



Miller Goodall
Environmental Services

NOISE ASSESSMENT

on behalf of

JANET DIXON TOWN PLANNERS LIMITED

for the site at

27 INGLEWHITE ROAD, LONGRIDGE, PRESTON, PR3 3JS

REPORT DATE: 27TH MARCH 2013

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Summary

Miller Goodall Environmental Services Ltd (MGES) was appointed by Janet Dixon Town Planners Limited, 10A Whalley Road, Clitheroe, Lancashire, BB7 1AW to undertake a noise assessment to support a planning application for a proposed change of use for industrial units on a site at 27 Inglewhite Road, Longridge. Permission currently exists for B8 use (storage or distribution) and the owner is proposing an extension of use to B2 (general industrial).

Existing background and ambient noise measurements were recorded on the site close to the boundary with nearby residential dwellings during periods of the day when the units would be in use and when background noise levels are likely to be at their lowest. This data and noise predictions derived using Cadna-A noise modeling software were subsequently used to set noise limits to control the potential impact on nearby noise sensitive receivers in accordance with relevant guidance in BS 4142:1997 and BS 8233: 1999.

Advice has also been provided on mitigation measures that may be applied to reduce any potential disturbance and allow an appropriate standard of amenity for local residents.

Prepared By Simon Faircloth MIOA

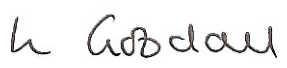
Reviewed By

Lesley Goodall MIOA

Signed



Signed



Date

25th March 2013

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25th March 2013

Contents

Summary	1
Contents	2
1 Introduction	4
2 Site Description	4
3 Methodology and Guidance	6
3.1 BS 4142: 1997 'Rating industrial noise affecting mixed residential and industrial areas'	6
3.2 BS 8233:1999	6
3.3 World Health Organisation (WHO) Guidelines for Community Noise 1999	7
3.4 Local Authority Requirements	7
4 Noise Survey	7
4.1.1 Introduction	7
4.1.2 Equipment	7
4.1.3 Date of monitoring and weather conditions	8
4.1.4 Personnel	8
4.1.5 Noise sources	8
5 Monitoring Results	8
5.1 Background and ambient noise levels	8
6 Noise Impact Assessment	9
6.1 Noise Modelling	9
6.1.1 Model parameters	9
6.1.2 Noise from industrial processes	9
6.1.3 Noise from fixed items of plant	10
6.1.4 Vehicle noise	10
6.2 Proposed BS 4142 Criteria	10
6.3 Results from the Noise Model	10
6.3.1 Results from Scenario 1a – doors closed	11
6.3.2 Results from Scenario 2a – doors open	11
6.3.3 Results from Scenario 1b – doors closed with enhanced wall construction	11
6.3.4 Results from Scenario 2b – doors open with enhanced wall construction	11
6.4 Assessment to BS 8233/WHO	11
7 Recommended Mitigation Measures	12
8 Conclusions	12
Glossary of Terms	13
Appendix 1a – Survey Measurement Data	14
Appendix 1b: Internal Noise Level Spectrum Used in Assessment	15
Appendix 2a: Noise model with roller shutter doors closed	16

Appendix 2b: Noise model with roller shutter doors open	17
Appendix 2c: Noise model with roller shutter doors closed and enhanced wall construction	18
Appendix 2d: Noise model with roller shutter doors open and enhanced wall construction	19

1 Introduction

Miller Goodall Environmental Services Ltd (MGES) has, on behalf of Janet Dixon Town Planners Limited of 10A Whalley Road, Clitheroe, Lancashire, BB7 1AW, undertaken a noise assessment to support an application for a proposed change of use of existing units on the site from Class B8, for which permission currently exists, to Class B2. The site is an existing small industrial estate currently used for a variety of commercial uses and was formerly the location of a joinery business (formerly Herbert T Forrest Ltd and more recently ARC Joinery and Building Services Ltd).

Measurements of existing background and ambient noise levels have been taken close to the boundary of the site with nearby residential properties. An assessment of the potential impact of noise from light industrial activities within the units has been undertaken using noise modeling software. Noise limits have also been proposed for any new items of externally located building services plant that may be required by the future tenants of the units. Mitigation measures have been proposed to reduce noise breakout from the units to acceptable levels.

