

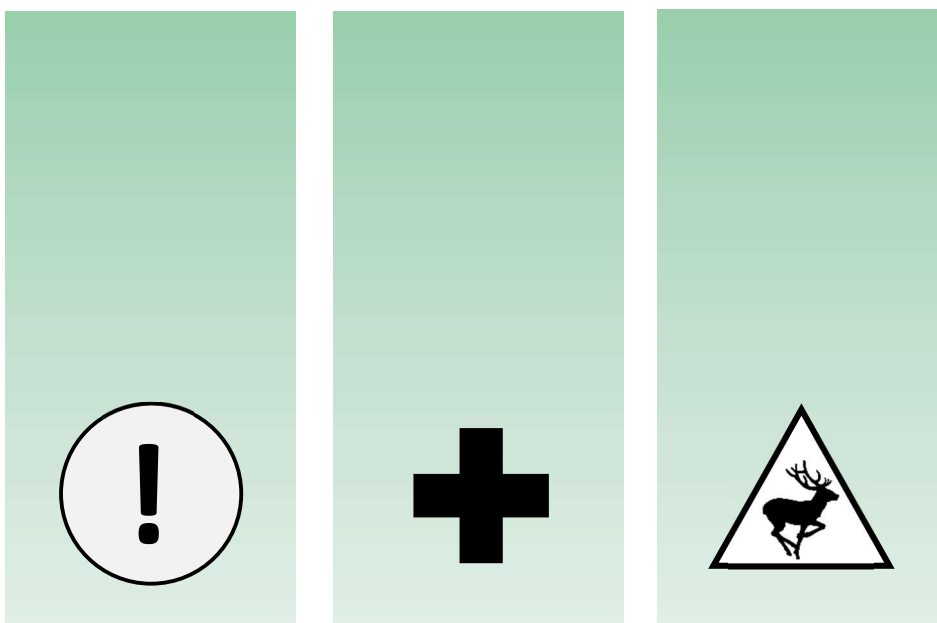
NOISE AND VIBRATION IMPACT ASSESSMENT

FORMER MONDI HOLCOMBE MILL, BURY

ENSAFE REFERENCE: AC108650-1R1

REPORT PREPARED FOR: ECCLESTON HOMES

DATE: 12TH AUGUST 2020



QUALITY ASSURANCE

Issue/revision	Issue 1	Revision 1	Revision 2
Remarks	-	Updated Layout	
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Project number	AC108650-1r0	AC108650-1r1	

EXECUTIVE SUMMARY

Ensafe (formerly REC Ltd) was commissioned by Eccleston Homes to provide a Noise and Vibration Impact Assessment for a proposed residential development at land at the Former Mondi Holcombe Mill in Ramsbottom.

This Noise and Vibration Impact Assessment has been undertaken to assess the impact of road traffic noise, cricket match noise and noise associated with the existing Ramsbottom Steam Train station on proposed receptors.

Considering road traffic noise, the assessment demonstrated that there would be exceedances in the garden areas associated with plots 8 and 21, mitigation measures are required in the form of a 1.8m barrier in between the garden area and Bridge Street. Additionally, while standard thermal double glazing has been found to be sufficient to ensure that internal criteria are met during both day and night times. However, with windows partially open for ventilation, there are exceedances. As such, an alternate means of ventilating noise sensitive habitable rooms, that does not require the opening of a window, is required.

On behalf of noise from the nearby commercial steam train station, it has been calculated that 2.4m tall barriers reduce the change in ambient from “Very Substantial” to “Substantial”. In this case, due to the locality of the site and the nature of the noise from the steam trains, it is deemed to achieve the lowest practicable levels and as such is considered acceptable. Additionally, alternate ventilation was found to be required in habitable rooms that overlook the railway.

Specifically, the following mitigation is required:

Barriers:

- 1.8m barrier is required around the garden area attached to plots 8 and 21
- 2.4m barriers are required on the western boundaries of plots 2–7 and 43–51; and
- 2.4m barriers are required on the southern boundaries of plots 7 and 51.

Alternate ventilation:

- Plots 1 to 4
- Plots 8 to 28
- Plots 30, 31 and 34;
- Buildings A and B; and
- All habitable rooms overlooking the railway. Namely, plots 2-7 and 43-67.

Regarding noise associated with the nearby Cricket Club, the impact upon the proposed residential development was found to be negligible.

Additionally, the likelihood of adverse comment on behalf of railway vibration has been deemed highly unlikely.

The barrier proposed for the Site can be of wooden fence or brick wall construction and should be of close boarded construction, be free from holes, sealed at the base and have a minimum mass of

10kg/m².

This assessment has shown that, in principle, there should be no adverse impact at the closest receptors as a result of the existing noise sources. Following the outcomes of the assessments, the overall recommendation for the development to the decision maker is to grant consent with suitable noise conditions.

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1. INTRODUCTION

Ensafe (formerly REC Ltd) has been commissioned by Eccleston Homes to prepare a Noise and Vibration Impact Assessment for Land at the Former Mondi Holcombe Mill, Bridge Street in Ramsbottom, Bury, to be referred to hereafter as '*the Site*'.

This assessment has been undertaken to identify key noise and vibration sources in the vicinity of the Site which may have the potential to impact upon the proposed residential development.

All acronyms used within this report are defined in the Glossary presented in Appendix II.

1.1 Site Location and Proposed Development

The Site currently comprises of disused buildings and a mill chimney with the rest of the site consisting of scrubland. The site is located off Bridge Street which borders the Site to the north. Ramsbottom Cricket Club borders the site to south, and Ramsbottom Steam Train Station to the west. The site is bound to the east by the River Irwell, beyond which lies residential buildings.

It is understood that proposals at the former Mondi Holcombe Mill comprises of the construction of flats and houses along with amended means of access and ancillary works. In total the proposal consists of 72 units.

This assessment has been undertaken with due regard to the supplied proposed site plan as follows:

- Planning Layout (Drawing No:102 Rev C) dated 04/11/19.

The Site plan is shown in Figure 1 of Appendix III.

1.2 Limitations

Where mitigation measures are specified in our report, it should be noted that these measures are relative to a specific sound source, both in terms of the measured sound pressure level and the character of the source. Where either the sound pressure level or the character of the sound varies following completion of the sound survey, Ensaf cannot be held responsible for any subsequent variations in the proposed mitigation performance.

Further limitations of this report are presented in Appendix I.

1.3 Reliance

Ensafe has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from Ensaf; a charge may be levied against such approval.

2. ASSESSMENT METHODOLOGY

2.1 National Planning Practice Guidance

Noise needs to be considered when new developments may create additional noise and when new developments would be sensitive to the prevailing acoustic environment. When preparing local or neighbourhood plans, or taking decisions about new development, there may also be opportunities to consider improvements to the acoustic environment.

Local planning authorities' plan-making and decision taking should take account of the acoustic environment and in doing so consider:

- Whether or not a significant adverse effect is occurring or likely to occur;
- Whether or not an adverse effect is occurring or likely to occur; and
- Whether or not a good standard of amenity can be achieved.

In line with the Explanatory Note of the Noise Policy Statement for England, this would include identifying whether the overall effect of the noise exposure (including the impact during the construction phase wherever applicable) is, or would be, above or below the significant observed adverse effect level and the lowest observed adverse effect level for the given situation.

The Observed Effect Levels are as follows:

- Significant observed adverse effect level: This is the level of noise exposure above which significant adverse effects on health and quality of life occur.
- Lowest observed adverse effect level: this is the level of noise exposure above which adverse effects on health and quality of life can be detected.
- No observed effect level: this is the level of noise exposure below which no effect at all on health or quality of life can be detected.

Table 1 summarises the noise exposure hierarchy, based on the likely average response.

Table 1 Noise Exposure Hierarchy

Perception	Examples of Outcomes	Increasing effect level	Action
Not Noticeable	No effect.	No Observed Effect	No specific measures required
Noticeable and not intrusive	Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.	No Observed Adverse Effect	No specific measures required
Lowest Observed Adverse Effect Levels			

Perception	Examples of Outcomes	Increasing effect level	Action
Noticeable and intrusive	Noise can be heard and causes small changes in behaviour and/or attitude, e.g. turning up volume of television; speaking more loudly; where there is no alternative ventilation, having to close windows for some of the time because of the noise. Potential for some reported sleep disturbance. Affects the acoustic character of the area such that there is a perceived change in the quality of life.	Observed Adverse Effect	Mitigate and reduce to a minimum
Significant Observed Adverse Effect Level			
Noticeable and disruptive	The noise causes a material change in behaviour and/or attitude, e.g. avoiding certain activities during periods of intrusion; where there is no alternative ventilation, having to keep windows closed most of the time because of the noise. Potential for sleep disturbance resulting in difficulty in getting to sleep, premature awakening and difficulty in getting back to sleep. Quality of life diminished due to change in acoustic character of the area.	Significant Observed Effect	Avoid
Noticeable and very disruptive	Extensive and regular changes in behaviour and/or an inability to mitigate effect of noise leading to psychological stress or physiological effects, e.g. regular sleep deprivation/awakening; loss of appetite, significant, medically definable harm, e.g. auditory and non-auditory	Unacceptable Adverse Effect	Prevent

The subjective nature of noise means that there is not a simple relationship between noise levels and the impact on those affected. This will depend on how various factors combine in any particular situation.

These factors include:

- The source and absolute level of the noise together with the time of day it occurs. Some types and level of noise will cause a greater adverse effect at night than if they occurred during the day – this is because people tend to be more sensitive to noise at night as they are trying to sleep. The adverse effect can also be greater simply because there is less background noise at night.
- For non-continuous sources of noise, the number of noise events, and the frequency and pattern of occurrence of the noise.
- the spectral content of the noise and the general character of the noise. The local topology and topography should also be taken into account along with the existing and, where appropriate, the planned character of the area.

More specific factors to consider when relevant:

- Where applicable, the cumulative impacts of more than one source should be taken into account along with the extent to which the source of noise is intermittent and of limited duration.
- Consideration should also be given to whether adverse internal effects can be completely removed by closing windows and, in the case of new residential development, if the proposed mitigation relies on windows being kept closed most of the time. In both cases a suitable alternative means of ventilation is likely to be necessary. Further information on ventilation can

be found in the Building Regulations.

- If external amenity spaces are an intrinsic part of the overall design, the acoustic environment of those spaces should be considered so that they can be enjoyed as intended.

2.5 British Standard BS8233: 2014: Guidance on Sound Insulation and Noise Reduction for Buildings

Noise Criterion Limits

The scope of this standard is the provision of recommendations for the control of noise in and around buildings. It suggests appropriate criteria and limits for different situations, which are primarily intended to guide the design of new buildings or refurbished buildings undergoing a change of use, rather than to assess the effect of changes in the external noise climate.

The standard suggests suitable internal noise levels within different types of buildings, including dwellings, as shown in Table 2:

Table 2 BS8233 Recommended Internal Noise Levels

Criterion	Typical Situation	Design $L_{Aeq, T}$ (dB)
Suitable resting/ sleeping conditions	Living Room	35
	Bedroom	30
For a Reasonable standard in bedrooms at night, individual noise evens (measured with fast time weighting) should not exceed 45dB L_{max}		

BS8233 goes on to recommend noise levels for gardens. According to BS8233;

“It is desirable that the external noise level does not exceed 50dB $L_{Aeq, T}$, with an upper guideline value of 55dB $L_{Aeq, T}$ which would be acceptable in noisier environments. However, it is also recognised that these guideline values are not achievable in all circumstances where development might be desirable. In higher noise areas, such as city centres or urban areas adjoining the strategic transport network, a compromise between elevated noise levels and other factors might be warranted”.

BS8233 goes on to say:

“In such a situation, development should be designed to achieve the lowest practicable levels in these external amenity spaces, but should not be prohibited”.

Ventilation Requirements

Where a partially open window cannot be relied upon to provide an adequate level of facade sound insulation performance, it is necessary to consider alternative ventilation for habitable rooms. Section 8.4.5.4 within BS8233 states:

“The Building Regulations’ supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation,

trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant's choice.

Alternatively, acoustic ventilation units (see 7.7.2 below) are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans."

Section 7.7.2 states:

"NOTE 5 If relying on closed windows to meet the guide values, there needs to be an appropriate alternative ventilation that does not compromise the façade insulation or the resulting noise level."

2.6 World Health Organisation's (WHO) 'Guidelines for Community Noise'

The WHO 'Guidelines for Community Noise' offers advice with regard to setting noise criteria applicable to sleep disturbance. Section 4.2.3 specifies:

'If the noise is not continuous, L_{Amax} or SEL are used to indicate the probability of noise-induced awakenings. Effects have been observed at individual L_{Amax} exposures of 45 dB or less. Consequently, it is important to limit the number of noise events with a L_{Amax} exceeding 45 dB.'

