9	69.6	43.0
04/06/2018	06:00:00	0:15:00	48.3	65.1	42.7
04/06/2018	06:15:00	0:15:00	45.3	65.7	41.1
04/06/2018	06:30:00	0:15:00	49.1	65.4	42.2
04/06/2018	06:45:00	0:15:00	47.0	64.0	40.6
AVERAGE			45.4	-	36.1
HIGHEST			50.9	71.1	43.0
LOWEST			34.6	43.1	31.4
MODE			-	-	32