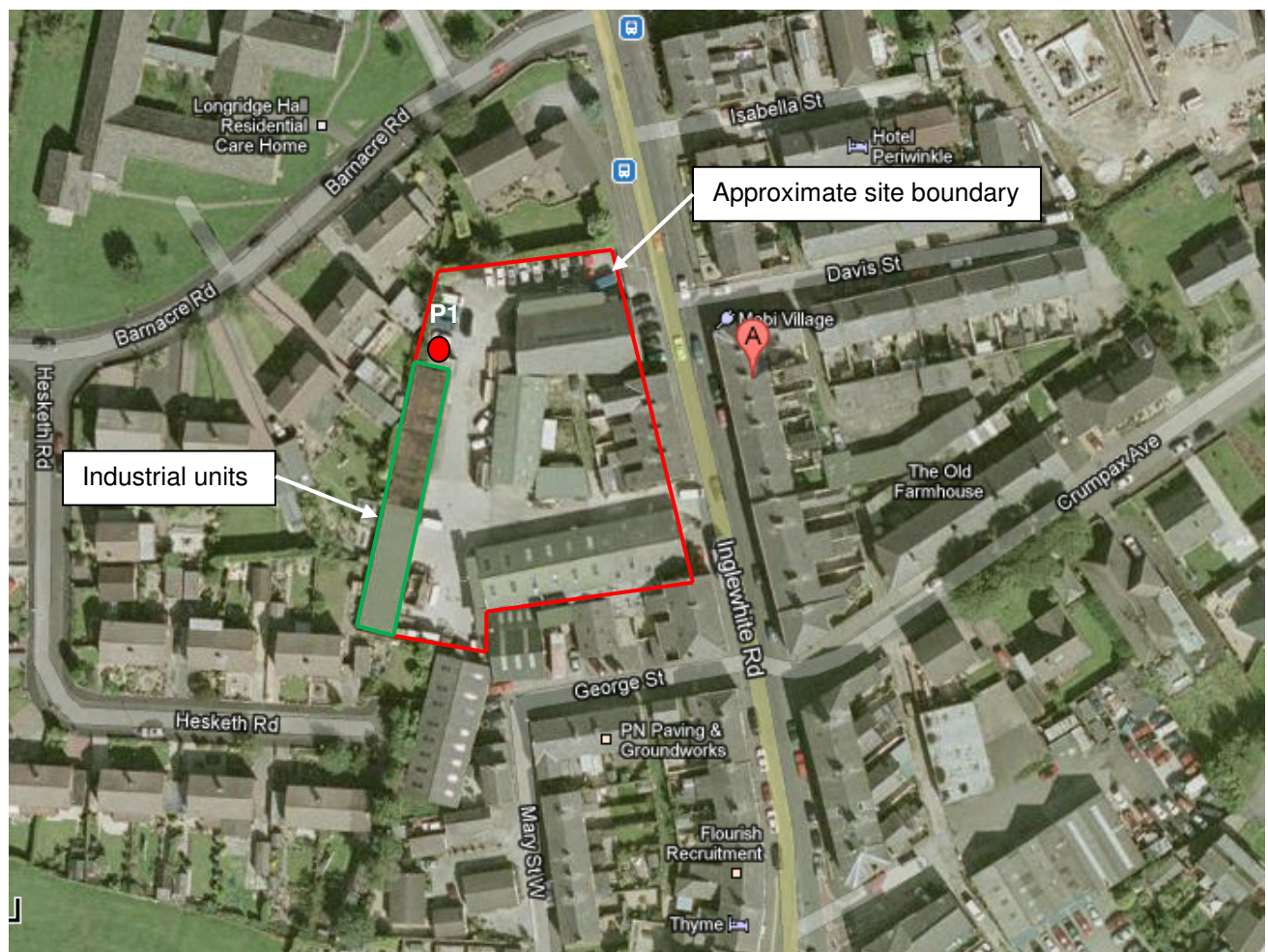
2 Site Description

The industrial units are located on an existing industrial site at 27 Inglewhite Road, Longridge. This was formerly the location of Herbert T Forrest Ltd joinery works, a joinery business which operated at the site until August 2012. The buildings formerly used by Forrest are now used for a variety of commercial uses by new tenants although there is a large building at the north of the site currently used for retail. Vehicles accessing the site include light goods vehicles (vans) and occasional HGVs. A car park at the northern boundary of the site serves staff and visitors to the retail premises.

The building for which the proposed change of use is sought is a row of 8 contemporary units constructed from insulated composite panels with roller shutter door access provided to 7 units; the unit on the southern end of the row currently has no roller shutter doors access. The units are not generally segregated internally although partitions would be erected if permission were granted to allow separate tenancies to each unit. It is understood the end uses of the units have yet to be ascertained but will fall within the B2 use class of General Industrial. Due to the relatively small size of the units, likely tenants would include small manufacturing works or specialist vehicle repair workshops.

The site lies within a mixed residential/industrial area and the nearest residential dwellings are located approximately 11 metres to the north west of the units. A 2.5 m high fence is located at the northern boundary of the site. Access to the units is via Inglewhite Road. Proposed hours of use are Monday to Saturday, 08:00 to 18:00.

An aerial view of the site is provided in Figure 1 showing the units for which the proposed change of use is sought and the measurement location P1 used to monitor the current ambient and background noise levels. A photograph of the units is provided in Figure 2.

Figure 1: Aerial view of site showing the units outlined in green and the microphone position P1**Figure 2: Photograph of units**

3 Methodology and Guidance

3.1 BS 4142: 1997 'Rating industrial noise affecting mixed residential and industrial areas'

BS 4142: 1997 provides guidance on the assessment of the likelihood of complaints relating to noise from industrial sources introduced into existing mixed residential and industrial areas.

The standard presents a method of rating noise levels by comparing the noise level of the new source (the Rating Level) with that of the existing background noise level at the nearest noise sensitive receiver in the absence of the source (the Background Noise Level).

The Specific Noise Level - the noise level produced by the source in question at the assessment location - is determined and a +5 dB correction applied for any unusual acoustic features such as discreet tones, whines, hisses or impulsive character. The corrected Specific Noise Level is referred to as the Rating Level.