The guidelines go on to state:

'At night, sound pressure levels at the outside façades of the living spaces should not exceed 45 dB L_{Aeq} and 60 dB L_{Amax} , so that people may sleep with bedroom windows open. These values have been obtained by assuming that the noise reduction from outside to inside with the window partly open is 15 dB.'

The sound insulation performance value of 15dB for a façade containing a partially open window accords with the guidance offered in BS8233:2014.

The guidelines reference a study by Vallet & Vernet (1991), which concluded that:

'For a good sleep, it is believed that indoor sound pressure levels should not exceed approximately 45 dB $L_{AF,max}$ more than 10-15 times per night.'

Accordingly, this assessment has utilised the 10th highest measured maximum noise level from the night-time period and allows for an assessment of a typical maximum noise level in determining façade sound insulation performance.

2.7 Institute of Environmental Management & Assessment 'Guideline for Environmental Noise Impact Assessment', October 2014

The guidelines address the key principles of noise impact assessment and are applicable to all development proposals where noise effects are likely to occur. The guidelines provide specific support on how noise impact assessment fits within the Environmental Impact Assessment (EIA) process. They cover:

- How to scope a Noise Assessment;
- Issues to be considered when defining the baseline noise environment;

- Prediction of changes in noise levels as a result of implementing development proposals; and,
- Definition and evaluation of the significance of the effect of changes in noise levels (for use only where the assessment is undertaken within an EIA).

Although the guidance states that it is only applicable for use in an Environmental Impact Assessment (EIA), in the absence of any other relevant guidance for assessing changes in ambient noise levels, it is the most appropriate document for establishing significance of effect.

Table 3 categorises the change in noise level for a noise sensitive receptor such as a residential dwelling.

Table 3 Effect Descriptors for Residential Dwellings

Effect	Change in Ambient Noise Level
Very substantial	>10dB
Substantial	5.0dB – 9.9dB
Moderate	3.0dB – 4.9dB
None / not significant	<2.9dB

2.8 British Standard BS6472: 2008: Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)

With respect to human exposure to building vibration, BS6472 provides guideline values of the Vibration Dose Value (VDV) above which various degrees of adverse comment may be expected from the occupants of residential buildings. The VDV is defined mathematically as the fourth root of the time integral of the fourth power of the vibration acceleration, after it has been frequency weighted. The guideline values recommended by BS6472 are shown in Table 4 below.

Table 4 BS6472 Guideline Values

Place	Low Probability of Adverse Comment	Adverse Comment Possible	Adverse Comment Probable
	VDV (m/s)		
Residential Buildings (16 hour Day)	0.2 – 0.4	0.4 – 0.8	0.8 – 1.6
Residential Buildings (8 Hour Night)	0.1 – 0.2	0.2 – 0.4	0.4 – 0.8

Where the vibration is intermittent rather than continuous in nature, BS6472 defines procedures for calculating the estimated Vibration Dose Value (eVDV), based on the number and duration of vibration events and the recorded value of the root mean square frequency weighted vibration acceleration. The frequency weighting takes into account the response of the human body to vibrations of different frequency and whether the person is lying down or standing. The eVDV can then be taken as the VDV for use in the assessment of human exposure to vibration in buildings.

The above guidance relates to vibration measured at the point of entry into the human body, which is usually taken to mean the ground surface or at a point mid-span of an upper storey floor, rather than the point of entry into the building (a foundation element).

3. NOISE SURVEYS

The noise measurement locations are shown on Figure 1 of Appendix III.

3.1 Road Traffic Noise Survey – Bridge Street

Ensafe (formerly REC Ltd) has conducted a Road Traffic Noise Survey in order to measure the level of noise generated by vehicles using Bridge Street. The survey was undertaken during the following time periods in accordance with CRTN:

- 12:00 Wednesday 18th to 12:00 Friday 20th December 2019.

The following noise measurement position was chosen for the Road Traffic Noise Survey:

- Noise Measurement Position 1 (NMP1): Located on the northern boundary of the site approximately 5m from the nearside kerbstone of Bridge Street. The microphone was located 1.5m above ground level and in free-field conditions. Noise at this location was dominated by vehicle pass-bys on Bridge Street.

A summary of the loudest measured 16hr and 8hr sound pressure levels from the Road Traffic Noise Survey is presented in Table 5 below. Hourly values are provided in Table A3 of Appendix IV.

Table 5 Summary of Measured Noise Levels for NMP1

Assessment Period	Measured Sound Pressure Levels (dB)	
	L _{Aeq,1hr}	10 th Highest L _{Amax,fast}
Night-time (23:00 – 07:00) 18 th –19 th	58.4	75.0
Daytime (07:00 – 23:00) 19 th	67.4	-

3.2 Source Noise Survey – Ramsbottom Steam Train Station

Ensafe (formerly REC Ltd) has conducted a 24-hour Source Noise Survey in order to determine the level of noise created by the nearby heritage railway station. The survey was carried out over the following time periods:

- 12:00 Tuesday 17th to 11:00 Wednesday 18th December 2019.

The following noise measurement position was chosen for the Source Noise Survey:

- Noise Measurement Position 2 (NMP2): Located on the western Site boundary adjacent to the railway station. The microphone was located at a height of 1.5m above ground level and in free-field conditions. Noise sources at this location consisted of predominantly distant road noise with occasional steam trains idling or passing on average twice a day. Additionally, the steam whistle on the train was occasionally used.

During the survey period, only two trains were recorded. Additionally, it was discovered later that the commercial schedule for the Steam Train stops was busier and the trains were found to be louder on weekends for tourism reasons, with up to six trains visiting the station per day. Therefore, due to the presence of louder trains, the audio from the weekend background and ambient survey was used to assess the impact of rail traffic upon the proposed receptors.

3.3 Background and Ambient Sound Survey

Ensafe has conducted a full weekend Background and Ambient Survey in order to establish the existing levels of background and ambient sound. The survey was carried out over the following time period:

- 15:00 Friday 3rd January to 15:00 Monday 6th January 2020.

The following noise measurement position was chosen for the Background and Ambient survey:

- Noise Measurement Position 3 (NMP3): Located securely at the south eastern portion of the site. The microphone was located 1.5m above ground level and in free-field conditions. Noise sources at this location consisted predominately of vehicle pass-bys on the Bridge Street with occasional steam trains at the local Ramsbottom station.

A summary of the range of measured sound pressure levels and median levels for daytime and night-time periods from the background sound survey are presented in Table 6.

Table 6 Range of Measured Background Sound Levels at NMP3

Date	Period	Range of Measured Sound Pressure Level, $L_{Aeq,T}$ (dB)	Median Measured Background Sound Level, $L_{A90,T}$ (dB)
Saturday 5 th January 2020	Daytime (07:00 – 23:00)	43.5 – 52.9	45.8
	Night-Time (23:00 – 07:00)	43.0 – 47.0	41.9
Sunday 6 th January 2020	Daytime (07:00 – 23:00)	45.5 – 55.2	48.4
	Night-Time (23:00 – 07:00)	39.6 – 45.5	38.9

Additionally, due to the presence of louder steam trains at the Ramsbottom Steam Train station on weekends, recorded audio from this meter more accurately represented the worst case hour and for that reason, it was used to assess the impact of the rail station on any proposed receptors.

A summary of the average measured sound pressure levels resulting from the worst effected hour of Rail noise are presented in Table 7.

Table 7 Summary of Measured Noise Levels for NMP3

Source	Duration Within Worst Measured Hour (s)	Measured Sound Pressure Level, $L_{Aeq,T}$ (dB)	Residual Sound Pressure Level, $L_{Aeq,T}$ (dB)	Distance to source (m)
Steam Engine	1009	57.6	52.9	107
Whistle	8	72.9	52.9	107

Weather conditions remained mostly dry and wind speeds stayed below 5.0m/s throughout the majority of the survey.

The following equipment was used for the Noise Survey. Calibration due dates are those at the time of the surveys.

Table 8 Noise Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date at Time of Measurement
NMP1	Sound Level Meter	01dB-Metravib Fusion	10819	27 November 2020
	Pre-amplifier	01dB Metravib	Internal	
	Microphone	GRAS 40CE	217637	
	Calibrator	01dB-Metravib CAL-21	34554787	10 June 2020
NMP2 & 3	Sound Level Meter	01dB-Metravib Fusion	11536	15 October 2021
	Pre-amplifier	01dB Metravib	Internal	
	Microphone	GRAS 40CE	291871	
	Calibrator	01dB-Metravib CAL-21	34975432	8 October 2020

The sound level meter was field calibrated prior to and following the survey. No significant drift was reported. Calibration certificates are available on request.

3.4 Rail Pass-by Vibration Survey

Ensafe (formerly REC Ltd) has conducted attended vibration measurements of train pass-bys alongside the attended rail noise survey, at the same location and during the same time period. Only two trains were present during the entire survey period.

A summary of the measured vibration levels is presented in Table 9.

Table 9 Summary of Measured Vibration Levels

Measurement Start Time	Type	Transverse Peak (mm/s)	Longitudinal Peak (mm/s)	Vertical Peak (mm/s)
14:00	Steam	0.381	0.27	0.159
14:55	Steam	0.175	0.286	0.175

The following equipment was used for the vibration survey.

Table 10 Vibration Measurement Equipment

Measurement Position	Equipment Description	Manufacturer & Type No.	Serial No.	Calibration Due Date at Time of Measurement
VMP1	Vibration Meter	Instantel Blastmate III	BA18274	8th June 2020
	Tri-axial Geophone	Instantel Geophone	BG17363	

4. NOISE IMPACT ASSESSMENT

4.1 Road Traffic Noise Assessment

For the purposes of this assessment, Ensafe have used noise modelling software, CadnaA 2019 MR2, to determine the impact of noise from vehicles travelling on the local road network.

The following inputs have been included in the model:

- Planning Layout (Drawing No:102 Rev C).
- Site elevations have been taken as existing and derived from 1m grid DTM;
- Proposed floor heights taken from the DWG planning layout 11 file supplied by John Matthews;
- A reflection order of 2 has been used in all calculations;
- 2-Storey Dwellings input at a height of 7.5m;
- Road traffic noise inputs as Road Sources and calibrated using NMP1; and
- Noise levels generated using ISO 9613-1 and ISO 9613-2 "Acoustics – Attenuation of sound during propagation outdoors" as incorporated into CadnaA software.

Figures 2 and 3 of Appendix III determine the predicted noise levels across the Site during the daytime and night-time periods, respectively.

4.1.1 External Amenity Area Noise Level Assessment

The Daytime Grid Noise Map of the proposed layout is illustrated in Figure 2. The model has determined that noise levels in proposed garden areas would range between below 45dB and up to 56dB during the daytime periods. The areas in which it would reach 56dB are in the garden areas associated with plots 8 and 21.

As this does not achieve the 55dB criterion in BS8233:2014, mitigation in some garden areas is required as a result of road traffic noise.

4.1.2 Internal Noise Level Assessment

In order to accurately determine the noise level within habitable rooms, it has been necessary to calculate the external noise level immediately outside the façade. Accordingly, the noise model has been used in order to calculate façade noise levels due to the impact of road traffic noise.

With regards to internal noise levels, BS8233:2014 suggest that a glazing unit with configuration 6mm glass/12mm air space/6mm glass affords sound insulation performance in the order of 33dB however this is for a pink noise spectrum. The same unit, weighted for road traffic noise using the '+C_{tr}' correction, has a sound insulation performance value of approximately 30dB and so this value has been used to calculate internal noise levels. It also goes on to recommend that a partially open window provides approximately 15dB attenuation.

The noise impact assessment tables in Appendix V show that all habitable rooms would achieve the daytime and night-time criteria when considering standard thermal double glazing that supplies 30dB R_w+C_{tr}. As such, no mitigation in the form of higher specification glazing is required on behalf of road noise.

With regards to alternative ventilation, it has been assumed that the opening of windows would be required for fresh air flow and background ventilation. If windows are opened, it has been shown, that the internal criteria would be exceeded by up to +16dB during the daytime on the northern most plots closest to the road.

With regards to the maximum instantaneous noise levels at night for Bridge Street, the 10th highest measured level at NMP1 has been corrected to the closest façade (which equates to 71dB). this results in an internal noise level of 38dB. Accordingly, standard glazing is sufficient (note no frequency content is accounted for due to the instantaneous nature of the noise so no correction for road traffic is applied). However, there would be an exceedance of +11dB at the closest plots when windows are open. As such, alternative ventilation would be required for the southern façade of the block of flats (plots 17 to 28) with line of sight to the road. However, alternate means of ventilation is already required on behalf of average day time levels and as such no further mitigation on behalf of instantaneous maximum night time levels is required.

4.2 IOA/IEMA Change in Ambient Assessment

In order to accurately assess the impact of the railway on the closest receptor, a standard change in ambient noise level assessment has been undertaken where a change of less than 2.9dB is considered negligible.