The Background Noise Level is arithmetically subtracted from the Rating Level to provide the BS 4142 Rating. A Rating of +10 dB or more indicates that complaints about noise are likely. A Rating of +5 dB is said to be of marginal significance. If the Rating Level is more than 10 dB below the measured Background Noise Level, this is a positive indication that complaints are unlikely.

3.2 BS 8233:1999

BS 8233:1999 – 'Sound Insulation and Noise Reduction for Buildings – Code of Practice' gives recommended design criteria for internal noise levels for different types of rooms within residential dwellings. This design criterion is based on guidance contained within the World Health Organization (WHO) document, Guidelines for Community Noise (1999). The criteria for bedrooms and living rooms, which have been set to avoid sleep disturbance and ensure suitable living/resting conditions are shown in Table 1.

Table 1: BS 8233 recommended sound levels in habitable rooms

Room	Criteria	Reasonable ($L_{Aeq,T}$)	Good ($L_{Aeq,T}$)
Bedrooms	Sleeping	35	30
Living Rooms	Resting	40	30

In addition to the above, this document recommends that maximum noise levels (L_{Amax}) of individual noise events should not normally exceed 45 dB in bedrooms at night. BS 8233:1999 does not provide guidance on how this may be interpreted, however a criteria of between 10-15 times per night-time period has commonly been adopted.

3.3 World Health Organisation (WHO) Guidelines for Community Noise 1999

Guidance is provided in the WHO guidelines relating to noise during the night time. The levels specified are the lower limits of those noted in BS 8233, i.e. $L_{Aeq,T} = 30$ dB and $L_{AFmax} = 45$ dB.

WHO also recommends that external amenity areas should not be subjected to daytime averaged noise levels greater than $L_{Aeq} 55$ dB, and preferably below $L_{Aeq} 50$ dB.

3.4 Local Authority Requirements

Discussions were held with James Russell, an Environmental Health Officer at Ribble Valley Borough Council, regarding the scope of the assessment and possible criteria. Mr Russell agreed that the proposed noise survey methodology was reasonable and suggested that an assessment of noise impact should utilise both BS 4142 and BS 8233/WHO guidance. No specific BS 4142 criteria were proposed by Mr Russell.

4 Noise Survey

4.1.1 Introduction

Background noise level measurements were undertaken at the location of the north western site boundary, 4 m from both the boundary fence and the end unit and approximately 11 m from the location of the nearest residential facade. Measurements were made at the times of the day specified in Table 3 following consultation with James Russell at Ribble Borough Council.

The measurement location is shown in Figure 1.

4.1.2 Equipment

Noise measurements were undertaken in general accordance with BS ISO 1996-2: 2007. The test equipment used was calibrated before and after measurements, with negligible deviation (<0.1 dB). Details of the equipment used are shown in Table 2 below.

Table 2: Noise monitoring equipment

Equipment Description	Type Number	Manufacturer	Serial No:	Date calibrated	Calibration Certification Number
Class 1 Integrating Real Time 1/3 Octave Sound Analyzer	Type 2260	Brüel & Kjær	2467009	15.09.11	C1107367
Calibrator	Type 4231	Brüel & Kjær	2478249	24.08.12	01010/1
Microphone	Type 4189	Brüel & Kjær	2508884	15.09.11	C1107367

4.1.3 Date of monitoring and weather conditions

Specific noise monitoring of the existing site was undertaken at the dates and times specified in Table 4.3 below.

Table 3: Dates, times and weather conditions during noise measurements

Date	Time Started	Time Finished	Weather conditions
Thursday 14/03/2013	08:14	11:15	Dry, clear and still, -1 °C to +2 °C

4.1.4 Personnel

Measurements were undertaken by Simon Faircloth of Miller Goodall Environmental Services Ltd.

4.1.5 Noise sources

The noise sources noted at the proposed development site during the survey were as follows:

- Local road traffic on Inglewhite Road
- Occasional noise associated with a storage unit on the site (scaffolding firm)
- Vehicle movements associated with staff and customer cars accessing the retail premises car park
- Light goods vehicles and noise from one HGV movement within the service yard.

5 Monitoring Results

5.1 Background and ambient noise levels

A summary of background and ambient noise measurements taken at measurement location P1 is provided in Table 4 below with full measurements in Appendix 1a. All measurements were taken at a height of 1.5 m in free field conditions, away from acoustically reflecting surfaces (other than the ground). Spectral data was recorded for each measurement position and is kept on file.

Table 4: Summary of noise measurements

Location	Date	Time Started	Elapsed Time (hr:min:sec)	$L_{Aeq,T}$ (dB)	L_{AFmax} (dB)	L_{AF90} (dB)
P1	14/03/2013	08:11:41	1:00:00	58.7	83.7	46.9
P1	14/03/2013	09:13:11	1:00:00	56.6	84.0	44.1
P1	14/03/2013	10:16:11	1:00:00	53.7	84.2	44.6

All data are sound pressure levels in dB re 20 μ Pa

The lowest background noise level measured during the noise assessment was 44 dB $L_{AF90,1\text{hour}}$.