It was found that the steam trains visiting the nearby station would be infrequent enough as to seem negligible if the noise were averaged out over the 16hour period as it would be if it were analysed using a standard rail transportation assessment. Due to the touristic usage of the steam train railway station, paired with the infrequency of the trains, a change in ambient assessment has been employed in this instance to properly analyse the impact of the railway station upon the proposed residential.

It has been noted that planning have raised the following concern: *"The noise survey was carried out in December when only 2 trains passed by. There is concern as to whether this would be reflective of a busier day on the railway line."*

As the railway assessment is a change in ambient level assessment the worst-case hour is assessed, meaning that the quantity of trains present during the day doesn't change the outcome as the severity of the impact is determined by the single worst hour of train noise. This is deemed as a worst-case scenario assessment because the trains are spaced out through the day and so there wouldn't be more than one train at a time idling at the station within a single hour. The change in ambient assessment is more stringent than a normal railway assessment and is required on behalf of the trains not actually being part of transport network but rather part of a tourism site.

4.2.1 Measured Trains

During the attended source noise survey, only two trains were present during the survey, however, some of the steam trains that visited the station on the weekend were notably louder than the steam trains that visited during the attended survey. As such, the background audio survey has been used to assess the train noise as it better represented the worst-case hour of rail noise. The loudest hour period consisted of a steam train arriving at the station and idling for 16 minutes before leaving the station.

A noise level of 57.6dB L_{Aeq} was measured during the worst effected hour for the Ramsbottom Railway station. In addition, the measured noise level has been corrected for residual noise where noise associated with the railway was not audible during the measurement period. A distance correction has been applied by means of a 3dB reduction per doubling of distance for a line source approximation of the train and a 6dB reduction per doubling of distance for the point source approximating the steam whistle. A time correction has been applied to a standard 1hr measurement period.

Table 11 Calculation of Noise Level at Receptors

Source	Measured Noise Level of Railway, $L_{Aeq,T}$ (dB)	Residual Corrected Noise level $L_{Aeq,T}$ (dB)	Measured on Time (s)	Time Corrected Noise Level (dB)	Measurement Distance to centre (m)	Distance to Receptor (m)	Sound Pressure Level at the Receptor, $L_{Aeq,1hr}$ (dB)
Train Idling	57.6	55.9	1009	50.4	107	25	56.7
Whistle	72.9	72.9	8	46.4	107	25	52.6

The combined hourly equivalent sound pressure level at the nearest proposed garden area is 58.2dB

The lowest measured L_{Aeq} 1-hour period during hours of operation for the station was taken from NMP3 as the lowest measured ambient noise level.

Table 12 Predicted Change in Ambient Noise Level

Receptor	Calculated Sound Pressure Level at the Receptor, $L_{Aeq,1hr}$ (dB)	Lowest Measured Ambient Sound Level $L_{Aeq,1hr}$ (dB)	Combined Noise Level (dB)	Difference +/- (dB)
Nearest Proposed	61.0	47.6	61.2	+13.6

Table 12 indicates that the ambient noise level will increase by 13.6dB at the centre of the closest proposed garden area due to noise from a steam train idling at the station. Table 13 compares this change in noise level to the appropriate criteria.

Table 13 Categorisation of Change in Ambient Noise Level – Idling Steam Train

Receptor	Predicted Change in Noise Level (dB)	Applicable Category
Nearest Proposed	+13.6	Very Substantial

Table 13 indicates that during the surveyed periods, the predicted change in ambient noise level results in a 'Very Substantial Effect'. Therefore, mitigation measures are required at the closest proposed receptors.

Additionally, with regard to internal noise levels, when the specific level is distance corrected to the nearest proposed facades to the railway line, a façade level of 61dB during the daytime. With windows closed, this would leave an internal level of 31dB and as such does not require mitigation with regards to higher specification glazing. However, with window partially open, this leaves an internal level of 46dB. this exceeds the internal day time criteria by 11dB and as such requires mitigation in the form of an alternate means of ventilation that ensures fresh air flow without the need to open a window. This would be required for all proposed habitable rooms with line of site to the railway. The necessary mitigation will be discussed in section 5.

4.3 Cricket Match Noise Impact Assessment

In order to accurately assess the impact of the cricket grounds to the south of the proposed site, measured data from the Ensafe library has been used for a first team cricket match at Kenilworth Cricket Club 50m distance from the centre of the playing area. This level has been distance corrected to 85m as representative of the closest proposed garden area:

The library been used in order to calculate the equivalent 1-hour noise level ($L_{Aeq,1hr}$). This noise level has been taken as representative of the closest receptors. The following assumptions have been made:

- Cricket Matches will only take place Saturday or Sunday between 10:00 and 19:00; and
- Given the influence of road traffic sound, the specific noise levels have been corrected for the residual noise level.

This assessment has calculated the resulting sound pressure levels for the proposed residential areas immediately adjacent to the Cricket Ground. Accordingly, this assessment has considered average (L_{Aeq}) noise levels.

Table 14 calculates the resulting noise level at the closest proposed residential areas due to a Cricket Match for the daytime period.

Table 14 Calculation of 1 Hour Noise Level at Receptors

Source	Corrected Measured Noise Level, $L_{Aeq,T}$ (dB)	On-Time (seconds)	Assessment Period (seconds)	Time Corrected and Residual Corrected Noise levels, $L_{Aeq,1hr}$ (dB)	Distance Corrected Noise Level at Receptor, $L_{Aeq,1hr}$ (dB)
Applause and hitting of the ball	55.8	354	3600	41.8	37.2
Shouting and Cheering	60.1	159	3600	45.5	40.9

Table 15 combines the specific noise level for both sources and logarithmically adds this to the existing average ambient noise level, the lowest of which was measured on Sunday; 52.9dB. The change in noise level is then calculated.

Table 15 Predicted Change in Noise Level due to Cricket Match

Source	Calculated Specific Noise Level at Receptor, $L_{Aeq,1hr}$ (dB)	Combined Specific Noise Level, $L_{Aeq,1hr}$ (dB) A	Existing Ambient Noise Level, $L_{Aeq,1hr}$ (dB) B	Combined Noise Level, $L_{Aeq,1hr}$ (dB) A + B	Change in Noise Level, $L_{Aeq,1hr}$ (dB)
Applause and hitting of the ball	37.2	42.4	47.6	48.8	+1.2
Shouting and Cheering	40.9				

Table 15 indicates that the ambient noise level at the closest proposed residential area will increase by +1.2dB during a Cricket Match. Table 16 compares this change in noise level to the appropriate criteria.

Table 16 Categorisation of Change in Ambient Noise Level – Cricket Match

Predicted Change in Noise Level (dB)	Applicable Category
+1.2	Negligible

Table 16 indicates that for the period with the lowest average measured 1-hour noise level, the predicted change in ambient noise level results in a 'negligible impact'. Therefore, mitigation measures are not required on behalf of cricket game noise.

4.1 Rail Vibration Assessment

The total VDV for the daytime period and night-time period, for trains has been calculated in accordance with the methodology presented in BS6472: 2008 using the appropriate weightings.

The numbers of passing trains in daytime and night time periods have been obtained from counting the number of trains scheduled on the East Lancashire Railway timetable on weekends.

Table 17 below summarises the results of the vibration assessment.

Table 17 Summary of Predicted Vibration Levels

Train Type	Anticipated Number of Movements		Predicted Vibration Dose Value ($m/s^{1.75}$)	
	Daytime	Night-time	Daytime	Night-time
	(07:00 to 23:00)	(23:00 to 07:00)	(07:00 to 23:00)	(23:00 to 07:00)
Steam	6	0	0.018	0.0
Total VDV			0.018	0.0

Table 18 determines the appropriate comment in accordance with BS6472:2008.

Table 18 **Determination of Applicable Comment**

Place	Calculated Vibration Dose Value ($\text{m/s}^{1.75}$)	Applicable Comment
Residential Buildings (16 Hour Day)	0.018	Unlikely probability of adverse comment

5. MITIGATION STRATEGY

5.1 Road Traffic Noise

5.1.1 External Amenity Area – Barrier Requirements

The assessment in Section 4.1 highlighted that there is an exceedance of the 55dB criteria set in BS8233 in the garden area associated with plots 8 and 21 on behalf of road traffic noise. As such an additional model has been run with a 1.8m barrier shielding these garden areas from the road to the north of the site.

As can be seen in figure 4 of Appendix III, with this barrier in place, levels drop from around 56dB to below 55dB. As this is below the 55dB criteria, this is deemed acceptable.

The barrier proposed for the Site can be of wooden fence or brick wall construction and should be of close boarded construction, be free from holes, sealed at the base and have a minimum mass of 10kg/m².

5.1.2 Internal Amenity Area – Glazing and Ventilation Requirements

The previous section has indicated that all living rooms and bedrooms will experience acceptable internal noise levels with standard thermal double glazing that provides at least 30dB $R_w + C_{t,r}$.

With a partially open window, the internal noise levels for habitable rooms in the following plots would experience exceedances of the internal criteria due to road traffic noise:

- Plots 1 to 4
- Plots 8 to 28
- Plots 30, 31 and 34; and
- Buildings A and B

Therefore, an alternate means of background ventilation is required for habitable rooms in these plots that does not require the opening of windows.

The largest exceedances are on the second floor of plots 8 and 9 overlooking Bridge Street, with an exceedance of +16dB. As such, if window mounted through frame trickle ventilators were used, a minimum performance of 31 $R_w + C_{tr}$ would be required.

The exact requirement for alternative ventilation ultimately falls to the developer and, from an acoustics perspective, needs to ensure that fresh air flow can be achieved without the need for opening windows. It is necessary to meet the requirements given in BS8233:2014, Section 8.4.5.4, which states that:

“The Building Regulations’ supporting documents on ventilation [48, 49, 50] recommend that habitable rooms in dwellings have background ventilation. Where openable windows cannot be relied upon for this ventilation, trickle ventilators can be used and sound attenuating types are available. However, windows may remain openable for rapid or purge ventilation, or at the occupant’s choice.

Alternatively, acoustic ventilation units (see 7.7.2) are available for insertion in external walls. These can provide sound reduction comparable with double glazed windows. However, ducted systems with intakes on the quiet side of the building might be required in very noisy situations, or where appearance rules out through-the-wall fans."

With mitigation in place, the No Observed Adverse Effect Level (NOAEL) which would be Noticeable and not intrusive would be achieved, resulting in:

"Noise can be heard but does not cause any change in behavior or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life."

5.2 Railway Noise

5.2.1 External Amenity Areas – Barrier Requirements

Section determined that as a result of steam trains idling at the nearby railway station, the change in ambient level during the worst affected hour in the daytime period at proposed receptors would be +13.6dB.

The highest barrier deemed feasible for this development is 2.4m in height. The train noise source is taken to be 2m tall and the standard receiver height of 1.5m is assumed. With a 2.4m barrier placed at the nearest garden areas with line of site to the station, a 2.4m barrier would provide a path difference of 0.06m taking relative ground heights into account. This would provide a noise reduction of 8.5dB for the majority of the garden space.

The resulting change in ambient with barriers in place is calculated in the table below.

Table 19 Predicted Change in Ambient Noise Level

Receptor	Calculated Sound Pressure Level at the Receptor, $L_{Aeq,1hr}$ (dB)	Lowest Measured Ambient Sound Level $L_{Aeq,1hr}$ (dB)	Combined Noise Level (dB)	Difference +/- (dB)
Nearest Proposed with 2.4m barrier in place	52.5	47.6	53.7	+6.1

This would result in a change in ambient of 'Substantial' impact.

However, It should be noted that the resulting hourly level would still be below the 55dB limit as set out in BS8233 and the presence of the noise source would be infrequent enough that the impact would apply for a very limited portion of the day.

Additionally, BS4142 repeatedly emphasises the importance of the characteristics of a noise on the psychological impact that it makes on surrounding inhabitants. In this case the noise of a steam train is not typically deemed a nuisance and often has a positive connotation attached.

Lastly, it is stated in BS8233 in its design criteria for external noise that in higher noise areas in which development is still desirable *"development should be designed to achieve the lowest practicable*

levels in these external amenity spaces, but should not be prohibited.” Therefore, it is advised in this instance that 2.4m barriers represent mitigation to achieve the lowest practicable levels and as such are deemed acceptable.

The barrier proposed for the Site can be of wooden fence or brick wall construction and should be of close boarded construction, be free from holes, sealed at the base and have a minimum mass of 10kg/m².

5.2.2 Internal Habitable Rooms

Section 4.1 determined that standard thermal double glazing performs sufficiently well in the plot closest to the railway. However, with a partially open window, the internal noise levels for habitable rooms overlooking the railway experience a +11dB exceedance of criteria with no mitigation in place.

Accordingly, it is necessary to consider an alternative ventilation scheme for these rooms which does not require the opening of windows to provide fresh air flow and background ventilation. Windows should remain openable for purge ventilation.

As an example, with an exceedance of +11dB, if through-frame trickle ventilators were to be used, a performance of at least 26dB _{D,n,ew} would be required to meet internal criteria.

The exact requirement for alternative ventilation ultimately falls to the developer and, from an acoustics perspective, needs to ensure that fresh air flow can be achieved without the need for opening windows. Wherever possible habitable rooms should be located away from the noise source with less noise sensitive rooms facing the noise source.

With mitigation in place, the No Observed Adverse Effect Level (NOAEL) which would be Noticeable and not intrusive would be achieved, resulting in:

“Noise can be heard but does not cause any change in behaviour or attitude. Can slightly affect the acoustic character of the area but not such that there is a perceived change in the quality of life.”

6. CONCLUSION

Ensafe (formerly REC Ltd) was commissioned by Ecclestone Homes to provide a Noise and Vibration Impact Assessment for a proposed residential development at land at the Former Mondi Holcombe Mill in Ramsbottom.

This Noise and Vibration Impact Assessment has been undertaken to assess the impact of road traffic noise, cricket match noise and noise associated with the existing Ramsbottom Steam Train station on proposed receptors.

Considering road traffic noise, the assessment demonstrated that there would be exceedances in the garden areas associated with plots 8 and 21, mitigation measures are required in the form of a 1.8m barrier in between the garden area and Bridge Street. Additionally, while standard thermal double glazing has been found to be sufficient to ensure that internal criteria are met during both day and night times. However, with windows partially open for ventilation, there are exceedances. As such, an alternate means of ventilating noise sensitive habitable rooms that does not require the opening of a window is required.

On behalf of noise from the nearby commercial steam train station, it has been calculated that 2.4m tall barriers reduce the change in ambient from “Very Substantial” to “Substantial”. In this case, due to the locality of the site and the nature of the noise from the steam trains, it is deemed to achieve the lowest practicable levels and as such is considered acceptable. Additionally, alternate ventilation was found to be required in habitable rooms that overlook the railway.

Specifically, the following mitigation is required:

Barriers:

- 1.8m barrier is required around the garden area attached to plots 8 and 21
- 2.4m barriers are required on the western boundaries of plots 2–7 and 43–51; and
- 2.4m barriers are required on the southern boundaries of plots 7 and 51.

Alternate ventilation:

- Plots 1 to 4
- Plots 8 to 28
- Plots 30, 31 and 34;
- Buildings A and B; and
- All habitable rooms overlooking the railway. Namely, plots 2-7 and 43-67.

Regarding noise associated with the nearby Cricket Club, the impact upon the proposed residential development was found to be negligible.

Additionally, the likelihood of adverse comment on behalf of railway vibration has been deemed highly unlikely.

The barrier proposed for the Site can be of wooden fence or brick wall construction and should be of close boarded construction, be free from holes, sealed at the base and have a minimum mass of

10kg/m².

This assessment has shown that, in principle, there should be no adverse impact at the closest receptors as a result of the existing noise and vibration sources. Following the outcomes of the assessments, the overall recommendation for the development to the decision maker is to grant consent with suitable noise conditions.

APPENDIX I LIMITATIONS

1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between Ensaf Limited and the Client as indicated in Section 1.2.
2. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.
3. Ensaf cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by Ensaf is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by Ensaf in this connection without their explicit written agreement there to by Ensaf.
4. Where a noise survey is required to inform the assessment, Ensaf will endeavour to ensure that all noise measurements taken are robust, representative and reliable in order to inform an accurate noise impact assessment.
5. Where mitigation measures are specified in our report, it should be noted that these measures are relative to a specific sound source, both in terms of the measured sound pressure level and the character of the source. Where either the sound pressure level or the character of the sound varies following completion of the sound survey, Ensaf cannot be held responsible for any subsequent variations in the proposed mitigation performance.

APPENDIX II GLOSSARY OF ACOUSTIC TERMINOLOGY

Noise

Noise is defined as unwanted sound. Human ears are able to respond to sound in the frequency range 20 Hz (deep bass) to 20,000 Hz (high treble) and over the audible range of 0 dB (the threshold of perception) to 140 dB (the threshold of pain). The ear does not respond equally to different frequencies of the same magnitude, but is more responsive to mid-frequencies than to lower or higher frequencies. To quantify noise in a manner that approximates the response of the human ear, a weighting mechanism is used. This reduces the importance of lower and higher frequencies, in a similar manner to the human ear.

Furthermore, the perception of noise may be determined by a number of other factors, which may not necessarily be acoustic. In general, the impact of noise depends upon its level, the margin by which it exceeds the background level, its character and its variation over a given period of time. In some cases, the time of day and other acoustic features such as tonality or impulsiveness may be important, as may the disposition of the affected individual. Any assessment of noise should give due consideration to all of these factors when assessing the significance of a noise source.

The most widely used weighting mechanism that best corresponds to the response of the human ear is the 'A'-weighting scale. This is widely used for environmental noise measurement, and the levels are denoted as dB(A) or L_{Aeq} , L_{A90} etc., according to the parameter being measured.

The decibel scale is logarithmic rather than linear, and hence a 3 dB increase in sound level represents a doubling of the sound energy present. Judgement of sound is subjective, but as a general guide a 10 dB(A) increase can be taken to represent a doubling of loudness, whilst an increase in the order of 3 dB(A) is generally regarded as the minimum difference needed to perceive a change under normal listening conditions.

An indication of the range of sound levels commonly found in the environment is given in the following table.

Table A1 Typical Sound Pressure Levels

Sound Pressure Level	Location/Example
0	Threshold of hearing
20 - 30	Quiet bedroom at night
30 - 40	Living room during the day
40 - 50	Typical office
50 - 60	Inside a car
60 - 70	Typical high street
70 - 90	Inside factory
100 - 110	Burglar alarm at 1m away
110 - 130	Jet aircraft on take off
140	Threshold of pain

Acoustic Terminology

Table A2 Terminology

Descriptor	Explanation
dB (decibel)	The scale on which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the root-mean-square pressure of the sound field and a reference pressure (2x10 ⁻⁵ Pa).
dB(A)	A-weighted decibel. This is a measure of the overall level of sound across the audible spectrum with a frequency weighting (i.e. 'A' weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
L _{Aeq, T}	L _{Aeq} is defined as the notional steady sound level which, over a stated period of time (T), would contain the same amount of acoustical energy as the A - weighted fluctuating sound measured over that period.
L _{Amax}	L _{Amax} is the maximum A - weighted sound pressure level recorded over the period stated. L _{Amax} is sometimes used in assessing environmental noise where occasional loud noises occur, which may have little effect on the overall Leq noise level but will still affect the noise environment. Unless described otherwise, it is measured using the 'fast' sound level meter response.
L ₁₀ & L ₉₀	If a non-steady noise is to be described it is necessary to know both its level and the degree of fluctuation. The Ln indices are used for this purpose, and the term refers to the level exceeded for n% of the time. Hence L ₁₀ is the level exceeded for 10% of the time and as such can be regarded as the 'average maximum level'. Similarly, L ₉₀ is the 'average minimum level' and is often used to describe the background noise. It is common practice to use the L ₁₀ index to describe traffic noise.
Free-field Level	A sound field determined at a point away from reflective surfaces other than the ground with no significant contributions due to sound from other reflective surfaces. Generally as measured outside and away from buildings.
Fast	A time weighting used in the root mean square section of a sound level meter with a 125millisecond time constant.
Slow	A time weighting used in the root mean square section of a sound level meter with a 1000millisecond time constant.