6 Noise Impact Assessment

6.1 Noise Modelling

6.1.1 Model parameters

In order to predict the potential impact of noise from activities associated with the proposed change of use on neighbouring residential properties, a noise model of the site was assembled using the Cadna-A noise modelling software. The following parameters for the noise model were also selected:

- Propagation of noise using algorithms within ISO 9613: 1993 *Acoustics - Attenuation of sound during propagation outdoors*.
- Default ground absorption of 0.5, equivalent to firm grassed areas and consistent with the residential gardens surrounding the site. The site itself was assigned a ground absorption of 0, equivalent to a hard, acoustically reflecting surface.
- Ground attenuation: spectral all sources
- No adverse meteorological effects
- Three orders of reflection
- Height data for buildings estimated from observations onsite
- 2.5 m high timber boundary fence at northern and southern site boundaries maintained
- Assessment receptors located at heights consistent with ground floor windows.

In order to assess noise breakout from the units, sound reduction indices were assigned the various elements of the building envelope. The walls and roof were formed from lightweight insulated steel panels and data for a similar construction from Kingspan suggested a weighted sound reduction index of around 23 dB R_w ; this correlated well to a predicted index obtained from the Insul sound insulation prediction software package. No test data was available for the roller shutter doors and so this was estimated using a mass law calculation for 9 swg steel with an allowance of 5% for gaps between adjacent panels. This gave an overall sound insulation rating of 14 dB R_w for a single bank, un-insulated roller shutter door which is considered reasonable.

6.1.2 Noise from industrial processes

As previously indicated, the final uses of the industrial units is not yet known and so the potential noise impact from any processes that might be undertaken within the units cannot be accurately assessed at this stage. However, it would be expected that noise from typical industrial processes could include the operation of fixed and hand-held items of machinery such as lathes, drills, compressors, pumps and fans.

Noise measurements were made in a similar sized industrial unit used for vehicle services and repairs. The specific internal noise levels measured when typical activities were taking place, such as use of a compressor

and air line, motorised vehicle ramps, hammering etc, was 78 dB $L_{Aeq,T}$. This level was used in the noise model to predict noise breakout as it is considered typical of the likely activities within the units. The L_{Aeq} spectrum measured and subsequently used in the assessment is provided in Appendix 1b. It is considered unlikely that the internal noise levels would normally exceed around 80 dB(A) over the course of a typical working day as this would equate to the Lower Action Level from the Control of Noise at Work Regulations, above which the employer would be expected to implement a program of noise control measures to reduce noise exposure to his or her employees.

6.1.3 Noise from fixed items of plant

The items of fixed, externally located plant that may be associated with the industrial units after the proposed change of use are unknown at this stage. It is possible, however, that sources could include localised air extraction units and the like. It is therefore considered that to control future noise emission from the development, the setting of noise emission limits relative to the pre-development background noise levels is appropriate.

For the purposes of noise modelling, a single point source was allocated to each unit, located 1 m above the height of the roof towards the rear (west facing) aspect of the building.

6.1.4 Vehicle noise

Currently the industrial units with the proposed change of use are used for storage and as such are frequented by delivery vehicles, as are the other industrial units on the site. These include light goods vehicles and on occasion larger HGVs. Therefore it is not expected that vehicle noise will increase significantly as a result of the change of usage.

6.2 Proposed BS 4142 Criteria

It is proposed that during the day, noise from externally located air extraction units is controlled to a Rating Level of 44 dB at the facades of the nearest residential properties, when assessed to BS 4142. This equates to a measured noise level at the facade of 39 dB $L_{Aeq,T}$ with a 5 dB correction applied to account for likely impulsive or intermittent nature of the noise. This proposed Rating Level is equivalent to the lowest measured background noise level and according to BS 4142 this would result in a subjective impact that was less than 'marginal significance'.

6.3 Results from the Noise Model

Two scenarios were modeled:

1. All 8 units operational with internal noise levels at 78 dB $L_{Aeq,1hr}$ and all 7 roller shutter doors closed;
2. All 8 units operational with internal noise levels at 78 dB $L_{Aeq,1hr}$ and all 7 roller shutter doors open to a height of 2 m.

In each model a single point source was allocated to the roof of each unit to account for a possible extract fan or similar. This fan had a rated sound pressure level of 57 dB(A) @ 1m.

6.3.1 Results from Scenario 1a – doors closed

The maximum sound pressure level predicted at the nearest residential facade was 42 dB $L_{Aeq,T}$; with the acoustic feature correction applied this equates to a Rating Level of 47 dB to BS 4142. A screen shot from the model is provided in Appendix 2a.

6.3.2 Results from Scenario 2a – doors open

The maximum sound pressure level predicted at the nearest residential facade was 44 dB $L_{Aeq,T}$; with the acoustic feature correction applied this equates to a Rating Level of 49 dB to BS 4142. A screen shot from the model is provided in Appendix 2b.

For each scenario the predicted Rating Level was in excess of the proposed limit of 44 dB. On analysis of the model data it was ascertained that the walls of the industrial unit had an insufficient level of sound insulation. The modelling exercise was repeated using a revised sound insulation spectrum for a lightweight insulated panel with plasterboard lining applied to all walls including the gable ends.

6.3.3 Results from Scenario 1b – doors closed with enhanced wall construction

The maximum sound pressure level predicted at the nearest residential facade was 39 dB $L_{Aeq,T}$; with the acoustic feature correction applied this equates to a Rating Level of 44 dB to BS 4142. A screen shot from the model is provided in Appendix 2c.

6.3.4 Results from Scenario 2b – doors open with enhanced wall construction

The maximum sound pressure level predicted at the nearest residential facade was 44 dB $L_{Aeq,T}$; with the acoustic feature correction applied this equates to a Rating Level of 49 dB to BS 4142. A screen shot from the model is provided in Appendix 2d.

With the enhanced wall construction and roller shutter doors closed, the predicted Rating Level is 44 dB and achieves the target criterion. With all roller shutter doors open, the predicted Rating Level is 49 dB despite the enhanced wall construction, which indicates that this is the dominant noise source. Although with doors open the proposed target criterion is not achieved, it is nevertheless only 5 dB above the measured background noise level, which equates to 'marginal significance' according to BS 4142. Furthermore, this is considered a worst case scenario with all units in operation and generating internal noise levels of up to 78 dB $L_{Aeq,T}$ and with all 7 roller shutter doors open. In reality, such a situation is unlikely to exist.

6.4 Assessment to BS 8233/WHO

The noise levels predicted by the model indicate a maximum noise level of 44 $L_{Aeq,T}$ at the nearest residential facade with all roller shutter doors open and all units generating noise.

The generally accepted rule of thumb is that a window left open for ventilation provides 10 – 15 dB attenuation from external noise sources with the WHO Guidelines for Community Noise suggesting 15 dB. Based on the predicted noise level of 44 $L_{Aeq,T}$ at the nearest dwelling, this would equate to an internal noise level of between 29 and 34 dB L_{Aeq} , achieving the 'good' internal noise levels stated within BS 8233 for habitable rooms during the day.

The noise levels within gardens as a result of the units will vary depending on the proximity to the units. The noise model indicates that with a plasterboard lining to the internal walls, predicted noise levels in gardens would not exceed around 52 dB $L_{Aeq,T}$. The WHO guidance of a recommended upper limit of 55 dB $L_{Aeq,T}$ is therefore predicted to be achieved.

7 Recommended Mitigation Measures

In order to achieve the proposed noise criteria with roller shutter doors closed, the following measures are recommended:

- All internal walls to the rear (west facing) and side (gable ends) of each unit are to be lined with a single sheet of high density plasterboard up to roof level to achieve a minimum mass of 10 kg/m². This is to be installed using a metal framing system to give a minimum cavity of 50 mm and a minimum 25 mm of mineral wool with a minimum density of 30 kg/m² is to be installed within the cavity. All joints in the plasterboard are to be taped or sealed with flexible mastic.
- All items of externally located building services plant are to be selected for low noise operation and must not generate discreet tones or whistles. All items of plant associated with each individual unit are to be controlled to a maximum sound pressure level of 57 dB(A) at 1 m in all directions, when measured under free-field conditions at maximum load. If more than one item of external plant is required by any one unit, the noise limit will apply to all items associated with that unit operating simultaneously.
- Any processes that require fixed, externally located plant items such as extract fans or hoods will need to comply with the noise limits stated above.
- Where possible, external plant items should be located as far away from the residential dwellings as possible and if feasible, ventilation grilles and louvres are to be angled away from dwellings.
- The proposed hours of operation of the industrial units are 08:00 to 18:00 Monday to Saturday. There is to be no operation of the units on Sundays or bank holidays.

8 Conclusions

This assessment shows that there is no reason why this site should not be granted planning permission for a change of use from B8 to B2 if adequate noise mitigation is used. This mitigation should include measures to upgrade the structure of the building, controls on noise levels from plant and equipment used within the units, careful siting and selection of external plant plus restrictions on hours of use of the units.

Glossary of Terms

Decibel (dB) The unit used to quantify sound pressure levels; it is derived from the logarithm of the ratio between the value of a quantity and a reference value. It is used to describe the level of many different quantities. For sound pressure level the reference quantity is 20 μPa , the threshold of normal hearing is in the region of 0 dB, and 140 dB is the threshold of pain. A change of 1 dB is only perceptible under controlled conditions.

dB L_A Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) which differentiates between sounds of different frequency (pitch) in a similar way to the human ear. Measurements in dB L_A broadly agree with people's assessment of loudness. A change of 3 dB L_A is the minimum perceptible under normal conditions, and a change of 10 dB L_A corresponds roughly to halving or doubling the loudness of a sound. The background noise level in a living room may be about 30 dB L_A ; normal conversation about 60 dB L_A at 1 meter; heavy road traffic about 80 dB L_A at 10 meters; the level near a pneumatic drill about 100 dB L_A .

$L_{A90,T}$ The A weighted noise level exceeded for 90% of the specified measurement period (T). In BS 4142: 1990 it is used to define background noise level.

$L_{Aeq,T}$ The equivalent continuous sound level. The sound level of a notionally steady sound having the same energy as a fluctuating sound over a specified measurement period (T). $L_{Aeq,T}$ is used to describe many types of noise and can be measured directly with an integrating sound level meter.

L_{Amax} The highest A-weighted noise level recorded during the time period. It is usually used to describe the highest noise level that occurred during the event.

R_w The weighted sound reduction index, a single number rating used to describe the sound insulation of building elements. It is defined in BS 717-1: 1997.