APPENDIX III FIGURES

Figure 1 - Noise Survey Measurement Positions

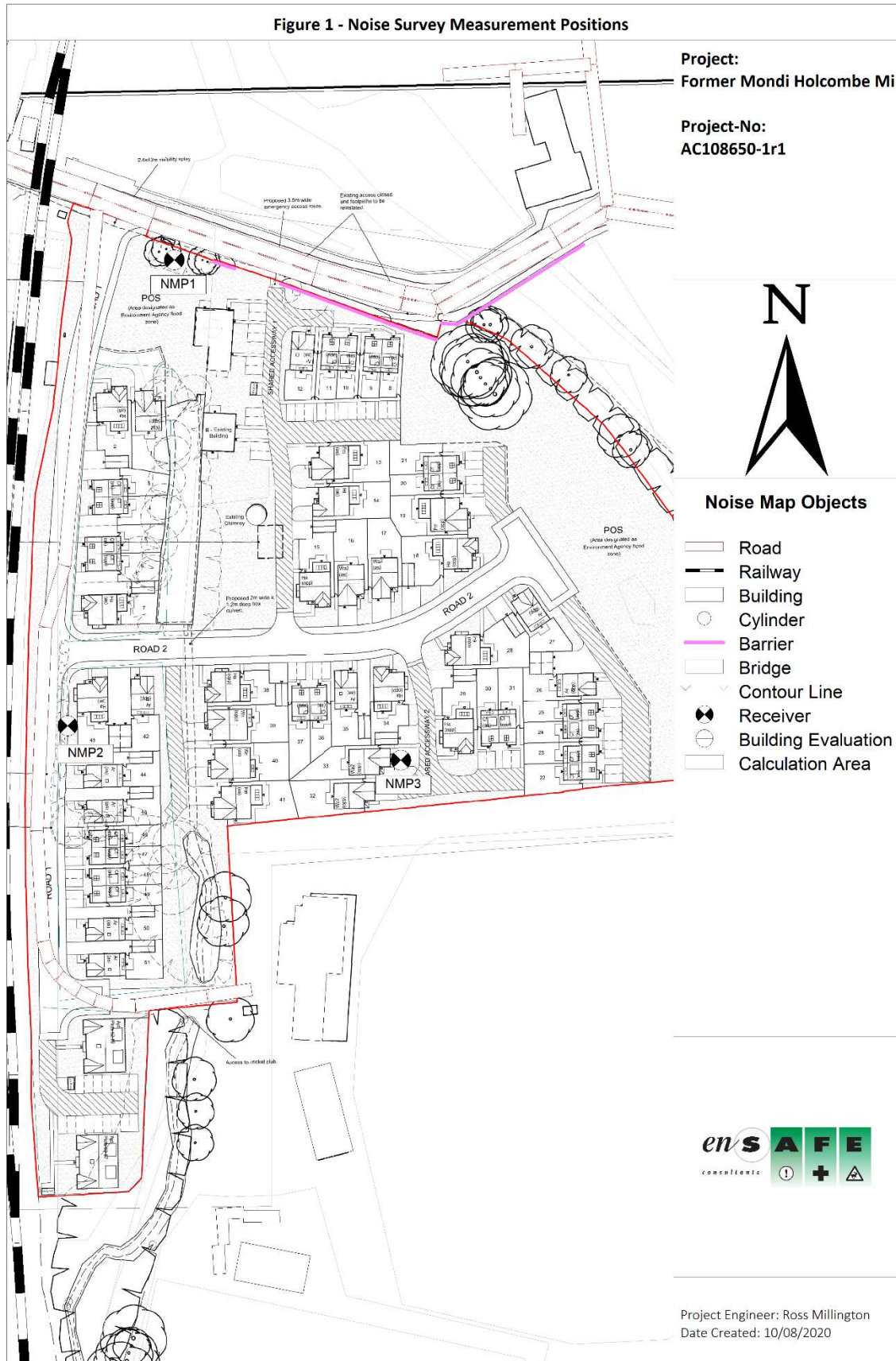


Figure 2 - Daytime Grid Noise Map - Calculation at 1.5m Above Ground

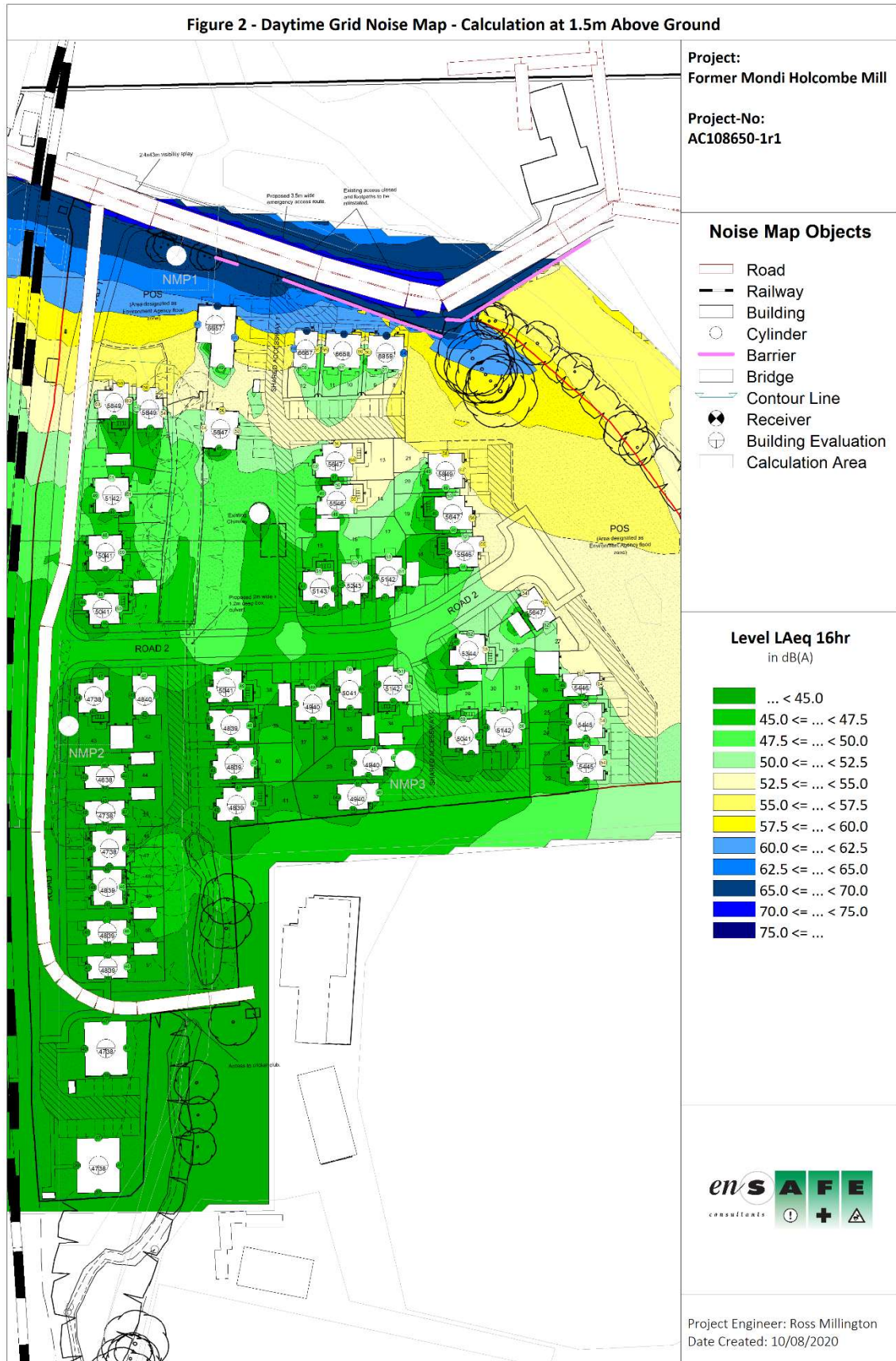


Figure 3 - Night-time Grid Noise Map - Calculation at 4m Above Ground

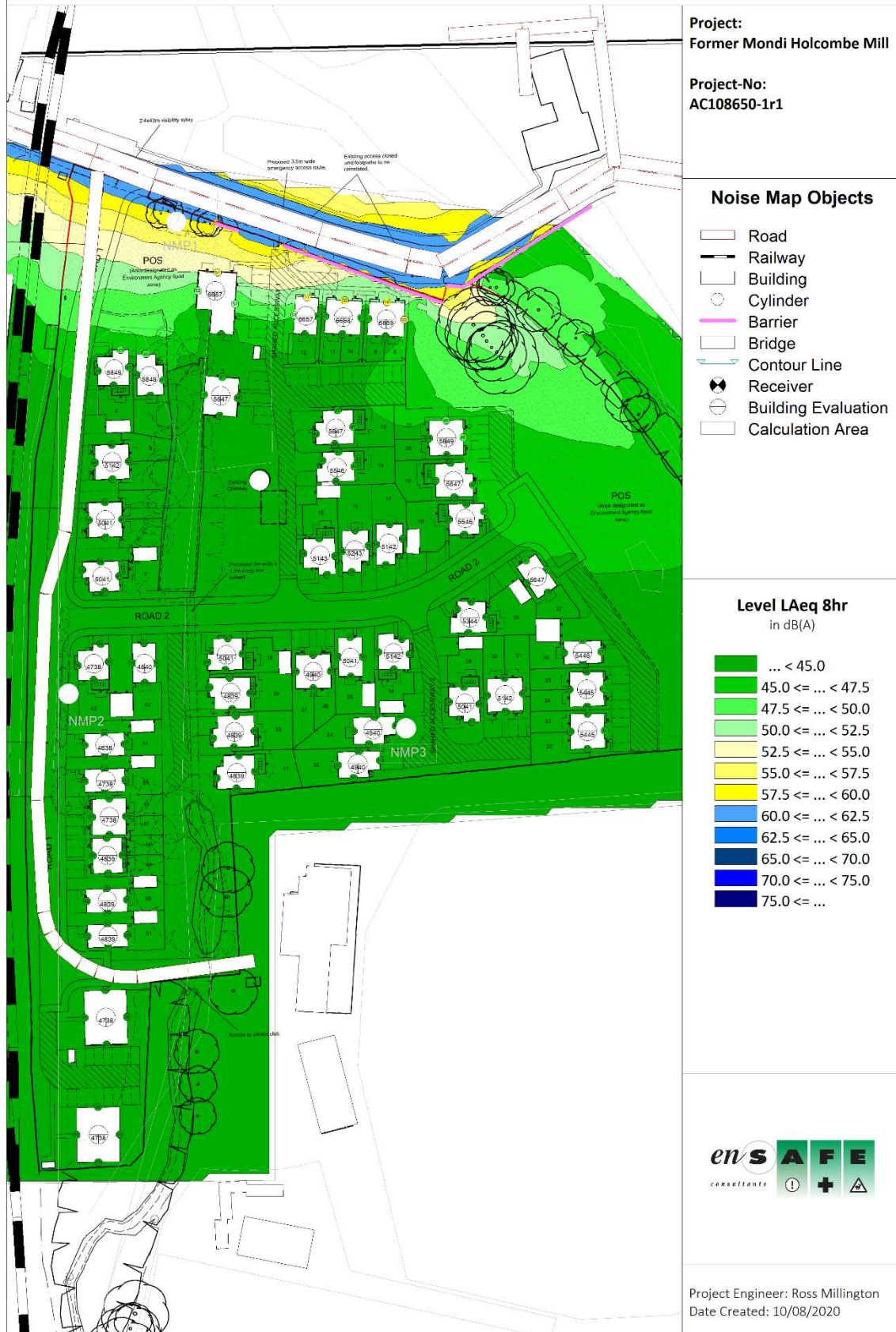
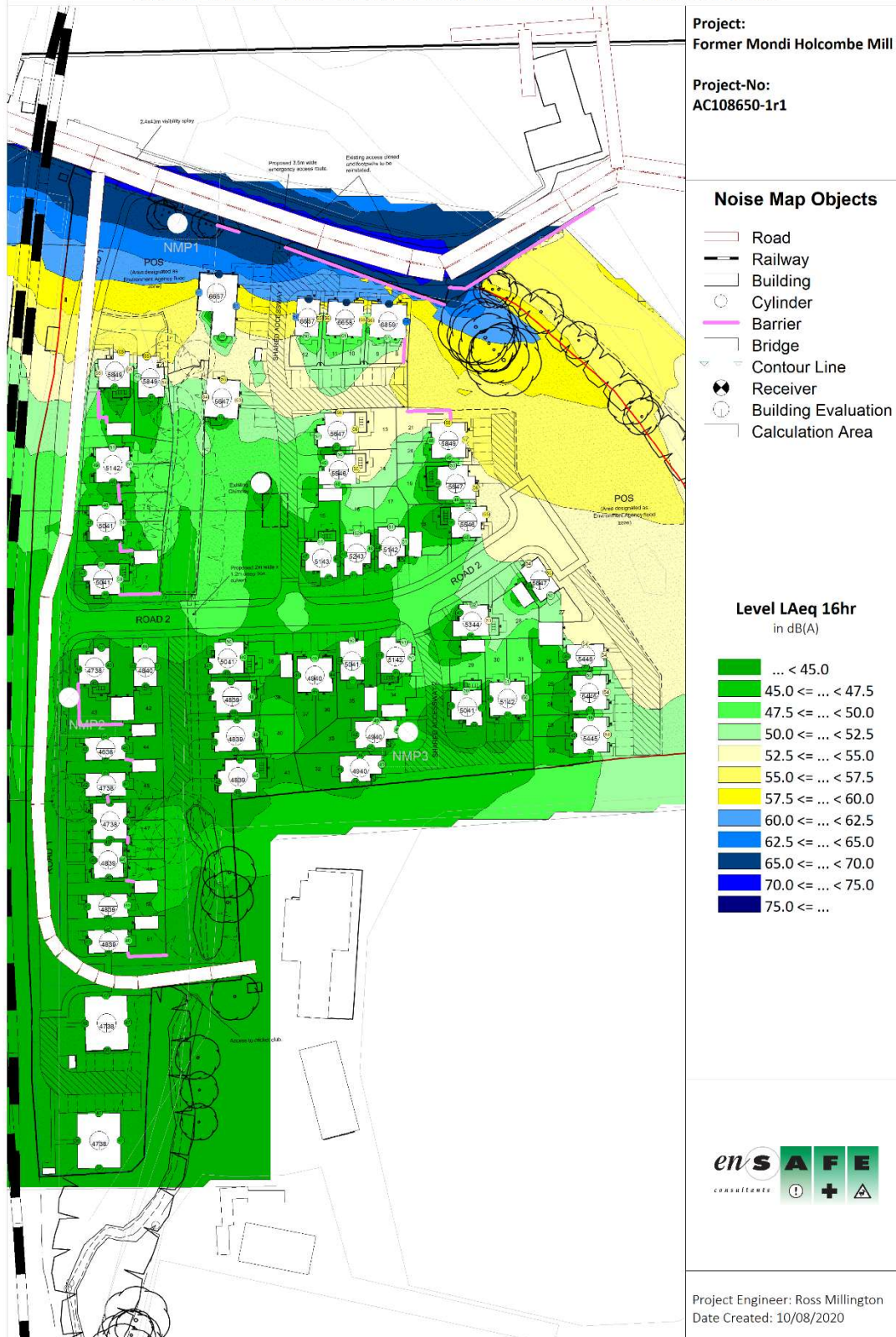


Figure 4 - Daytime Grid Noise Map w/ Mitigation - Calculation at 1.5m Above Ground



APPENDIX IV MEASURED DATA

Table A4 Measured Road Traffic Noise Levels Used in Report – NMP2

Measurement Start Time	Hourly Measured Noise Level (dB)		
	L _{Aeq,1hr}	L _{A90,1hr}	L _{A10,1hr}
18/12/2019 23:00	58.3	49.4	62.5
19/12/2019 00:00	55.4	48.8	56.5
19/12/2019 01:00	53.6	48.4	52.5
19/12/2019 02:00	52.7	48.3	51.4
19/12/2019 03:00	53.4	48.2	51.2
19/12/2019 04:00	57.1	49.5	58.2
19/12/2019 05:00	60.2	51.7	64.1
19/12/2019 06:00	63.7	54.3	67.4
19/12/2019 07:00	65	57.4	68
19/12/2019 08:00	63.6	57.2	66.9
19/12/2019 09:00	64.5	57.3	67.4
19/12/2019 10:00	64	56.5	66.9
19/12/2019 11:00	65.3	56.5	67.4
19/12/2019 12:00	65.7	56.7	67.1
19/12/2019 13:00	65.5	56.9	67.3
19/12/2019 14:00	66.8	57.9	67.1
19/12/2019 15:00	72.8	59.5	69.1
19/12/2019 16:00	70.8	57.5	68.4
19/12/2019 17:00	66.6	59	68.3
19/12/2019 18:00	69.3	58	67.8
19/12/2019 19:00	71.3	56	67
19/12/2019 20:00	61.6	54	65.5
19/12/2019 21:00	60.7	52.1	64.6
19/12/2019 22:00	59.3	51.2	63.5
19/12/2019 23:00	57.2	50	61.1

Table A4 Measured Background and Ambient Noise Levels – NMP3

Measurement Start Time	Hourly Measured Noise Level (dB)		
	L _{Aeq,1hr}	L _{A90,1hr}	L _{A10,1hr}
05/01/2020 00:00	43.5	40.3	45.8
05/01/2020 01:00	41.6	39.3	43.4
05/01/2020 02:00	40.6	38.2	42.7
05/01/2020 03:00	41	38.6	42.5
05/01/2020 04:00	39.6	38	40.7
05/01/2020 05:00	41.5	38.4	43.3
05/01/2020 06:00	42.3	39.3	44.3
05/01/2020 07:00	43.5	40.1	45.6
05/01/2020 08:00	45.5	42.3	47.6
05/01/2020 09:00	47.6	43.7	49.2
05/01/2020 10:00	50.3	46.8	51.6
05/01/2020 11:00	51	47.3	54.9
05/01/2020 12:00	50.9	48.1	51.4
05/01/2020 13:00	50.9	48.9	51.8
05/01/2020 14:00	52.9	47.9	57.5
05/01/2020 15:00	49.8	47.9	51
05/01/2020 16:00	51.1	47.1	53.3
05/01/2020 17:00	47.8	45.8	49.1
05/01/2020 18:00	47.8	45.7	49.1
05/01/2020 19:00	47.7	44.9	49.2
05/01/2020 20:00	46.5	44.1	48.1
05/01/2020 21:00	45.7	43	47.5
05/01/2020 22:00	44.6	41.6	46.5
05/01/2020 23:00	43	40	44.9
04/01/2020 00:00	45	42.1	46.8
04/01/2020 01:00	44.2	41.6	46
04/01/2020 02:00	45.6	41.8	48.2
04/01/2020 03:00	44.3	41.5	46.1
04/01/2020 04:00	44.9	42.1	46.7