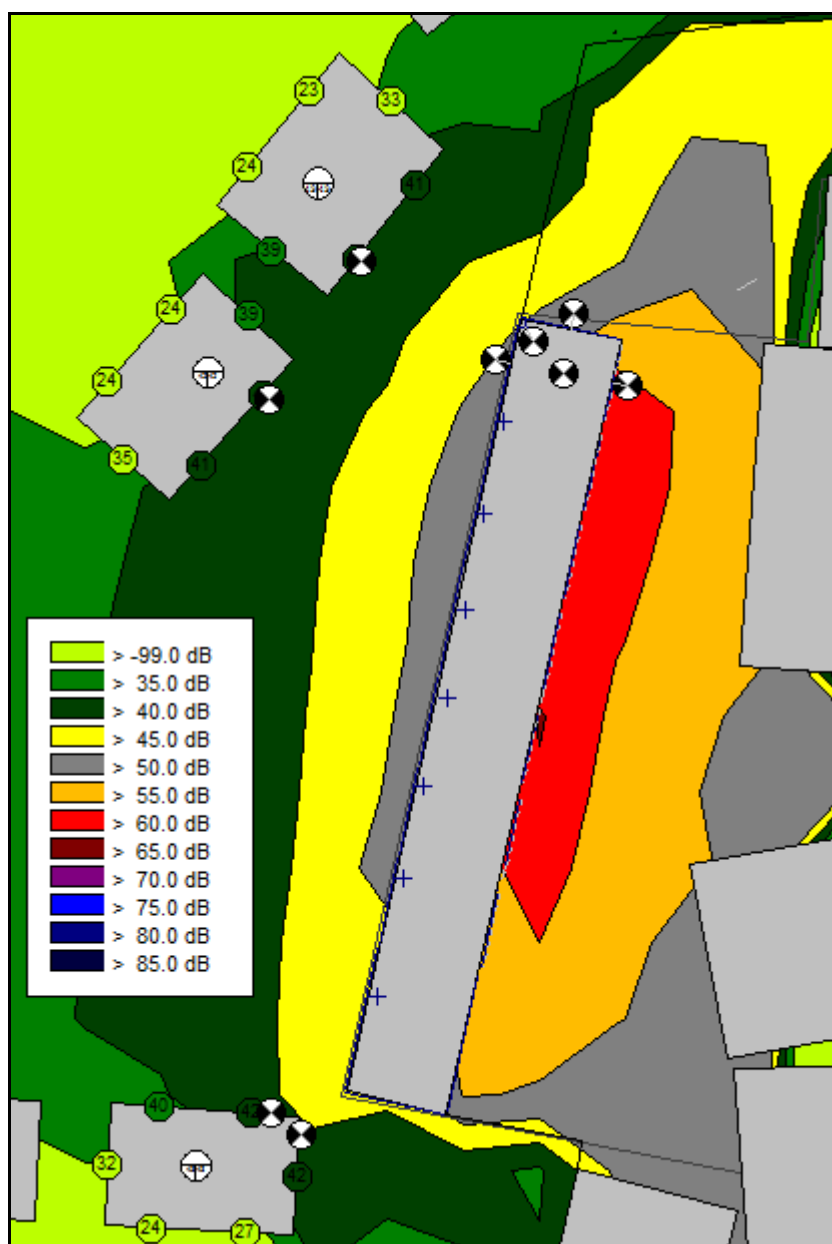
Appendix 1a – Survey Measurement Data

Location	Date	Time Started	Elapsed Time (hr:min:sec)	$L_{Aeq,T}$ (dB)	L_{AFMAX} (dB)	L_{AF1} (dB)	L_{AF10} (dB)	L_{AF90} (dB)	L_{AF99} (dB)	L_{AFmin} (dB)
P1	14/03/2013	08:11:41	0:03:19	56.3	75.2	64.2	59.2	47.4	44.7	43.5
P1	14/03/2013	08:15:00	0:05:00	54.7	65.1	61.5	58.2	47.0	44.5	42.6
P1	14/03/2013	08:20:00	0:05:00	58.7	80.9	68.7	60.4	47.0	43.4	42.3
P1	14/03/2013	08:25:00	0:05:00	56.5	69.6	62.5	58.6	52.7	51.8	51.2
P1	14/03/2013	08:30:00	0:05:00	56.6	69.5	63.7	58.6	53.5	52.6	51.8
P1	14/03/2013	08:35:00	0:05:00	56.5	71.5	67.0	58.9	46.6	44.9	44.1
P1	14/03/2013	08:40:00	0:05:00	53.8	76.7	61.6	56.9	44.9	43.1	41.9
P1	14/03/2013	08:45:00	0:05:00	56.0	69.5	64.7	59.1	47.9	45.5	43.4
P1	14/03/2013	08:50:00	0:05:00	53.9	64.9	61.7	57.4	46.3	44.3	43.4
P1	14/03/2013	08:55:00	0:05:00	55.8	75.2	65.1	58.2	46.5	43.7	42.5
P1	14/03/2013	09:00:00	0:05:00	56.0	68.8	65.2	59.0	48.5	45.5	43.4
P1	14/03/2013	09:05:00	0:05:00	66.5	83.7	81.5	63.9	46.0	43.5	41.3
P1	14/03/2013	09:10:00	0:01:41	54.0	63.9	61.1	57.3	46.2	43.1	42.5
P1	14/03/2013	09:13:11	0:01:49	53.8	67.2	61.0	57.2	46.3	44.5	43.9
P1	14/03/2013	09:15:00	0:05:00	62.5	81.4	75.4	64.7	45.0	40.5	39.0
P1	14/03/2013	09:20:00	0:05:00	55.5	74.4	68.1	54.6	44.8	42.6	41.7
P1	14/03/2013	09:25:00	0:05:00	53.7	77.9	61.7	55.6	46.0	44.1	42.4
P1	14/03/2013	09:30:00	0:05:00	52.2	70.3	61.5	54.6	47.0	45.3	44.3
P1	14/03/2013	09:35:00	0:05:00	52.9	73.7	61.6	55.2	46.7	45.4	44.0
P1	14/03/2013	09:40:00	0:05:00	60.0	84.0	71.9	61.4	47.1	45.6	43.7
P1	14/03/2013	09:45:00	0:05:00	57.4	83.7	68.7	55.7	47.3	45.4	44.3
P1	14/03/2013	09:50:00	0:05:00	56.4	70.4	66.8	60.9	46.5	44.7	43.3
P1	14/03/2013	09:55:00	0:05:00	52.7	65.9	64.2	55.0	42.9	40.1	39.1
P1	14/03/2013	10:00:00	0:05:00	53.3	72.9	65.2	54.8	40.8	38.7	37.7
P1	14/03/2013	10:05:00	0:05:00	51.1	67.9	64.0	51.5	40.0	37.5	36.3
P1	14/03/2013	10:10:00	0:03:11	51.8	64.9	62.1	55.7	40.6	37.7	36.6
P1	14/03/2013	10:16:11	0:03:49	50.3	63.9	58.6	53.6	42.4	39.3	37.2
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P1	14/03/2013	10:25:00	0:05:00	50.7	68.6	60.8	52.9	42.3	39.5	37.9
P1	14/03/2013	10:30:00	0:05:00	56.7	84.2	64.6	56.3	44.9	42.9	41.6
P1	14/03/2013	10:35:00	0:05:00	51.1	67.9	58.6	54.5	44.5	41.9	40.0
P1	14/03/2013	10:40:00	0:05:00	53.8	78.6	64.4	55.5	44.4	41.4	39.5
P1	14/03/2013	10:45:00	0:05:00	51.4	64.6	60.3	54.9	44.3	41.8	40.2
P1	14/03/2013	10:50:00	0:05:00	52.4	68.5	61.4	54.9	46.1	43.0	41.4
P1	14/03/2013	10:55:00	0:05:00	55.9	74.0	67.1	59.1	45.9	42.7	40.1
P1	14/03/2013	11:00:00	0:05:00	54.7	67.1	62.6	58.2	49.1	46.5	45.6
P1	14/03/2013	11:05:00	0:05:00	50.9	68.3	59.5	53.5	44.5	41.4	39.4
P1	14/03/2013	11:10:00	0:05:00	54.5	71.5	65.5	57.4	44.0	41.0	39.0
P1	14/03/2013	11:15:00	0:01:11	59.2	75.0	69.2	62.1	52.7	47.6	46.4

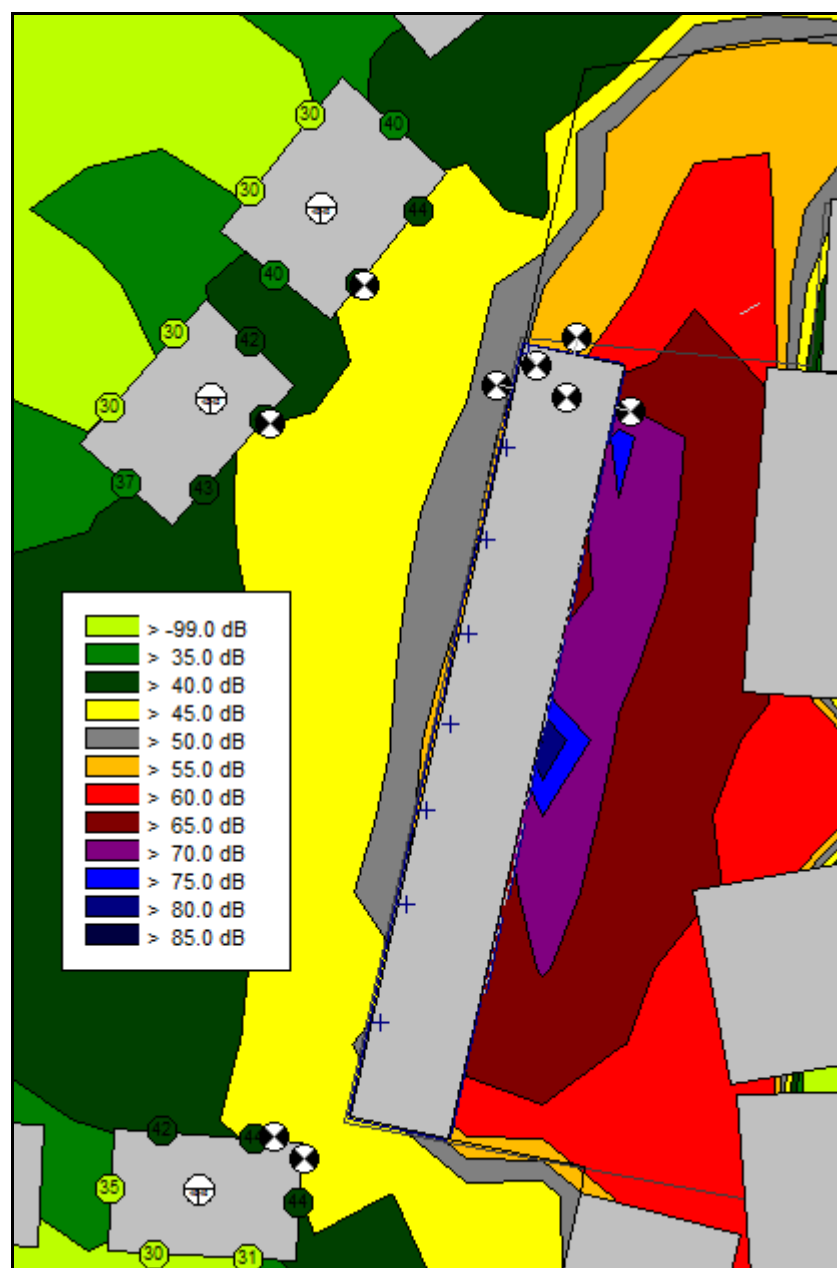
Appendix 1b: Internal Noise Level Spectrum Used in Assessment