Measurement Start Time	Hourly Measured Noise Level (dB)		
	L _{Aeq,1hr}	L _{A90,1hr}	L _{A10,1hr}
04/01/2020 05:00	45.9	42.9	48
04/01/2020 06:00	47	44.4	48.8
04/01/2020 07:00	48.6	45.7	50.5
04/01/2020 08:00	51.4	48.4	53.4
04/01/2020 09:00	54.5	50	53.8
04/01/2020 10:00	55.2	51.1	57.6
04/01/2020 11:00	54.4	51	57.6
04/01/2020 12:00	54.3	51.3	54.3
04/01/2020 13:00	54.1	51.3	56.3
04/01/2020 14:00	55.1	51	59
04/01/2020 15:00	53.6	50.4	55.8
04/01/2020 16:00	52.5	48.4	55.6
04/01/2020 17:00	51.5	47.3	50.9
04/01/2020 18:00	47.6	44.8	49.4
04/01/2020 19:00	46.6	44.2	48.2
04/01/2020 20:00	46.1	43.4	48
04/01/2020 21:00	45.5	42.6	47.4
04/01/2020 22:00	47.8	43.4	48.4
04/01/2020 23:00	45.5	42.4	47.4

APPENDIX V NOISE IMPACT ASSESSMENT

A4 Daytime Internal Noise Impact Assessment

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
1	Gnd	N	56	26	-9	41	6
1	1st	N	57	27	-8	42	7
1	Gnd	W	49	19	-16	34	-1
1	1st	W	51	21	-14	36	1
1	Gnd	S	42	12	-23	27	-8
1	1st	S	47	17	-18	32	-3
1	Gnd	E	51	21	-14	36	1
1	1st	E	53	23	-12	38	3
2	Gnd	W	51	21	-14	36	1
2	1st	W	53	23	-12	38	3
2	Gnd	N	56	26	-9	41	6
2	1st	N	58	28	-7	43	8
2	Gnd	E	51	21	-14	36	1
2	1st	E	53	23	-12	38	3
2	Gnd	S	41	11	-24	26	-9
2	1st	S	44	14	-21	29	-6
3, 4	Gnd	W	47	17	-18	32	-3
3, 4	1st	W	49	19	-16	34	-1
3, 4	Gnd	N	49	19	-16	34	-1
3, 4	1st	N	51	21	-14	36	1
3, 4	Gnd	E	48	18	-17	33	-2
3, 4	1st	E	50	20	-15	35	0
3, 4	Gnd	S	43	13	-22	28	-7
3, 4	1st	S	46	16	-19	31	-4
5, 6	Gnd	W	45	15	-20	30	-5
5, 6	1st	W	47	17	-18	32	-3
5, 6	Gnd	N	46	16	-19	31	-4
5, 6	1st	N	48	18	-17	33	-2
5, 6	Gnd	E	47	17	-18	32	-3
5, 6	1st	E	49	19	-16	34	-1
5, 6	Gnd	S	43	13	-22	28	-7
5, 6	1st	S	46	16	-19	31	-4
7	Gnd	W	44	14	-21	29	-6
7	1st	W	46	16	-19	31	-4
7	Gnd	N	45	15	-20	30	-5
7	1st	N	47	17	-18	32	-3
7	Gnd	E	47	17	-18	32	-3

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
7	1st	E	50	20	-15	35	0
7	Gnd	S	43	13	-22	28	-7
7	1st	S	46	16	-19	31	-4
8, 9	Gnd	W	51	21	-14	36	1
8, 9	1st	W	56	26	-9	41	6
8, 9	Gnd	N	62	32	-3	47	12
8, 9	1st	N	67	37	2	52	17
8, 9	Gnd	E	58	28	-7	43	8
8, 9	1st	E	63	33	-2	48	13
8, 9	Gnd	S	49	19	-16	34	-1
8, 9	1st	S	51	21	-14	36	1
10, 11	Gnd	W	52	22	-13	37	2
10, 11	1st	W	56	26	-9	41	6
10, 11	Gnd	N	62	32	-3	47	12
10, 11	1st	N	66	36	1	51	16
10, 11	Gnd	E	51	21	-14	36	1
10, 11	1st	E	55	25	-10	40	5
10, 11	Gnd	S	49	19	-16	34	-1
10, 11	1st	S	50	20	-15	35	0
12	Gnd	S	48	18	-17	33	-2
12	1st	S	50	20	-15	35	0
12	Gnd	W	58	28	-7	43	8
12	1st	W	60	30	-5	45	10
12	Gnd	N	61	31	-4	46	11
12	1st	N	65	35	0	50	15
12	Gnd	E	51	21	-14	36	1
12	1st	E	55	25	-10	40	5
13	Gnd	N	54	24	-11	39	4
13	1st	N	56	26	-9	41	6
13	Gnd	E	54	24	-11	39	4
13	1st	E	56	26	-9	41	6
13	Gnd	S	43	13	-22	28	-7
13	1st	S	47	17	-18	32	-3
13	Gnd	W	50	20	-15	35	0
13	1st	W	51	21	-14	36	1
14	Gnd	W	46	16	-19	31	-4
14	1st	W	48	18	-17	33	-2
14	Gnd	N	47	17	-18	32	-3

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
14	1st	N	49	19	-16	34	-1
14	Gnd	E	52	22	-13	37	2
14	1st	E	55	25	-10	40	5
14	Gnd	S	43	13	-22	28	-7
14	1st	S	47	17	-18	32	-3
15	Gnd	W	45	15	-20	30	-5
15	1st	W	47	17	-18	32	-3
15	Gnd	N	49	19	-16	34	-1
15	1st	N	51	21	-14	36	1
15	Gnd	E	40	10	-25	25	-10
15	1st	E	44	14	-21	29	-6
15	Gnd	S	43	13	-22	28	-7
15	1st	S	46	16	-19	31	-4
16	Gnd	N	49	19	-16	34	-1
16	1st	N	52	22	-13	37	2
16	Gnd	W	41	11	-24	26	-9
16	1st	W	44	14	-21	29	-6
16	Gnd	S	44	14	-21	29	-6
16	1st	S	47	17	-18	32	-3
16	Gnd	E	45	15	-20	30	-5
16	1st	E	47	17	-18	32	-3
17	Gnd	S	44	14	-21	29	-6
17	1st	S	47	17	-18	32	-3
17	Gnd	W	41	11	-24	26	-9
17	1st	W	44	14	-21	29	-6
17	Gnd	N	48	18	-17	33	-2
17	1st	N	50	20	-15	35	0
17	Gnd	E	46	16	-19	31	-4
17	1st	E	51	21	-14	36	1
18	Gnd	E	54	24	-11	39	4
18	1st	E	55	25	-10	40	5
18	Gnd	N	50	20	-15	35	0
18	1st	N	51	21	-14	36	1
18	Gnd	W	42	12	-23	27	-8
18	1st	W	45	15	-20	30	-5
18	Gnd	S	47	17	-18	32	-3
18	1st	S	48	18	-17	33	-2
19	Gnd	N	48	18	-17	33	-2

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
19	1st	N	50	20	-15	35	0
19	Gnd	W	43	13	-22	28	-7
19	1st	W	45	15	-20	30	-5
19	Gnd	S	46	16	-19	31	-4
19	1st	S	48	18	-17	33	-2
19	Gnd	E	55	25	-10	40	5
19	1st	E	55	25	-10	40	5
20, 21	Gnd	S	48	18	-17	33	-2
20, 21	1st	S	49	19	-16	34	-1
20, 21	Gnd	W	45	15	-20	30	-5
20, 21	1st	W	47	17	-18	32	-3
20, 21	Gnd	N	56	26	-9	41	6
20, 21	1st	N	57	27	-8	42	7
20, 21	Gnd	E	55	25	-10	40	5
20, 21	1st	E	57	27	-8	42	7
22, 23	Gnd	S	43	13	-22	28	-7
22, 23	1st	S	45	15	-20	30	-5
22, 23	Gnd	W	42	12	-23	27	-8
22, 23	1st	W	44	14	-21	29	-6
22, 23	Gnd	N	48	18	-17	33	-2
22, 23	1st	N	49	19	-16	34	-1
22, 23	Gnd	E	52	22	-13	37	2
22, 23	1st	E	53	23	-12	38	3
24, 25	Gnd	S	45	15	-20	30	-5
24, 25	1st	S	47	17	-18	32	-3
24, 25	Gnd	W	41	11	-24	26	-9
24, 25	1st	W	44	14	-21	29	-6
24, 25	Gnd	N	49	19	-16	34	-1
24, 25	1st	N	50	20	-15	35	0
24, 25	Gnd	E	53	23	-12	38	3
24, 25	1st	E	54	24	-11	39	4
26	Gnd	W	44	14	-21	29	-6
26	1st	W	46	16	-19	31	-4
26	Gnd	N	53	23	-12	38	3
26	1st	N	54	24	-11	39	4
26	Gnd	E	53	23	-12	38	3
26	1st	E	54	24	-11	39	4
26	Gnd	S	45	15	-20	30	-5

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
26	1st	S	47	17	-18	32	-3
27	Gnd	N	52	22	-13	37	2
27	1st	N	53	23	-12	38	3
27	Gnd	W	40	10	-25	25	-10
27	1st	W	43	13	-22	28	-7
27	Gnd	S	50	20	-15	35	0
27	1st	S	51	21	-14	36	1
27	Gnd	E	54	24	-11	39	4
27	1st	E	55	25	-10	40	5
28	Gnd	S	43	13	-22	28	-7
28	1st	S	46	16	-19	31	-4
28	Gnd	W	42	12	-23	27	-8
28	1st	W	44	14	-21	29	-6
28	Gnd	N	51	21	-14	36	1
28	1st	N	52	22	-13	37	2
28	Gnd	E	51	21	-14	36	1
28	1st	E	53	23	-12	38	3
29	Gnd	S	41	11	-24	26	-9
29	1st	S	44	14	-21	29	-6
29	Gnd	E	44	14	-21	29	-6
29	1st	E	47	17	-18	32	-3
29	Gnd	N	48	18	-17	33	-2
29	1st	N	49	19	-16	34	-1
29	Gnd	W	41	11	-24	26	-9
29	1st	W	43	13	-22	28	-7
30, 31	Gnd	W	40	10	-25	25	-10
30, 31	1st	W	43	13	-22	28	-7
30, 31	Gnd	N	49	19	-16	34	-1
30, 31	1st	N	51	21	-14	36	1
30, 31	Gnd	E	47	17	-18	32	-3
30, 31	1st	E	49	19	-16	34	-1
30, 31	Gnd	S	42	12	-23	27	-8
30, 31	1st	S	44	14	-21	29	-6
32	Gnd	W	39	9	-26	24	-11
32	1st	W	42	12	-23	27	-8
32	Gnd	N	42	12	-23	27	-8
32	1st	N	46	16	-19	31	-4
32	Gnd	E	46	16	-19	31	-4

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
32	1st	E	49	19	-16	34	-1
32	Gnd	S	42	12	-23	27	-8
32	1st	S	44	14	-21	29	-6
33	Gnd	W	39	9	-26	24	-11
33	1st	W	42	12	-23	27	-8
33	Gnd	N	46	16	-19	31	-4
33	1st	N	48	18	-17	33	-2
33	Gnd	E	46	16	-19	31	-4
33	1st	E	49	19	-16	34	-1
33	Gnd	S	42	12	-23	27	-8
33	1st	S	44	14	-21	29	-6
34	Gnd	W	40	10	-25	25	-10
34	1st	W	43	13	-22	28	-7
34	Gnd	S	41	11	-24	26	-9
34	1st	S	45	15	-20	30	-5
34	Gnd	E	49	19	-16	34	-1
34	1st	E	51	21	-14	36	1
34	Gnd	N	48	18	-17	33	-2
34	1st	N	50	20	-15	35	0
35	Gnd	S	41	11	-24	26	-9
35	1st	S	45	15	-20	30	-5
35	Gnd	W	42	12	-23	27	-8
35	1st	W	44	14	-21	29	-6
35	Gnd	N	47	17	-18	32	-3
35	1st	N	49	19	-16	34	-1
35	Gnd	E	42	12	-23	27	-8
35	1st	E	46	16	-19	31	-4
36, 37	Gnd	W	44	14	-21	29	-6
36, 37	1st	W	46	16	-19	31	-4
36, 37	Gnd	S	42	12	-23	27	-8
36, 37	1st	S	45	15	-20	30	-5
36, 37	Gnd	E	39	9	-26	24	-11
36, 37	1st	E	44	14	-21	29	-6
36, 37	Gnd	N	46	16	-19	31	-4
36, 37	1st	N	48	18	-17	33	-2
38	Gnd	S	39	9	-26	24	-11
38	1st	S	43	13	-22	28	-7
38	Gnd	E	46	16	-19	31	-4