Description	63	125	250	500	1k	2k	4k	8k	dBA
Internal $L_{Aeq,45min}$ measured in maintenance garage	69	72	72	74	75	70	68	66	78

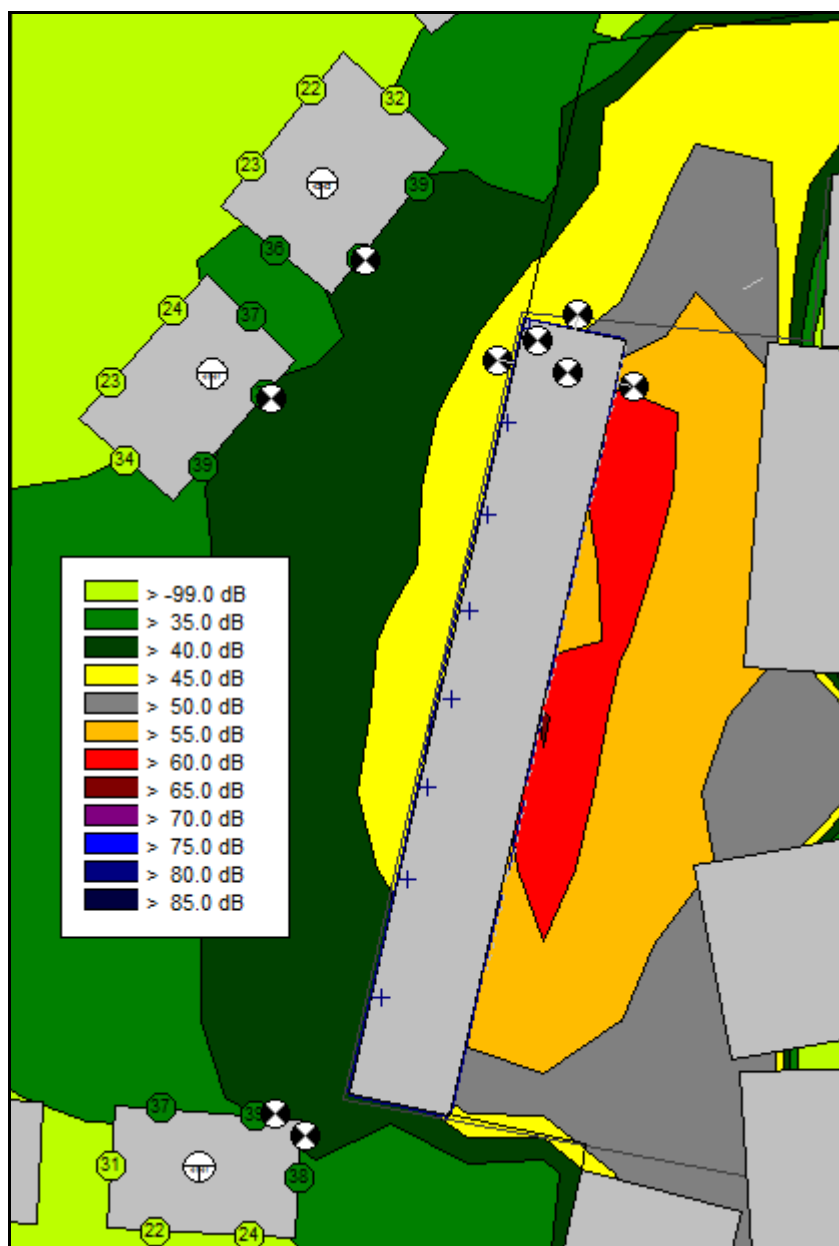
Appendix 2a: Noise model with roller shutter doors closed



Appendix 2b: Noise model with roller shutter doors open



Appendix 2c: Noise model with roller shutter doors closed and enhanced wall construction



Appendix 2d: Noise model with roller shutter doors open and enhanced wall construction