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
38	1st	E	48	18	-17	33	-2
38	Gnd	N	48	18	-17	33	-2
38	1st	N	49	19	-16	34	-1
38	Gnd	W	43	13	-22	28	-7
38	1st	W	45	15	-20	30	-5
39	Gnd	W	41	11	-24	26	-9
39	1st	W	43	13	-22	28	-7
39	Gnd	N	43	13	-22	28	-7
39	1st	N	46	16	-19	31	-4
39	Gnd	E	45	15	-20	30	-5
39	1st	E	47	17	-18	32	-3
39	Gnd	S	40	10	-25	25	-10
39	1st	S	43	13	-22	28	-7
40	Gnd	S	40	10	-25	25	-10
40	1st	S	43	13	-22	28	-7
40	Gnd	W	41	11	-24	26	-9
40	1st	W	43	13	-22	28	-7
40	Gnd	N	43	13	-22	28	-7
40	1st	N	46	16	-19	31	-4
40	Gnd	E	45	15	-20	30	-5
40	1st	E	48	18	-17	33	-2
41	Gnd	W	39	9	-26	24	-11
41	1st	W	42	12	-23	27	-8
41	Gnd	S	41	11	-24	26	-9
41	1st	S	43	13	-22	28	-7
41	Gnd	E	45	15	-20	30	-5
41	1st	E	48	18	-17	33	-2
41	Gnd	N	44	14	-21	29	-6
41	1st	N	46	16	-19	31	-4
42	Gnd	S	38	8	-27	23	-12
42	1st	S	42	12	-23	27	-8
42	Gnd	W	39	9	-26	24	-11
42	1st	W	42	12	-23	27	-8
42	Gnd	E	45	15	-20	30	-5
42	1st	E	47	17	-18	32	-3
43	Gnd	S	38	8	-27	23	-12
43	1st	S	42	12	-23	27	-8
43	Gnd	E	42	12	-23	27	-8

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
43	1st	E	45	15	-20	30	-5
43	Gnd	N	45	15	-20	30	-5
43	1st	N	47	17	-18	32	-3
43	Gnd	W	41	11	-24	26	-9
43	1st	W	43	13	-22	28	-7
44	Gnd	N	43	13	-22	28	-7
44	1st	N	46	16	-19	31	-4
44	Gnd	E	43	13	-22	28	-7
44	1st	E	46	16	-19	31	-4
44	Gnd	S	38	8	-27	23	-12
44	1st	S	42	12	-23	27	-8
44	Gnd	W	39	9	-26	24	-11
44	1st	W	41	11	-24	26	-9
45	Gnd	W	39	9	-26	24	-11
45	1st	W	41	11	-24	26	-9
45	Gnd	N	41	11	-24	26	-9
45	1st	N	45	15	-20	30	-5
45	Gnd	E	44	14	-21	29	-6
45	1st	E	46	16	-19	31	-4
45	Gnd	S	40	10	-25	25	-10
45	1st	S	42	12	-23	27	-8
46, 47	Gnd	N	41	11	-24	26	-9
46, 47	1st	N	44	14	-21	29	-6
46, 47	Gnd	W	36	6	-29	21	-14
46, 47	1st	W	40	10	-25	25	-10
46, 47	Gnd	S	40	10	-25	25	-10
46, 47	1st	S	41	11	-24	26	-9
46, 47	Gnd	E	45	15	-20	30	-5
46, 47	1st	E	47	17	-18	32	-3
48, 49	Gnd	N	41	11	-24	26	-9
48, 49	1st	N	43	13	-22	28	-7
48, 49	Gnd	W	37	7	-28	22	-13
48, 49	1st	W	40	10	-25	25	-10
48, 49	Gnd	S	38	8	-27	23	-12
48, 49	1st	S	41	11	-24	26	-9
48, 49	Gnd	E	46	16	-19	31	-4
48, 49	1st	E	47	17	-18	32	-3
50	Gnd	W	38	8	-27	23	-12

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
50	1st	W	40	10	-25	25	-10
50	Gnd	N	44	14	-21	29	-6
50	1st	N	46	16	-19	31	-4
50	Gnd	E	46	16	-19	31	-4
50	1st	E	47	17	-18	32	-3
50	Gnd	S	38	8	-27	23	-12
50	1st	S	41	11	-24	26	-9
51	Gnd	W	38	8	-27	23	-12
51	1st	W	40	10	-25	25	-10
51	Gnd	N	43	13	-22	28	-7
51	1st	N	46	16	-19	31	-4
51	Gnd	E	45	15	-20	30	-5
51	1st	E	47	17	-18	32	-3
51	Gnd	S	37	7	-28	22	-13
51	1st	S	40	10	-25	25	-10
52 - 59	Gnd	W	37	7	-28	22	-13
52 - 59	1st	W	40	10	-25	25	-10
52 - 59	Gnd	N	43	13	-22	28	-7
52 - 59	1st	N	46	16	-19	31	-4
52 - 59	Gnd	E	44	14	-21	29	-6
52 - 59	1st	E	46	16	-19	31	-4
52 - 59	Gnd	S	34	4	-31	19	-16
52 - 59	1st	S	37	7	-28	22	-13
60 - 67	Gnd	N	44	14	-21	29	-6
60 - 67	1st	N	46	16	-19	31	-4
60 - 67	Gnd	W	36	6	-29	21	-14
60 - 67	1st	W	39	9	-26	24	-11
60 - 67	Gnd	S	33	3	-32	18	-17
60 - 67	1st	S	36	6	-29	21	-14
60 - 67	Gnd	E	44	14	-21	29	-6
60 - 67	1st	E	46	16	-19	31	-4
A Building	Gnd	W	58	28	-7	43	8
A Building	1st	W	60	30	-5	45	10
A Building	Gnd	N	64	34	-1	49	14
A Building	1st	N	66	36	1	51	16
A Building	Gnd	E	59	29	-6	44	9
A Building	1st	E	61	31	-4	46	11
A Building	Gnd	S	47	17	-18	32	-3

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,8hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 30dB $L_{Aeq,8hr}$ (dB)
A Building	1st	S	49	19	-16	34	-1
B Building	Gnd	W	52	22	-13	37	2
B Building	1st	W	54	24	-11	39	4
B Building	Gnd	N	54	24	-11	39	4
B Building	1st	N	56	26	-9	41	6
B Building	Gnd	E	52	22	-13	37	2
B Building	1st	E	53	23	-12	38	3
B Building	Gnd	S	41	11	-24	26	-9
B Building	1st	S	45	15	-20	30	-5

Table A5 Night-time Internal Noise Impact Assessment

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
1	Gnd	N	47	17	-13	32	2
1	1st	N	49	19	-11	34	4
1	Gnd	W	40	10	-20	25	-5
1	1st	W	42	12	-18	27	-3
1	Gnd	S	33	3	-27	18	-12
1	1st	S	38	8	-22	23	-7
1	Gnd	E	42	12	-18	27	-3
1	1st	E	44	14	-16	29	-1
2	Gnd	W	42	12	-18	27	-3
2	1st	W	44	14	-16	29	-1
2	Gnd	N	47	17	-13	32	2
2	1st	N	49	19	-11	34	4
2	Gnd	E	43	13	-17	28	-2
2	1st	E	44	14	-16	29	-1
2	Gnd	S	32	2	-28	17	-13
2	1st	S	36	6	-24	21	-9
3, 4	Gnd	W	38	8	-22	23	-7
3, 4	1st	W	40	10	-20	25	-5
3, 4	Gnd	N	40	10	-20	25	-5
3, 4	1st	N	42	12	-18	27	-3
3, 4	Gnd	E	39	9	-21	24	-6

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
3, 4	1st	E	41	11	-19	26	-4
3, 4	Gnd	S	34	4	-26	19	-11
3, 4	1st	S	37	7	-23	22	-8
5, 6	Gnd	W	36	6	-24	21	-9
5, 6	1st	W	38	8	-22	23	-7
5, 6	Gnd	N	37	7	-23	22	-8
5, 6	1st	N	39	9	-21	24	-6
5, 6	Gnd	E	38	8	-22	23	-7
5, 6	1st	E	40	10	-20	25	-5
5, 6	Gnd	S	34	4	-26	19	-11
5, 6	1st	S	37	7	-23	22	-8
7	Gnd	W	36	6	-24	21	-9
7	1st	W	37	7	-23	22	-8
7	Gnd	N	36	6	-24	21	-9
7	1st	N	38	8	-22	23	-7
7	Gnd	E	38	8	-22	23	-7
7	1st	E	41	11	-19	26	-4
7	Gnd	S	35	5	-25	20	-10
7	1st	S	37	7	-23	22	-8
8, 9	Gnd	W	42	12	-18	27	-3
8, 9	1st	W	47	17	-13	32	2
8, 9	Gnd	N	53	23	-7	38	8
8, 9	1st	N	58	28	-2	43	13
8, 9	Gnd	E	49	19	-11	34	4
8, 9	1st	E	55	25	-5	40	10
8, 9	Gnd	S	41	11	-19	26	-4
8, 9	1st	S	42	12	-18	27	-3
10, 11	Gnd	W	43	13	-17	28	-2
10, 11	1st	W	47	17	-13	32	2
10, 11	Gnd	N	53	23	-7	38	8
10, 11	1st	N	57	27	-3	42	12
10, 11	Gnd	E	42	12	-18	27	-3
10, 11	1st	E	46	16	-14	31	1
10, 11	Gnd	S	40	10	-20	25	-5
10, 11	1st	S	42	12	-18	27	-3
12	Gnd	S	39	9	-21	24	-6
12	1st	S	41	11	-19	26	-4
12	Gnd	W	49	19	-11	34	4

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
12	1st	W	51	21	-9	36	6
12	Gnd	N	52	22	-8	37	7
12	1st	N	56	26	-4	41	11
12	Gnd	E	42	12	-18	27	-3
12	1st	E	46	16	-14	31	1
13	Gnd	N	45	15	-15	30	0
13	1st	N	47	17	-13	32	2
13	Gnd	E	45	15	-15	30	0
13	1st	E	47	17	-13	32	2
13	Gnd	S	34	4	-26	19	-11
13	1st	S	38	8	-22	23	-7
13	Gnd	W	41	11	-19	26	-4
13	1st	W	42	12	-18	27	-3
14	Gnd	W	37	7	-23	22	-8
14	1st	W	39	9	-21	24	-6
14	Gnd	N	38	8	-22	23	-7
14	1st	N	40	10	-20	25	-5
14	Gnd	E	44	14	-16	29	-1
14	1st	E	46	16	-14	31	1
14	Gnd	S	34	4	-26	19	-11
14	1st	S	38	8	-22	23	-7
15	Gnd	W	36	6	-24	21	-9
15	1st	W	38	8	-22	23	-7
15	Gnd	N	40	10	-20	25	-5
15	1st	N	42	12	-18	27	-3
15	Gnd	E	31	1	-29	16	-14
15	1st	E	35	5	-25	20	-10
15	Gnd	S	34	4	-26	19	-11
15	1st	S	37	7	-23	22	-8
16	Gnd	N	40	10	-20	25	-5
16	1st	N	43	13	-17	28	-2
16	Gnd	W	32	2	-28	17	-13
16	1st	W	35	5	-25	20	-10
16	Gnd	S	35	5	-25	20	-10
16	1st	S	38	8	-22	23	-7
16	Gnd	E	36	6	-24	21	-9
16	1st	E	38	8	-22	23	-7
17	Gnd	S	35	5	-25	20	-10

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
17	1st	S	38	8	-22	23	-7
17	Gnd	W	32	2	-28	17	-13
17	1st	W	35	5	-25	20	-10
17	Gnd	N	39	9	-21	24	-6
17	1st	N	42	12	-18	27	-3
17	Gnd	E	38	8	-22	23	-7
17	1st	E	42	12	-18	27	-3
18	Gnd	E	45	15	-15	30	0
18	1st	E	46	16	-14	31	1
18	Gnd	N	41	11	-19	26	-4
18	1st	N	42	12	-18	27	-3
18	Gnd	W	34	4	-26	19	-11
18	1st	W	36	6	-24	21	-9
18	Gnd	S	38	8	-22	23	-7
18	1st	S	39	9	-21	24	-6
19	Gnd	N	39	9	-21	24	-6
19	1st	N	41	11	-19	26	-4
19	Gnd	W	34	4	-26	19	-11
19	1st	W	36	6	-24	21	-9
19	Gnd	S	37	7	-23	22	-8
19	1st	S	39	9	-21	24	-6
19	Gnd	E	46	16	-14	31	1
19	1st	E	46	16	-14	31	1
20, 21	Gnd	S	39	9	-21	24	-6
20, 21	1st	S	40	10	-20	25	-5
20, 21	Gnd	W	36	6	-24	21	-9
20, 21	1st	W	38	8	-22	23	-7
20, 21	Gnd	N	47	17	-13	32	2
20, 21	1st	N	48	18	-12	33	3
20, 21	Gnd	E	47	17	-13	32	2
20, 21	1st	E	48	18	-12	33	3
22, 23	Gnd	S	34	4	-26	19	-11
22, 23	1st	S	36	6	-24	21	-9
22, 23	Gnd	W	33	3	-27	18	-12
22, 23	1st	W	35	5	-25	20	-10
22, 23	Gnd	N	39	9	-21	24	-6
22, 23	1st	N	40	10	-20	25	-5
22, 23	Gnd	E	43	13	-17	28	-2

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
22, 23	1st	E	44	14	-16	29	-1
24, 25	Gnd	S	36	6	-24	21	-9
24, 25	1st	S	38	8	-22	23	-7
24, 25	Gnd	W	32	2	-28	17	-13
24, 25	1st	W	35	5	-25	20	-10
24, 25	Gnd	N	40	10	-20	25	-5
24, 25	1st	N	41	11	-19	26	-4
24, 25	Gnd	E	44	14	-16	29	-1
24, 25	1st	E	45	15	-15	30	0
26	Gnd	W	35	5	-25	20	-10
26	1st	W	37	7	-23	22	-8
26	Gnd	N	44	14	-16	29	-1
26	1st	N	45	15	-15	30	0
26	Gnd	E	44	14	-16	29	-1
26	1st	E	45	15	-15	30	0
26	Gnd	S	36	6	-24	21	-9
26	1st	S	38	8	-22	23	-7
27	Gnd	N	43	13	-17	28	-2
27	1st	N	44	14	-16	29	-1
27	Gnd	W	31	1	-29	16	-14
27	1st	W	34	4	-26	19	-11
27	Gnd	S	41	11	-19	26	-4
27	1st	S	43	13	-17	28	-2
27	Gnd	E	45	15	-15	30	0
27	1st	E	46	16	-14	31	1
28	Gnd	S	34	4	-26	19	-11
28	1st	S	37	7	-23	22	-8
28	Gnd	W	33	3	-27	18	-12
28	1st	W	35	5	-25	20	-10
28	Gnd	N	42	12	-18	27	-3
28	1st	N	43	13	-17	28	-2
28	Gnd	E	43	13	-17	28	-2
28	1st	E	44	14	-16	29	-1
29	Gnd	S	32	2	-28	17	-13
29	1st	S	35	5	-25	20	-10
29	Gnd	E	35	5	-25	20	-10
29	1st	E	38	8	-22	23	-7
29	Gnd	N	39	9	-21	24	-6

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
29	1st	N	40	10	-20	25	-5
29	Gnd	W	32	2	-28	17	-13
29	1st	W	34	4	-26	19	-11
30, 31	Gnd	W	31	1	-29	16	-14
30, 31	1st	W	34	4	-26	19	-11
30, 31	Gnd	N	40	10	-20	25	-5
30, 31	1st	N	42	12	-18	27	-3
30, 31	Gnd	E	38	8	-22	23	-7
30, 31	1st	E	40	10	-20	25	-5
30, 31	Gnd	S	33	3	-27	18	-12
30, 31	1st	S	35	5	-25	20	-10
32	Gnd	W	31	1	-29	16	-14
32	1st	W	33	3	-27	18	-12
32	Gnd	N	33	3	-27	18	-12
32	1st	N	37	7	-23	22	-8
32	Gnd	E	37	7	-23	22	-8
32	1st	E	40	10	-20	25	-5
32	Gnd	S	33	3	-27	18	-12
32	1st	S	35	5	-25	20	-10
33	Gnd	W	30	0	-30	15	-15
33	1st	W	33	3	-27	18	-12
33	Gnd	N	37	7	-23	22	-8
33	1st	N	39	9	-21	24	-6
33	Gnd	E	38	8	-22	23	-7
33	1st	E	40	10	-20	25	-5
33	Gnd	S	33	3	-27	18	-12
33	1st	S	35	5	-25	20	-10
34	Gnd	W	31	1	-29	16	-14
34	1st	W	34	4	-26	19	-11
34	Gnd	S	32	2	-28	17	-13
34	1st	S	36	6	-24	21	-9
34	Gnd	E	40	10	-20	25	-5
34	1st	E	42	12	-18	27	-3
34	Gnd	N	40	10	-20	25	-5
34	1st	N	41	11	-19	26	-4
35	Gnd	S	32	2	-28	17	-13
35	1st	S	36	6	-24	21	-9
35	Gnd	W	33	3	-27	18	-12

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
35	1st	W	35	5	-25	20	-10
35	Gnd	N	38	8	-22	23	-7
35	1st	N	40	10	-20	25	-5
35	Gnd	E	34	4	-26	19	-11
35	1st	E	37	7	-23	22	-8
36, 37	Gnd	W	35	5	-25	20	-10
36, 37	1st	W	37	7	-23	22	-8
36, 37	Gnd	S	33	3	-27	18	-12
36, 37	1st	S	36	6	-24	21	-9
36, 37	Gnd	E	30	0	-30	15	-15
36, 37	1st	E	35	5	-25	20	-10
36, 37	Gnd	N	37	7	-23	22	-8
36, 37	1st	N	39	9	-21	24	-6
38	Gnd	S	30	0	-30	15	-15
38	1st	S	34	4	-26	19	-11
38	Gnd	E	37	7	-23	22	-8
38	1st	E	39	9	-21	24	-6
38	Gnd	N	39	9	-21	24	-6
38	1st	N	41	11	-19	26	-4
38	Gnd	W	34	4	-26	19	-11
38	1st	W	36	6	-24	21	-9
39	Gnd	W	32	2	-28	17	-13
39	1st	W	34	4	-26	19	-11
39	Gnd	N	34	4	-26	19	-11
39	1st	N	37	7	-23	22	-8
39	Gnd	E	36	6	-24	21	-9
39	1st	E	39	9	-21	24	-6
39	Gnd	S	31	1	-29	16	-14
39	1st	S	34	4	-26	19	-11
40	Gnd	S	31	1	-29	16	-14
40	1st	S	34	4	-26	19	-11
40	Gnd	W	32	2	-28	17	-13
40	1st	W	34	4	-26	19	-11
40	Gnd	N	34	4	-26	19	-11
40	1st	N	37	7	-23	22	-8
40	Gnd	E	36	6	-24	21	-9
40	1st	E	39	9	-21	24	-6
41	Gnd	W	30	0	-30	15	-15

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
41	1st	W	33	3	-27	18	-12
41	Gnd	S	32	2	-28	17	-13
41	1st	S	34	4	-26	19	-11
41	Gnd	E	36	6	-24	21	-9
41	1st	E	39	9	-21	24	-6
41	Gnd	N	35	5	-25	20	-10
41	1st	N	37	7	-23	22	-8
42	Gnd	S	29	-1	-31	14	-16
42	1st	S	33	3	-27	18	-12
42	Gnd	W	30	0	-30	15	-15
42	1st	W	33	3	-27	18	-12
42	Gnd	E	36	6	-24	21	-9
42	1st	E	38	8	-22	23	-7
43	Gnd	S	29	-1	-31	14	-16
43	1st	S	33	3	-27	18	-12
43	Gnd	E	34	4	-26	19	-11
43	1st	E	36	6	-24	21	-9
43	Gnd	N	36	6	-24	21	-9
43	1st	N	38	8	-22	23	-7
43	Gnd	W	32	2	-28	17	-13
43	1st	W	34	4	-26	19	-11
44	Gnd	N	34	4	-26	19	-11
44	1st	N	37	7	-23	22	-8
44	Gnd	E	34	4	-26	19	-11
44	1st	E	37	7	-23	22	-8
44	Gnd	S	30	0	-30	15	-15
44	1st	S	33	3	-27	18	-12
44	Gnd	W	30	0	-30	15	-15
44	1st	W	32	2	-28	17	-13
45	Gnd	W	30	0	-30	15	-15
45	1st	W	32	2	-28	17	-13
45	Gnd	N	32	2	-28	17	-13
45	1st	N	36	6	-24	21	-9
45	Gnd	E	35	5	-25	20	-10
45	1st	E	37	7	-23	22	-8
45	Gnd	S	31	1	-29	16	-14
45	1st	S	33	3	-27	18	-12
46, 47	Gnd	N	32	2	-28	17	-13

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
46, 47	1st	N	35	5	-25	20	-10
46, 47	Gnd	W	27	-3	-33	12	-18
46, 47	1st	W	31	1	-29	16	-14
46, 47	Gnd	S	31	1	-29	16	-14
46, 47	1st	S	32	2	-28	17	-13
46, 47	Gnd	E	36	6	-24	21	-9
46, 47	1st	E	38	8	-22	23	-7
48, 49	Gnd	N	32	2	-28	17	-13
48, 49	1st	N	34	4	-26	19	-11
48, 49	Gnd	W	28	-2	-32	13	-17
48, 49	1st	W	31	1	-29	16	-14
48, 49	Gnd	S	29	-1	-31	14	-16
48, 49	1st	S	32	2	-28	17	-13
48, 49	Gnd	E	37	7	-23	22	-8
48, 49	1st	E	38	8	-22	23	-7
50	Gnd	W	29	-1	-31	14	-16
50	1st	W	32	2	-28	17	-13
50	Gnd	N	35	5	-25	20	-10
50	1st	N	37	7	-23	22	-8
50	Gnd	E	37	7	-23	22	-8
50	1st	E	39	9	-21	24	-6
50	Gnd	S	29	-1	-31	14	-16
50	1st	S	32	2	-28	17	-13
51	Gnd	W	29	-1	-31	14	-16
51	1st	W	31	1	-29	16	-14
51	Gnd	N	34	4	-26	19	-11
51	1st	N	37	7	-23	22	-8
51	Gnd	E	36	6	-24	21	-9
51	1st	E	39	9	-21	24	-6
51	Gnd	S	28	-2	-32	13	-17
51	1st	S	31	1	-29	16	-14
52 - 59	Gnd	W	28	-2	-32	13	-17
52 - 59	1st	W	31	1	-29	16	-14
52 - 59	Gnd	N	35	5	-25	20	-10
52 - 59	1st	N	37	7	-23	22	-8
52 - 59	Gnd	E	35	5	-25	20	-10
52 - 59	1st	E	37	7	-23	22	-8
52 - 59	Gnd	S	25	-5	-35	10	-20

Building	Storey	Façade Orientation	Predicted External Noise Level at the Façade, $L_{Aeq,8hr}$ (dB)	Internal Noise Level Assuming Standard Thermal Double Glazing, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)	Internal Noise Level Assuming Partially Open Window, $L_{Aeq,16hr}$ (dB)	Difference with BS8233:2014 Internal Noise Criterion, 35dB $L_{Aeq,16hr}$ (dB)
52 - 59	1st	S	29	-1	-31	14	-16
60 - 67	Gnd	N	35	5	-25	20	-10
60 - 67	1st	N	37	7	-23	22	-8
60 - 67	Gnd	W	27	-3	-33	12	-18
60 - 67	1st	W	30	0	-30	15	-15
60 - 67	Gnd	S	24	-6	-36	9	-21
60 - 67	1st	S	27	-3	-33	12	-18
60 - 67	Gnd	E	35	5	-25	20	-10
60 - 67	1st	E	37	7	-23	22	-8
A Building	Gnd	W	50	20	-10	35	5
A Building	1st	W	51	21	-9	36	6
A Building	Gnd	N	55	25	-5	40	10
A Building	1st	N	57	27	-3	42	12
A Building	Gnd	E	50	20	-10	35	5
A Building	1st	E	52	22	-8	37	7
A Building	Gnd	S	38	8	-22	23	-7
A Building	1st	S	40	10	-20	25	-5
B Building	Gnd	W	43	13	-17	28	-2
B Building	1st	W	45	15	-15	30	0
B Building	Gnd	N	45	15	-15	30	0
B Building	1st	N	47	17	-13	32	2
B Building	Gnd	E	43	13	-17	28	-2
B Building	1st	E	44	14	-16	29	-1
B Building	Gnd	S	32	2	-28	17	-13
B Building	1st	S	36	6	-24	21	-9